



## Studies on the Role of Seaweed *Sargassum wightii* on the Growth and Yield of *Abelmoschus esculentus* L.

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### ABSTRACT

Nowadays, the use of chemical fertilizers in modern agriculture have degraded the soil health and make it unsuitable for cultivation. Recently, the extracts of seaweeds (seaweed liquid fertilizer) has come in the market as it may contain many plant growth promoting hormones like aux in, gibberellin, trace elements, vitamins, amino acids and micronutrients. In this experimental study, the collected seaweed species were grinded to fine powder and analysed for the presence of elements by SEM-EDS. Based on the SEM-EDS results, the brown algae *Sargassum wightii* were selected for the further studies. To prepare the extract, the *S. wightii* powdered sample of 10g was taken in 100ml of distilled water and heated for 30mins and filtered using a muslin cloth. The pot culture experiment was carried out in the backyard of Department of Agricultural Microbiology, Annamalai University. The extract was made into different concentrations viz., 1%, 2.5%, 5%, 7.5% and control. The bhendi seeds were soaked in the different concentrations of the seaweed extract. The different concentrations of the extract was also applied as foliar application to bhendi crop at different intervals. Among the different concentrations 2.5% shows the maximum growth parameters such as root length (29cm), shoot length (62cm) and leaf area index (3.3268) followed by the concentration 1% viz., root length (24cm), shoot length (54cm) leaf area index (3.1774) respectively. The minimum growth parameters were shown in control root length (20cm), shoot length (48cm) and leaf area index (3.0224). The maximum yield parameters was shown in 2.5% concentration viz., number of fruits (14.20), fruit length (13.84cm), fruit dry weight (13.48g) and yield (12.40) followed by the concentration 1%. The minimum yield parameters were recorded in the control (9.70), (13.64cm), (13.07g) and (8.16).

**Keywords:** Seaweed, *S. wightii*, bhendi, crop, yield, element.





## INTRODUCTION

Seaweeds are the one of the important marine resource mostly found in the shallow environment. Seaweeds or marine algae have high commercial value as the source of phycocolloids such as agar, agarose and carragennan. They also employed as main source in many industrial application such as enzymes, dyes, drugs and growth promoting substances. Nowadays, the use of chemical fertilizers in modern agriculture have degraded the soil health and make it unsuitable for cultivation. Seaweeds are the marine macroalgae found in the shallow coastal water and are one of the important marine resources. Recently, the extracts of seaweeds (seaweed liquid fertilizer) has come in the market as it may contain many plant growth promoting hormones like auxin, gibberellin, trace elements, vitamins, amino acids and micronutrients. Strik *et al.*, 2004 has suggested that the seaweeds extracts are known to be effective fertilizers in many crops. SLF are predominantly high in phyto hormones which plays an important role in seed germination reported by Stirk *et al.*, (2020). Seaweeds are also an excellent source of vitamin A, B1, B2, C, D and riboflavin, niacin, pantothenic and folic acid. Ganapathy *et al.*, 2013 have reported that the seaweed liquid fertilizer is the new generation for organic fertilizers and contains the highly effective nutritious source and promotes faster germination of seeds, increase yield and resistant ability of many crops. Bokil *et al.*, 1974 have revealed that the seaweed fertilizers are found to be more successful than the chemical fertilizers.

The plant growth hormone of seaweed has many advantageous effect to stimulate germination and growth. Seaweed manure are known to be rich in potassium but poor in nitrogen and phosphorus than the farm manure. Many researchers have reported that the liquid extract from the seaweeds has gained much interest as foliar spray for inducing faster growth and yield of cereal crops, fruits, vegetables, fruits, orchards and horticultural crops. The application of seaweed extracts on crop plants has a beneficial effects such as early germination and establishment, improved the performance of crop and yield, elevated resistance to biotic and a biotic stress. The application of seaweed liquid fertilizer is recommended to the farmers for attaining better growth, biochemical constituents and antioxidant enhancement. The application of seaweed in liquid formulation to *Ocimum sanctum* and soybean increased the growth of the crops (Uthirapandi *et al.*, 2018). The application of different species of seaweeds as a liquid organic fertilizers in sufficient amount improved soil condition and growth of crops (Badar *et al.*, 2015). Seaweed extract as a liquid fertilizer can trigger different features of crops such as good health, root system development, mineral absorption, shoot enlargement, increased photosynthesis rate and crop yield (Sridhar and Rengasamy, 2010).

## MATERIALS AND METHODS

The seaweed samples of ten different species was collected from Mandapam in Rameswaram, Tamil Nadu. Among these ten species, five belongs to red algae and remaining five were belongs to brown algae. They were identified based on their morphological character. The collected seaweeds were washed thoroughly in seawater to remove the debris, stones and other particles present in it. After they were washed it was transferred to the plastic bag and taken to the laboratory. The collected seaweeds were again washed in fresh water to remove all the particles in it. They were kept in shade for 2-3 days for drying. After drying completely, they were grinded into a fine powder and sieved and kept in a air tight container for further use.

The grounded seaweed powder was analysed for the presence of elements in it. The elements were analysed by SEM-EDS (Scanning Electron Microscopy- Energy Dispersive Spectroscopy). Based on the SEM-EDS result, one seaweed namely *Sargassum wightii* which belongs to brown algae were selected for further studies. The *S. wightii* were applied to the bhendi crop as a foliar application. To prepare the extract, the *S. wightii* powdered sample of 10g was taken in 100ml of distilled water and heated for 30mins. After it was allowed to cool for few minutes and they were filtered through muslin cloth. The filtrate of the seaweed extract was considered as a 100% crude extract or hot water extract. It was kept in refrigerator for future purpose. This crude extract was prepared to different



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concentrations 1%, 2.5%, 5%, 7.5% and control. The seeds of bhendi were sterilized and soaked in these different concentrations for overnight. The soaked seeds was transferred and their growth was observed at different intervals.

**RESULTS**

The Elemental composition of seaweed *Sargassum wightii* by SEM-EDS were presented in the Table-1. The results shows that the maximum amount of element present in the *Sargassum wightii* were calcium (Ca) (27.32%) followed by copper (Cu) (25.56%). Potassium (K) (23.92%) shows higher amount next to the above elements. The minimum amount of element is Iron (Fe) (1.76%) present in the *S. wightii*. The hot water extract (crude extract) were used for the analysis of growth parameters. The extract was subjected to different concentrations. The results of the growth parameters were represented in the table-2. The concentration of the 2.5% shows the maximum growth parameters such as root length (29cm), shoot length (62cm) and leaf area index (3.3268) followed by the concentration 1% viz., root length (24cm), shoot length (54cm) leaf area index (3.1774) respectively. The minimum growth parameters were shown in control root length (20cm), shoot length (48cm) and leaf area index (3.0224).

The effect of seaweed extract (crude extract) of *Sargassum wightii* were used in different concentrations for the analysis of yield parameters in bhendi. The results were shown in the table -3 and Fig-1. The results of the above table shows that the maximum yield attributes in the concentration 2.5% such as number of fruits (14.20), fruit length (13.84cm), fruit dry weight (13.48g) and yield (12.40) followed by the concentration 1%. The minimum yield parameters were recorded in the control (9.70), (13.64cm), (13.07g) and (8.16).

**DISCUSSION**

Marine macro algae (seaweeds) is an important factor of the marine living resources of the world. In many crops like vegetables, trees, flowering plants and grain crops seaweed extracts were used as a fertilizer are effective. Extracts of seaweed are known to stimulate and speed up the cell division, cell elongation, differentiation and protein synthesis which describes the stimulatory effect of seaweed on seed germination has been reported by El-Sheekh, *et al.*, (2016). Altindal D (2019) revealed that the seaweed extracts has a beneficial effects on seed germination due to the presence of phyto hormones such as gibberellic acid and auxin. Singh P K and Chandel A S, (2005) reported that application of seaweed extract to many crops shows a physiological responses due to the presence of cytokinins. S T Zodape *et al.*, 2008 determined that the application of SLF (Seaweed Liquid Fertilizer) shows an increase in plant growth, grain yield and also quality of the product. SLF sprayed to plants at 2.5% concentration showed a significant increase per plot in fruit yield (20.47%), fruit length (31.77%), fruit diameter (18.26%) and number of fruits (37.47%). G. Thirumaran *et al.*, 2009 have reported that the foliar application of SLF (*Rosenvingea intricata*) at 20% concentration shows a maximum number of fruits (7.33±0.47), fruit length (14.2±0.4 cm), fruit weight (12.43±0.56). The minimum yield parameters were shown in 100% concentration of SLF. Hence, in this experimental study foliar application of *Sargassum wightii* as a liquid fertilizer to bhendi plants shows a maximum growth and yield in 2.5% concentration. The highest growth parameters of root length, shoot length and leaf area index (29cm), (62cm) and (3.3268) was observed in 2.5% concentration followed by 1% concentration. The minimum growth parameters was shown in control. At 2.5% concentration of SLF increased the yield parameters viz., number of fruits (14.20), fruit length (13.84 cm), fruit dry weight (13.48g) and yield (12.40t/ha) followed by 1% concentration. The least yield parameters was observed in the control.

**CONCLUSION**

Seaweed or marine algae is one of the important bio-stimulator which can increase the growth and yield of the crop. From the present study, it was revealed that 2.5% *Sargassum wightii* increased the crop growth around 25% over the





control. So, from the result it was suggested that the application of seaweed at recommended dose can improve the crop growth and quality which in turn reduce the application of chemical fertilizer.

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**Table 1: Elemental composition of seaweed *Sargassum wightii* by SEM-EDS**

| S.No         | Elements       | Percentage (%) |
|--------------|----------------|----------------|
| 1.           | Sodium (Na)    | 5.05           |
| 2.           | Magnesium (Mg) | 3.95           |
| 3.           | Silicon (Si)   | 2.70           |
| 4.           | Chlorine (Cl)  | 9.74           |
| 5.           | Potassium (K)  | 23.92          |
| 6.           | Calcium (Ca)   | 27.32          |
| 7.           | Iron (Fe)      | 1.76           |
| 8.           | Copper (Cu)    | 25.56          |
| <b>Total</b> |                | <b>100</b>     |





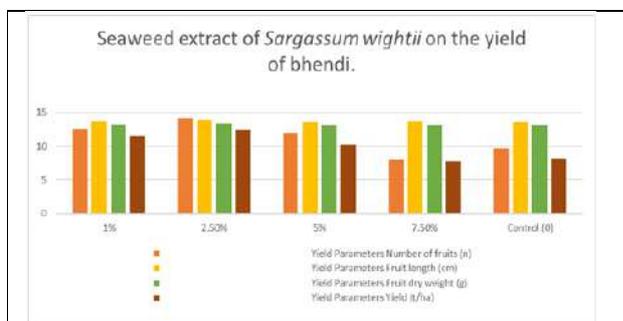
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**Table 2: Seaweed extract of *Sargassum wightii* on the growth of Bhendi.**

| Extract concentration (%) | Germination percentage (%) | Growth parameters |                   |                 |
|---------------------------|----------------------------|-------------------|-------------------|-----------------|
|                           |                            | Root length (cm)  | Shoot length (cm) | Leaf area index |
| 1%                        | 96                         | 24                | 54                | 3.1774          |
| 2.5%                      | 96                         | 29                | 62                | 3.3268          |
| 5%                        | 94                         | 23                | 52                | 3.1662          |
| 7.5%                      | 86                         | 22                | 51                | 3.0882          |
| Control (0)               | 92                         | 20                | 48                | 3.0224          |
| <b>SED</b>                | 0.67                       | 0.298             | 0.547             | 0.29            |
| <b>CD (p=0.05)</b>        | 1.35                       | 0.599             | 1.099             | 0.060           |

**Table 3: Seaweed extract of *Sargassum wightii* on the yield of bhendi.**

| Extract concentration (%) | Yield Parameters     |                   |                      |              |
|---------------------------|----------------------|-------------------|----------------------|--------------|
|                           | Number of fruits (n) | Fruit length (cm) | Fruit dry weight (g) | Yield (t/ha) |
| 1%                        | 12.60                | 13.71             | 13.16                | 11.46        |
| 2.5%                      | 14.20                | 13.84             | 13.48                | 12.40        |
| 5%                        | 12.0                 | 13.64             | 13.12                | 10.24        |
| 7.5%                      | 8.0                  | 13.72             | 13.11                | 7.76         |
| Control (0)               | 9.70                 | 13.64             | 13.07                | 8.16         |
| <b>SED</b>                | 0.199                | 0.134             | 0.039                | 0.278        |
| <b>CD(p=0.05)</b>         | 0.239                | 0.270             | 0.80                 | 0.563        |



**Fig 1. Seaweed extract of *Sargassum wightii* on the yield of bhendi.**



**Fig 2. Pot culture view of bhendi plant.**





## Phytochemical Analysis and Antioxidant Activity of *Dalechampia scandens* var. *Cordofana* (Hochst.ex A.Rich) Muell.Arg.

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### ABSTRACT

The plant species *Dalechampia scandens* var. *Cordofana* (Hochst. ex A. Rich) Muell. Arg. belongs to the family Euphorbiaceae of Angiospermae, has been found in the Sanand region of Ahmedabad district, and is less explored. The purpose of this study is to prepare the extracts of the leaves and stem of the plant using a polar solvent (Methanol) and a non-polar solvent (Toluene) and conduct preliminary phytochemical screening and quantitative analysis of phenolics and flavonoids using the Folin-Coicalteau Method and colorimetric Aluminium Chloride Assay, respectively, as well as an antioxidant assay using the Ferric Ion Reducing Antioxidant Power (FRAP) Assay. The metabolic extract of leaf and stem revealed a higher number of phytochemicals, with the metabolic extract of leaf showing maximum total phenolic content and the stem giving maximum total flavonoid content as compared to the toluene extract. The methanol extract of the leaf and stem also showed high antioxidant capacity. Furthermore, possible purification of phytochemicals present in methanolic extract may help in identifying the exact phytochemicals and generating phytochemical profiles and studying their variation with the same species growing in different environments or different *Dalechampia* spp.

**Keywords:** Antioxidant, *Dalechampia scandens* var. *cordofana* leaf and stem extract FRAP, Pharmaceuticals, Phytochemical screening, Secondary metabolites, TFC, TPC.





## INTRODUCTION

Phytochemicals are the biologically active compounds present in different parts of plants, such as leaves, flowers, seeds, bark, roots, and pulps [1]. These are organic compounds that provide definite and meaningful physiological action on the human body [2] and other animals. They have existed since the advent of the Plant Kingdom. The phytochemicals are classified based on physical, chemical, protective functions or curative potential, functional groups, and biosynthetic pathways into primary and secondary metabolites [3]. Secondary metabolites are those compounds produced by plants as side-products of the pathways of primary metabolites, which do not directly take part in the growth, development, and continuation of the progeny of the plants. However, they are essentially for protecting plant species from pests, predators, parasite plants, plant pathogens, pollution, radiation, and a biotic stress, which play an indispensable role in ecology, competition, and species interaction in the biosphere. These secondary metabolites contribute to the plant's colour, aroma, and flavor [4].

The phytochemicals present in these plants also play a vital role in preventing diseases and disorders and promoting overall well-being. The discovery of these chemical compounds has encouraged the research of commercial and industrial aspects, such as in cosmetic industries, spa industries, painting, clothing, and leather industries, traditional or alternative medicine systems, pharmaceutical industries, dietary supplement industries, food, wine, and beverage industries [5,6], the defence and military, etc., which has impacted our economy and societal norms significantly with changing times. Also, discovering phytochemicals and functional groups and reconfiguring the existing ones [5] has opened a new era of interdisciplinary fields employing ethno botany, in-silico study techniques, nanobiotechnological, molecular docking procedures in bioinformatics, and cheminformatics. The structure and activity of the phytochemicals are interconnected, which is essential in the creation of novel compounds and drugs and the improvement of many drugs in pharmaceuticals.

Current work has been conducted on the species *Dalechampia scandens* var. *cordofana* (Hochst. ex A. Rich) Muell. Arg. Phytochemical screening and antioxidant activity of the selected plant have not been reported till date except for one preliminary phytochemical screening by Hungund and Pathak in 1971 [7]. Plant material was collected from the outskirts of Ahmadabad district, Gujarat, India. The plant species is present as a twinner with alternate, trifoliolate, petiolated leaves, and leaflets oblong or lanceolate, serrate, hairy leaflets. Flowers are monoecious, present in cup-like involucre yellow bracts [8], which also bear glands. Irritable juice or latex secreted by glands is inflammatory to the skin, producing an itching effect from hairy glands while segregating the plant.

The purpose of current research on *Dalechampia scandens* var. *cordofana* (Hochst. ex A. Rich) Muell.Arg. is to perform preliminary phytochemical screening, quantitative phytochemical analysis, and check antioxidative potential, which might be helpful to explore its use in the pharmaceutical industry and therapeutics.

## MATERIALS AND METHODS

### Chemicals

99% Methanol (v/v) %, 99% Toluene (v/v) %, 10% Ammonium solution, 5% FeCl<sub>3</sub> solution, 2% FeCl<sub>3</sub> solution, 20% Na<sub>2</sub>CO<sub>3</sub> solution, 0.1% FeCl<sub>3</sub> solution, 1% Lead acetate solution 10% Lead acetate solution, 20% Sodium nitroprusside solution, 1% Aluminium chloride solution, 5% Copper acetate solution, Mayer's Reagent (Potassium mercuric iodide), Wagner's Reagent (Potassium iodide + Iodine), Hager's Reagent (Saturated Picric Acid), Dragendorff's Reagent (Solution of potassium bismuth iodide), Molisch's Reagent (Naphthol dissolved in 95% Ethanol), Fehling A Reagent (Copper (II) Sulphate), Fehling B Reagent (Mixture of Potassium Sodium tart rate and strong alkali), Barfoed's Reagent (**Neutral Copper Acetate in 1% Acetic Acid solution**), Benedict's Reagent (Complex Mixture of Sodium Carbonate, Sodium Citrate and Copper (II) Pent hydrate), Million's Reagent (Mercuric Nitrate and Mercurous Nitrate dissolved in Concentrated HNO<sub>3</sub>), Concentrated Sulphuric Acid (H<sub>2</sub>SO<sub>4</sub>), Folin-Coicalteau Reagent (Phosphomolybdate + Phosphotungstate solution), Chloroform (CHCl<sub>3</sub>), Pyridine (C<sub>5</sub>H<sub>5</sub>N), Gallic Acid, 10%

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Aluminium chloride solution, 1M Potassium Acetate solution, Quercetin, 10mM TPTZ in 40mM HCl, 20mM FeCl<sub>3</sub>, 300mM pH 3.6 Acetate Buffer, FeSO<sub>4</sub>.7H<sub>2</sub>O

### Collection of Plant Material

Fresh leaves and stems of plants *Dalechampia scandens* var. *cordofana* (Hochst . ex A. Rich) Muell. Arg. has been collected from the outskirts (Sanand) of the Ahmadabad district. The collected leaves and stems of the plant were washed carefully with distilled water, segregated and air-dried, then ground in the mixer grinder to produce a fine powder.

### Plant extraction

The cold extraction method [9] is applied here, in which the dried, powdered material is macerated in the solvent on a shaker for 24 hours. Using an analytical weighing balance, 10gm of powdered leaf and stem samples were weighed and dissolved in 99% Methanol (Semi-Polar solvent) and 99% Toluene (Non-Polar solvent) in a 1:20 ratio, respectively, in Erlenmeyer flasks. For 24 hours, the flasks were shaken. Next, the solutions prepared are filtered using Whatmann Filter paper No. 1. After filtration, the samples were poured into different petri plates and air-dried. For further procedures, the extract-containing petri-plates are sealed with tape and stored in a laboratory refrigerator. The percentage yield of the four extracts is calculated using the following standard formula [9,10].

$$\text{Percentage yield} = \frac{\text{Weight of the Dry Extract}}{\text{Weight of Plant powder take}} \times 100$$

### Qualitative phytochemical analysis

Qualitative phytochemical analysis was performed by preparing a stock solution of plant extract. A stock solution is created by combining plant extract and solvent in a 1:1 ratio. 30 mg of stem and leaf extracts are dissolved in 30 ml of methanol (1 mg/ml). Phytochemical screening was carried out using standard test procedures and was conducted for alkaloids, carbohydrates, proteins, phenolics, flavonoids, tannins, saponin, glycosides, quinones, cardiac glycosides, steroids, terpenoids, and diterpenes [11,12,9,13,14,15] as follows

#### Alkaloids

- **Mayer's Test:** 1 ml of filtrate is treated with 2-3 ml of Mayer's reagent. The formation of a creamy white to yellow precipitate/colouration indicates the presence of alkaloids.
- **Wagner's Test:** 1ml of filtrate is added to 1ml of Wagner's reagent. The formation of a reddish-brown colour/precipitate indicates a positive test for the presence of alkaloids.
- **Hager's Test:** 2 ml of filtrate are treated with 2 ml of Hager's reagent. The formation of a yellow-coloured precipitate indicates the presence of alkaloids.
- **Dragendorff's Test:** 1 ml of filtrate is dissolved with a few drops of Dragendorff's reagent. The presence of alkaloids is confirmed by the appearance of a reddish-orange precipitate/colouration

#### Carbohydrates

- **Molisch's Test:** 1ml of filtrate is added to 1ml of Molisch's reagent. The formation of a red or dull violet-coloured ring at the interface of two layers indicates a positive test for the presence of carbohydrates.
- **Fehling's Test:** Boil for 2 minutes with 1 ml of filtrate, 1 ml of Fehling A, and equal amounts of Fehling B solution. The development of a brick-red precipitate suggests a positive test for carbohydrates.
- **Barfoed's Test:** 1 ml of filtrate is added to Barfoed's reagent and boiled for two minutes. A brick-red precipitate formation suggests a positive test for carbohydrates.
- **Benedict's Test:** 2 ml of filtrate is added to 2 ml of Benedict's reagent and boiled for 2 minutes. The formation of an orange-brick red precipitate reveals the presence of reducing sugars.





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#### Proteins

- **Million's Test:** 1ml of filtrate is treated with 1ml of Million's reagent. The formation of white precipitates or coloration is proof of the presence of proteins.

#### Phenolics

- **Brayer's Test (FeCl<sub>3</sub> Test):** 1ml of filtrate is treated with a few ml of 5% FeCl<sub>3</sub> solution. The development of Bluish-Black to Dark Green colouration depicts a positive test for phenols.
- **Lead acetate Test:** 1ml of filtrate is treated with a few drops of 10% lead acetate solution. The formation of a creamy to yellow precipitate indicates the presence of phenolic compounds.
- **Folin-Coicalteau Test:** 1ml of filtrate and 1ml of FC reagent are mixed together. The formation of bluish-green to a dark green colour or dark blue indicates the presence of phenolic compounds.

#### Flavonoids

- **Lead Acetate Test:** 1ml of filtrate is treated with a few drops of a 10% lead acetate solution. The formation of a yellow precipitate reveals the presence of flavonoids.
- **H<sub>2</sub>SO<sub>4</sub> Test:** 1 ml of filtrate is treated with a few drops of concentrated sulfuric acid. The availability of flavonoids is detected by the production of an orange/red coloration.
- **Aluminium Chloride Test:** 2ml of filtrate is treated with 4-5 drops of 1% Aluminium Chloride Solution.

#### Tannins

- **FeCl<sub>3</sub> Test:** 1ml of filtrate is added to 0.1% FeCl<sub>3</sub> solution. The formation of brownish-green or blackish-blue coloration indicates the presence of tannins.
- **Lead Acetate Test:** 1ml of filtrate is treated with a 1% lead acetate solution. The formation of a yellow-coloured precipitate indicates a positive test for tannins.

#### Quinones

- **H<sub>2</sub>SO<sub>4</sub> Test:** 1 ml of filtrate is treated with a few drops of concentrated sulfuric acid. The formation of an orange/red colour indicates a positive test for quinones.

#### Saponins

- **Froth/Foam Test:** 1ml of filtrate is dissolved in 2-3ml of distilled water, taken in a test tube and shaken vigorously for 15-20 minutes. Let it stand for about 10-15 minutes. The persistence of foam for a few minutes is evidence of the presence of saponins.

#### Glycosides

- **H<sub>2</sub>SO<sub>4</sub> Test:** 1ml of the filtrate was added to 1ml of concentrated Sulfuric acid. The formation of an orange-red colour indicates the presence of glycosides.
- **Ammonia Test:** 1ml filtrate is treated with 2-3ml chloroform and shaken well. To this, a 10% ammonia solution is added. The formation of pink colour indicates a positive test for the presence of glycosides.

#### Cardiac glycosides

- **Legal Test:** 2ml filtrate was added to 1 ml of pyridine and 1 ml of 20% sodium nitroprusside solution. The formation of pink to wine-red or blood-red coloration suggests the presence of cardiac glycosides.
- **Keller-Killani Test:** 3-4ml filtrate is mixed with 2ml glacial acetic acid, a few drops FeCl<sub>3</sub>, and 1ml concentrated H<sub>2</sub>SO<sub>4</sub>. The formation of a brown ring at the interface indicates the presence of Cardiac Glycosides.

#### Steroids

- **Salkowski's Test:** 1ml of filtrate is treated with 2ml of chloroform and 2ml concentrated H<sub>2</sub>SO<sub>4</sub>, which forms 2 layers. The formation of a reddish-brown/rusty coloration at the interface indicates the presence of Steroids.





### Terpenoids

- **Salkowski's Test:** 1ml of filtrate is treated with 2ml of chloroform and 2ml concentrated H<sub>2</sub>SO<sub>4</sub>, which forms 2 layers. The formation of reddish-brown/rusty coloration at the interface depicts the presence of Terpenoids.
- **Copper Acetate Test:** 2ml of filtrate is dissolved in distilled water and treated with 2ml of 5% Copper Acetate solution. The formation of emerald green colouration shows the presence of Terpenoids.

### Diterpenes

- **Copper Acetate Test:** 2ml of filtrate is dissolved in distilled water and treated with 2ml of 5% Copper Acetate solution. The formation of emerald green colouration gives the positive result for the presence of diterpenes.

### Quantitative phytochemical analysis

The quantitative analysis of phytochemical constituents is essential for determining the exact amounts of phytochemicals present. For conducting quantitative analysis, the stock solution was prepared with a concentration of 1 mg/ml in 99% Methanol solvent. Similarly, the standard solutions (Gallic Acid–TPC and Quercetin–TFC) were prepared with a concentration of 1 mg/ml.

### Determination of Total Phenolic Content (TPC)

The total phenol content of the plant sample was determined using the Folin-Ciocalteu assay procedure, a modification of the Folin-Denis test procedure. The total phenolic content of each sample was determined by taking 1ml of Folin-Coicalteau reagent and 4ml of freshly prepared 20% Na<sub>2</sub>CO<sub>3</sub> in 1ml of plant extract. The whole solution was diluted with 30 ml of distilled water and incubated in the dark for 30–40 minutes. Duplicates of the sample were measured using a spectrophotometer and readings of absorbance of the wavelength as Optical Density (O.D.) were recorded at 765 nm. A standard calibration curve for Gallic acid (Graph-1,  $y = 0.0016x + 0.2797$ ;  $R^2 = 0.9728$ ) was used for quantification of the phenolic content of an unknown sample. The total phenolic content is expressed in terms of mg GAE/g (milligrams of gallic acid equivalent per gram of sample) by using the following formula:

$$\text{GAE} = \text{C} \times \text{V/M} [9,10].$$

Where,

**C**= Concentration of sample obtained from solving the equation of standard calibration graph obtained, (in mg/ml),

**V**= Volume of sample used (ml) and

**M**= Mass of extract taken in grams.

### Determination of Total Flavonoid Content (TFC)

The total flavonoid content of plant extract is estimated through the colorimetric assay. For estimating total flavonoid content, 0.1ml of freshly prepared 10%AlCl<sub>3</sub> and 0.1ml (100ml) of 1M Potassium Acetate are added to the 1ml of plant extract. Then the solution was diluted with 40 ml distilled water and incubated for 20–30 minutes. Duplicates of the sample were measured using a spectrophotometer at a 415nm wavelength. The standard calibration graph of Quercetin ( $y = 0.0018x + 0.101$ ;  $R^2 = 0.9948$ ) was used to estimate the total flavonoid content of an unknown sample. The amount of flavonoid content is expressed in terms of mgQE/g of the sample (milligrams of quercetin equivalent per gram of sample), using the formula [9]:  $\text{QE} = \text{C} \times \text{V/M}$

Where,

**C**= Concentration of sample obtained from solving the equation of standard calibration graph (mg/mL)

**V**= Volume of sample (ml) and

**M**= Mass of extract taken in grams.

### Antioxidant assay

#### Ferric ion Reducing Antioxidant Power (FRAP) Assay

The total antioxidant content of the plant sample was determined using the FRAP colorimetric assay. To estimate antioxidant activity, 4ml of FRAP working solution was added to 0.5ml of plant extract. Then the solution was diluted by 10ml of deionized water and incubated for 40–45 minutes. A spectrophotometer with a 593 nm



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wavelength was used to measure the absorbance of duplicates. The power of an unknown plant sample was calculated by using the calibration curve of  $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$  ( $y = 0.004x - 0.0227$ ;  $R^2 = 0.9948$ ). The antioxidant power is expressed in terms of mg  $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$  E/g of sample (mg  $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$  E/g = milligrams of  $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$  equivalent per gram of sample) using the formula:

$$\text{FeSO}_4 \cdot 7\text{H}_2\text{O E} = C \times V/M.$$

Where,

**C**=Concentration of sample obtained from solving the equation of standard calibration graph (mg/ml)

**V**=Volume of sample used (ml) and

**M**= Mass of extract taken in grams.

### STATISTICAL ANALYSIS

All the results of quantitative phytochemical analysis are conducted in duplicates in order to minimise error by taking an average and have been denoted in the form of **mean standard deviation (S.D.)**. The calculations for statistical analysis were conducted in the Microsoft Office 2019 Excel application. From the three graphs, different equations are obtained in the form of regression equations for the straight line,  $y = mx + c$ , where  $y$  = Absorbance of extract,  $m$  = Slope of the graph,  $x$  = Concentration of extract, and  $c$  = Intercept of the graph [16], for further calculation of TPC, TFC, and FRAP Assay.

## RESULTS AND DISCUSSION

There hasn't been much research work done on *Dalechampia scandens var. cordofana* (Hochst. ex A. Rich) Muell. Arg. This current study aims to explore the various secondary metabolites of this plant, which in turn can be applied in various industries as raw materials. The methanolic extract of the leaf of this plant has shown maximum yield with 19.81% of dry extract, containing all major phytochemicals like alkaloids, carbohydrates, phenolics, flavonoids, saponins, proteins, tannins, glycosides, cardiac glycosides, terpenoids, etc., as referred to in Table-1&2, whereas toluene extract of both leaves and stem of this plant showed the presence of the least number of phytochemicals as compared to methanol extract.

From the quantitative analysis results (Table-3) and antioxidant assay (Table-4), methanolic extract of leaf and stem showed the maximum amount of total phenolic content, total flavonoid content, and antioxidant activities. Leaves Methanol shows the highest amount of total phenolic content with  $484.563 \pm 0.0785$  mg GAE/g of sample as compared to that of *Plumeria pudica* ( $248.33 \pm 3.33$  mg GAE/g of sample) [10], *Dichanthium annalutum* ( $246 \pm 0.003$  mg GAE/g of sample), *Boerhaavia diffusa* ( $223 \pm 0.003$  mg GAE/g of sample) and *Digera muricata* ( $103 \pm 0.005$  mg GAE/g of sample) [17] and stem Methanol shows maximum amount of total flavonoid content with  $113.333 \pm 0.00070$  mgQE/g, as compared to that of *Dichanthium annalutum* ( $238 \pm 0.009$  mg QE/g of sample), *Boerhaavia diffusa* ( $241 \pm 0.004$  mg QE/g of sample) and *Digera muricata* ( $202 \pm 0.013$  mg QE/g of sample) [17]. However, Methanolic extracts of both leaf and stem showed high antioxidant content with  $217.2125 \pm 0.005656$  mg  $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$  E/g and  $219.7125 \pm 0.003535$  mg  $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$  E/g respectively.

This research also further solidifies the fact that the polar solvent (Methanol) is able to retain or extract phytochemicals better than a non-polar solvent [9] and that polar solvents are more favored to isolate any phytoconstituent. These phytochemicals like tannins, phenolics and flavonoids are instrumental as potent antioxidants and are often exploited in the pharmaceutical industry for their anti-inflammatory, anti-tumour, anti-cancerous, anti-ageing, anti-diabetic and anti-obesity effects and are used in the treatment of various cardiovascular diseases, diabetes, eye disorders resulting from ageing, neurodegenerative diseases, like, Alzheimer's disease, hypertension and protective action against Inflammatory Bowel Disease (IBD) which includes ulcerative colitis (UC) and Crohn's disease[18].



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The plant studied *Dalechampia scandens* var. *cordofana* (Hochst. ex A. Rich) Muell. Arg., has a high total phenolic content, a high flavonoid content, and antioxidant properties. This plant has also been less studied for phytochemical analysis, hence it is essential for further purification of the phyto-constituents especially secondary metabolites like alkaloids, tannins, phenolics, flavonoids, etc., which were discovered to be highest in methanolic extract of leaf and stem using modern techniques, viz. High Performance Liquid Chromatography (HPLC) and various other chromatography techniques may help in generating a phytochemical profile of the plant, identifying the exact chemical structure of the phyto-constituents, and can find its application in other disciplines of basic and applied biology, like phylogeny and evolutionary biology, biotechnology, nanotechnology, pharmaceuticals for drug designing, bioinformatics for molecular docking, microbiology, etc. With the variation in the ecological niches and available limiting resources, the plants might show variation in their phytochemical profiles as compared to their counterparts growing in different environments, which can be further researched upon.

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**Table-1: Percentage yield of *Dalechampia scandens* var. *cordofana* (Hochst. ex A. Rich) Muell.Arg. plant extracts.**

| Sr.No | Plant parts | Methanol | Toluene |
|-------|-------------|----------|---------|
| 1.    | Leaf        | 19.81%   | 3.56%   |
| 2.    | Stem        | 8.85%    | 3.18%   |

**Table-2: Qualitative phytochemical analysis of *Dalechampia scandens* var. *cordofana* (Hochst. ex A. Rich) Muell.Arg.**

| Test                                      | Leaves   |         | Stem     |         |
|---|----------|---------|----------|---------|
|   | Methanol | Toluene | Methanol | Toluene |
| <b>Alkaloids</b>                          |          |         |          |         |
| Mayer's Test                              | +        | +       | -        | +       |
| Wagner's Test                             | -        | -       | -        | -       |
| Hager's Test                              | +        | +       | +        | +       |
| Dragendorff's Test                        | +        | +       | -        | +       |
| <b>Carbohydrates</b>                      |          |         |          |         |
| Molisch's Test                            | +        | +       | +        | +       |
| Fehling's Test                            | +        | -       | -        | -       |
| Barfoed's Test                            | +        | -       | -        | -       |
| Benedict's Test                           | +        | -       | -        | -       |
| <b>Proteins</b>                           |          |         |          |         |
| Million's Test                            | +        | +       | +        | +       |
| <b>Phenolics</b>                          |          |         |          |         |
| Brayer's Test<br>(FeCl <sub>3</sub> Test) | +        | -       | -        | -       |
| LeadAcetateTest                           | +        | +       | -        | +       |
| Folin-Coicalteau Test                     | +        | -       | +        | -       |
| <b>Flavonoids</b>                         |          |         |          |         |
| Lead Acetate Test                         | +        | +       | +        | +       |
| H <sub>2</sub> SO <sub>4</sub> Test       | +        | -       | +        | -       |
| Aluminium Chloride Test                   | +        | +       | -        | -       |





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| <b>Tannins</b>                      |   |   |   |   |
|-------------------------------------|---|---|---|---|
| FeCl <sub>3</sub> Test              | + | - | - | - |
| Lead Acetate Test                   | + | - | - | - |
| <b>Quinones</b>                     |   |   |   |   |
| H <sub>2</sub> SO <sub>4</sub> Test | + | - | + | - |
| <b>Saponin</b>                      |   |   |   |   |
| Froth/Foam Test                     | + | - | + | - |
| <b>Glycosides</b>                   |   |   |   |   |
| H <sub>2</sub> SO <sub>4</sub> Test | + | - | + | - |
| Ammonia Test                        | + | - | - | - |
| <b>Cardiac glycosides</b>           |   |   |   |   |
| Legal Test                          | + | + | + | + |
| Keller-Killani Test                 | + | + | + | + |
| <b>Steroids</b>                     |   |   |   |   |
| Salkowski's Test                    | + | - | - | - |
| <b>Terpenoids</b>                   |   |   |   |   |
| Salkowski's Test                    | + | - | - | - |
| Copper Acetate Test                 | + | - | - | - |
| <b>Diterpene</b>                    |   |   |   |   |
| Copper Acetate Test                 | + | - | - | - |

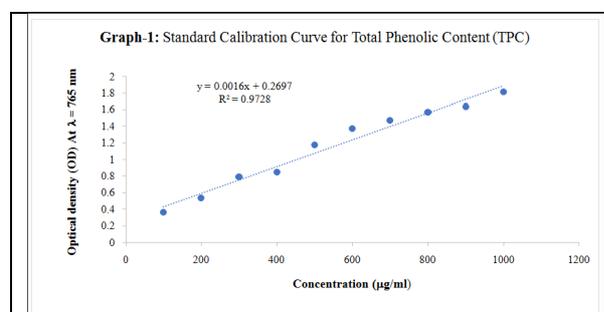
('+' Indicate presence of phytochemical, '-' Indicate absence of phytochemical)

**Table-3: Quantitative phytochemical analysis of *Dalechampia scandens* var. *cordofana* (Hochst. ex A. Rich) Muell.Arg.**

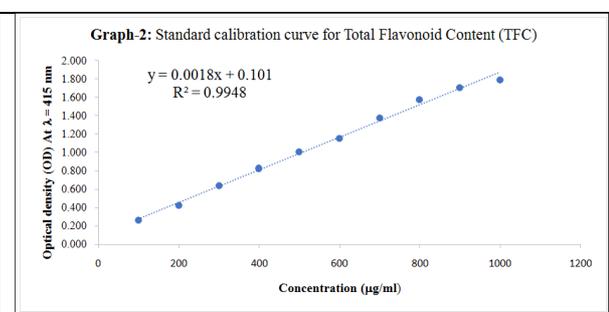
| Sr.no. | Content       | Leaf          |              | Stem           |              |
|--------|---------------|---------------|--------------|----------------|--------------|
|        |               | Methanol      | Toluene      | Methanol       | Toluene      |
| 1.     | TPC(mg GAE/g) | 484.563±0.078 | -            | 197.6875±0.023 | -            |
| 2.     | TFC (mgOE/g)  | 98.888±0.001  | 92.222±0.001 | 113.333±0.0007 | 86.111±0.001 |

**Table -4: Antioxidant activities of *Dalechampia scandens* var. *cordofana* (Hochst. ex A. Rich) Muell.Arg.**

| Sr.no. | Content  | Leaf          |           | Stem          |              |
|--------|--|---------------|-----------|---------------|--------------|
|        |  | Methanol      | Toluene   | Methanol      | Toluene      |
| 1.     | FRAP (mg FeSO <sub>4</sub> .7H <sub>2</sub> O/g) | 217.212±0.006 | 712±0.002 | 219.712±0.003 | 31.587±0.001 |



**Graph-1: Standard Calibration Curve for Total Phenolic Content (TPC)**

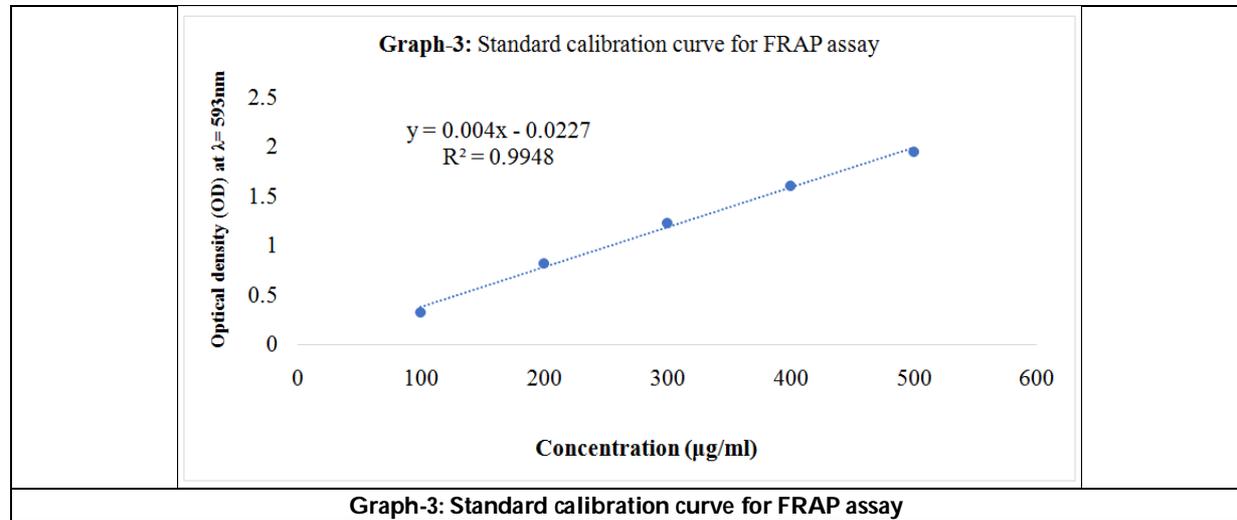


**Graph-2: Standard calibration curve for Total Flavonoid Content (TFC)**





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## Strategic Communication: A Phenomenological Study on Handling Cognitive Behaviors

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### ABSTRACT

Communication is the process of sharing ideas, information, and messages with others in a particular time and place. Communication includes verbal (writing and speaking), as well as nonverbal communication (such as facial expressions, body language, or gestures), visual communication (the use of images or pictures, such as painting, photography, video or film) and electronic communication (telephone calls, electronic mail, cable television, or satellite broadcasts). Communication is a vital part of personal life and is also important in business, education, and other situations where people encounter one another (Encarta, 1998). In strategic communication we design clear goals and realize how the attitude, behavior and perception of a particular set of audience are aligned with the objective we have already set (Paul, 2011). In strategic communication, message development, or the process of creating key points or ideas, requires high levels of planning and research. These messages are targeted, or created with a specific audience in mind, and help to position an organization's communication goals with its structural goals. As the world becomes increasingly interconnected through new forms of communication, the role of strategic communications is to help organizations understand how to effectively deliver their message to key audiences. The essence of this paper is that economic crises have not only negatively impacted the financial system of the society and but also has considerably contributed to the emotional and psychological turbulence of the affected people. This issue drives often a more consistent moral behavior in terms of public consciousness and responsibility since the level of understanding of culture and language among the technocrats of industries and academia do not





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maintain parity. As the growth of a country depends on the growth of its citizens hence it becomes inevitable to promote strategic communication skills.

**Keywords:** public relations, crisis, economy, social changes, strategic communication forces.

## INTRODUCTION

Communication is a very powerful pursuit to achieve a requisite goal. Companies, Government and Non-Government Organizations, private and public sectors spend significant amount of money in public relation (PR), information materials and visibility strategies, addressed to the public at large, expecting that the mass media would take up the message and circulate it to the target audience. Apart from institutional communication, independent media add their credibility by proclaiming the information to the crowd. The intrinsic coupling of credibility and independence of media, however, is often underrated. If anything goes wrong, PR agents are replaced rather than changing the policy, and the power of the institutional communication is overestimated.

Culture is an important factor of communication. Culture refers to a System of shared meanings that are expressed through different symbolic forms such as rituals, stories, symbols, myths that hold a group of people together. People who share a common culture share a similar communication pattern. Culture, in the broad sense of the term, results from human interaction with nature and generalized ways of social interaction, including knowledge, languages and belief systems shared by a number of people. The dominant perception of culture is heritage, tangible and intangible, forming a cultural environment that shapes attitudes and behavior and gives identity. Underestimated is the process of cultural creation. As knowledge is evolving, so are languages and belief systems. Every human being contributes as much cultural changes as he or she is shaped by cultural heritage. Thus, diversity is inherent in culture, and no culture can flourish in isolation. The Report of the World Commission on Culture and Development (1995) reflects this with its wonderful title "Our Creative Diversity". But unfortunately culture is undervalued as a major factor of change.

The power of education is definitely not to be overestimated. Too often, however, education is not fully considered as interaction of teaching and learning, of formal schooling and informal learning in society. Modern concepts such as lifelong learning and learning society indicates growing awareness of the fact that, in the 21st century, learning has become as much, as, important as teaching. The contribution of the Anna Lindh Foundation to the 2006 Euro Med Women Ministerial Conference focuses on culture, education and communication media as key factors in changing attitudes, behavior, and, more generally, societies. The authors take into account that neither education nor culture nor media can be seen as mere instruments, ready for achieving expected results from appropriate input. The challenges and recommendations gathered in this paper are based on the assumption that real changes in human relations can only be achieved with clear focus on the human being as learner, creator and communicator.

Communication is the process of sharing ideas, information, and messages with others in a particular time and place. Communication includes writing and talking, as well as nonverbal communication (such as facial expressions, body language, or gestures), visual communication (the use of images or pictures, such as painting, photography, video or film) and electronic communication (telephone calls, electronic mail, cable television, or satellite broadcasts). Communication is a vital part of personal life and is also important in business, education, and any other situations where people encounter each other (Encarta, 1998). Over the years, we had the opportunity to work within an organization precisely an educational institution in which communication is vital to its employees as well as to the students. We have focused on the teaching learning process where communication plays an important role and we have realized the problem regarding the perforation of communication between the teachers and students. With this in mind, a study was completed within the organization to determine if there was an internal communication gap that existed between teachers and students which was a major cause for the learners not adapting to the learning



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skills. When there is an internal communication gap within an organization there is usually a breakdown in the way information is sent from the sender to the receiver. This is precedent in institutions where students are involved for whom language acquisition is a major challenge. In this type of a system where learners do not have a command over a predominant language such as English.

**IMPORTANCE OF THE STUDY**

We are basically a social species. We love to be around people, interact with them, share with them, and do various pursuits together. In our personal lives, we need family, friends, acquaintances and others to fulfill various psycho-emotional needs like security, comfort, friendship, and love. Therefore we have a need to learn a language which brings us closer to people in particular and society in general. In the work environment, we need each other in order to achieve our goals and objectives for a global acceptance. Neither of these goals can be achieved without proper communication efficiency. Communication is the cardinal string that weaves us together. As a deduction there is an urge for us to learn a language which has a global acceptance. Communication enables us to express our needs, dreams, wants, ideas, and emotions efficaciously. The better we are at communication, the more effective we are at achieving our hopes and dreams (Alessandra, Hunsaker, 1993).

Based upon conversations among students and teachers, the present paper emphasizes on the lack of communication within the teaching learning system where the students do not receive what the teacher wants to teach them. This propagates the theory that sent message and received message are not the same. As a result of which both the students and teachers do not reach their targeted goal. When there is an internal communication gap it becomes difficult for anyone to effectively achieve goals in a global scenario. Therefore the main aim of a teacher is to help the students to acquire a language that will give them a global exposure. The teachers are required to make some changes in the teaching learning methods in order to make the students skillful communicators. The students may initially face a couple of problems in learning the language. Firstly there has to be an acceptance of learning a new language which is different from their comfort zone to communicate. Secondly it is different from their mother tongue.

**Purpose of the Study**

The purpose of this study is to determine whether or not there is an internal communication gap that exists between the teachers and students. The three objectives of this study are to:

- 1) Discover whether or not there is an internal communication gap between teachers and the students.
- 2) Determine the subject's perception of their understanding level of communication.
- 3) Identify the ways in which students usually receive most of the information.

**Definition of Terms**

Sender - somebody or something that sends or transmits something. To prove yourself as an effective communicator, you must first establish your credibility in front of the target audience. Credibility can be defined as believability, the trustworthiness and acceptance of the audience on the sender or speaker. In the business arena, this involves displaying knowledge of the subject, knowing the target audience and the context of the message. Knowing, analyzing and adapting to the audience (individuals or groups to which you are delivering your message) increase the credibility of the sender. But when one fails to understand whom the sender is communicating it would create misunderstanding. Message –the verbal and nonverbal components of language that is sent to the receiver by the sender which conveys an idea. It may be verbal or nonverbal, and they may be intentional or unintentional.

Verbal message: any type of spoken or written communication that uses one or more words. Non Verbal message: All the nonverbal aspects of our behavior: facial expressions, posture, tone of voice, hand movements, manner of dress, and so on. Written, oral and nonverbal communications are affected by the sender's tone, method of organization, validity of the argument, what is communicated and what is left out, as well as your individual style of communicating. Messages also have intellectual and emotional components, with intellect allowing us the ability to reason and emotion allowing us to present motivational appeals, ultimately changing minds and actions (Fowler,





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2005). Channel - a medium or a means of communication or expression. It carries the message from the sender to the receiver. Receiver - The person or people who receive the message. Along with the words, the sender uses intentionally and unintentionally different nonverbal cues like tone and pitch, intonation, facial expressions and his/her emotion and feelings( sometimes filtered and sometimes unfiltered). The receivers receive the message along with its accompaniment. It is to be kept in mind that the prompts that are sent to the receivers are part of the message and hence the feelings, emotional quotient of the audience have to be taken into consideration.

Feedback is the response in the form of opinions about something that is discussed to provide useful information for future decisions and development. In every society, humans have developed spoken and written language as a means of sharing messages and meanings. The most common form of daily communication is interpersonal- that is, face-to-face, at the same time and in the same place (Encarta, 2005). In response to the sender's message the receivers or the audience will provide a feedback. The feedback is either verbal or nonverbal reactions to the communicated message. Feedback connects the sender with the receiver and turns communication a two way process. Pay close attention to this feedback as it is crucial to ensuring the audience understood your message (Fowler, 2005).

Context - the words or phrases or passages that come before and after a particular word or passage in a speech or piece of writing and help to explain its full meaning (Encarta, 2005). The situation in which your message is delivered is the context. This may include the surrounding environment or broader culture i.e. corporate culture, international cultures, etc. (Fowler, 2005) Students usually communicate through a response that is perceived by them according to their understanding and perception.

Barriers: Barriers create obstruction in the process of communication. This controls the progress or movement of the process. It breaks the rhythm that is expected in a desired outcome. It stops the process of communication by partially sending the message. There can be different types of barriers e.g. physical barriers and emotional barriers. Physical barriers include medium, crowd, physical object, distance, noise etc. Emotional barriers include intra personal behavior; inter personal behavior, categorical thinking, wrong assumptions etc.

Communication barriers can pop-up at every stage of the communication process (which consists of sender, message, channel, receiver, feedback and context) and have the potential to create misunderstanding and confusion. To be an effective communicator and to get your point across without misunderstanding and confusion, your goal should be to lessen the frequency of these barriers at each stage of this process with clear, concise, accurate, well planned communications (Fowler & Manktelow, 2005).

Filters: Filters are like barriers but the only difference is they filter the process of communication. They channelize or clean the process as a result the message is not properly received by the receiver. It mainly occurs at the psychological level or individual level ( E.g. Social status, skill, orthodox thinking, content, culture, gender etc). Both barriers and filters distort the process of communication. The participant has to be conscious of their presence and act accordingly. If they want the process of communication to be fruitful they must eliminate as much as possible the barriers and filters from the process.

Communication, being the heart of business, is the most important of all entrepreneurial skills. The destiny of the business depends on the quality of your relationships. Your ability to transmit information helps both clients and employees feel they can communicate with and ultimately trust you (Black Enterprise, Charles, 1998, pg 116). Internal communication is more important today than in previous years partly because the business and market conditions are more complex. There is a lot of information in the marketplace and it's crucial that employees understand it. The development of a strategic internal communication strategy and its implementation can provide a number of benefits to organizations, such as keeping employees motivated and engaged, and sharing clear, consistent messages with employees in a timely manner (Black Enterprise, Clemons, pg 46).



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Internal communications do not need to be extensive to be effective. The important factor appears to be a continuous flow of information. Let us assume the students as public speakers. Whether they are talking with friends or their neighbor at home, they are conveying a picture of the institution and how it is doing. The more they are informed, the better they can represent the company in the broader community. (Phelps, 2000). Rapport building is a significant element in business. An organization, whatever its size, mission, vision or motive, it is merely a collection of people assembled to pursue a common objective. An organization functions through its people, who in turn function through communication.

Employees have their own sources, their own information network, separate from the management channels. These networks usually carry information prior to the official declaration. Not that the employee network is flawless. Their system transmits information indiscriminately. It may not always operate in the best interests of the organization, but it does provide a check-point when management fantasies are disguised as information. Furthermore, it enables employees to participate in the communication process, and it fills their need for information which at least seems to come from a credible source (another employee) (Brennan, 1974). Students, like all other people, require outlets for their thoughts and feelings and they find them. So the management should not arbitrarily assume that the relative absence of employee complaint is a positive sign. Employees may be expressing themselves through other channels: meetings with peer groups, representatives, and teachers; or through passive-aggressive behavior such as work slowdowns, carelessness, tardiness, absenteeism, and apathy. These can be symptoms that employees feel other means of participation are unavailable to them (Brennan, 1974). The skill of listening becomes extremely important when we talk about "upward communication." There are many avenues through which management can send messages downward through business correspondences, but there are few avenues for movement of information in the upward direction (Nichols & Stevens, 1999).

Skilled communicators are able to build rapport with coworkers and business associates, which can help move projects along more efficiently. They know whose expertise to tap when they need assistance and are efficient at resolving conflicts and building consensus among team members (USA Today, 2002). Efficacy in leadership and aptitude for communication are the significant attributes to strengthen an organization.

**Strategic forces that influence Business Communication.**

Legal and Ethical Constraints (the international laws, domestic laws, code of ethics and Personal values). Personal code of ethics of the employees and employer(s), social pressures, ethical code of the organization, ethical climate of the industry, government rules and regulations are some of the factors that that influences the ethical business communication. Some of the most common ethical issues in international business include outsourcing, working standards and conditions, workplace diversity and equal opportunity, trust and integrity, supervisory oversight, human rights, religion the political arena, bribery and corruption. Ethical behavior and corporate social responsibility can bring significant benefits to a business. They may attract customers to the firm's products, thereby boosting sales and profits, male employees want to stay with the business, reduce labor turnover and therefore increase productivity.

**Diversity Challenges. (Language differences, Cultural differences, Education etc)**

When trying to understand how to more effectively encode and decode messages, it's important to understand that people's identities are diverse and complex, often shaped by their environment, history, and experience. We sometimes generalize in order to make sense of or evaluate a situation, but being mindful and listening carefully will help us do a better job of responding to a situation case-by-case instead of falling back on discriminatory or racist attitudes, bias, or stereotyping.

Diversified Culture causes difficulties in the process of communication due to varied perception and background of the participants as they are from different cultural platform. They use a different set of signs, symbols, customs, rituals and behavioral patterns. Even people of different culture use different accents, dialects or different languages and body language. The beliefs, value system, sense of morality and ethics are also unknown to a person who does





not belong to that culture. Educated mass and uneducated mass behave differently. Each group has got their own prejudices. And to top it all, people of a particular educational back ground behave differently than that of the other. The approach and attitude of academicians are completely different from bureaucrats.

#### **Changing Technology. (Accuracy and Security issues, telecommunication Software development)**

“For all the dollars spent by American companies on R&D, there often remains a persistent and troubling gap between the inherent value of the technology they develop and their ability to put it to work effectively. At a time of fierce global competition, the distance between technical promise and genuine achievement is a matter of especially grave concern. Drawing on their long study of the difficulties managers have had in closing this gap, the authors identify half a dozen key challenges that managers responsible for implementing new technology must surmount: their inescapably dual role, the variety of internal markets to be served, legitimate resistance to change, the right degree of promotion, the choice of implementation site, and the need for one person to take overall responsibility.” (Barton & Kraus, 1985).

Introduction of new technology brings new types of problems to the organization than lessening the burden of work. It presents a different array of challenges in front of the management than does the work of effective project administration. In order to utilize the benefits of the new technology, managers need to face and handle the challenges efficiently. A dual role (Those who manage technological change must often serve as both technical developers and implementers), Marketing perspective (That involving users in a new technology's design phase boosts user satisfaction is quite well known, but the proper extent, timing, and type of user involvement will vary greatly from company to company.), framework for information (Just as marketing managers carefully plan the research through which they will gather critical product information, so implementation managers must develop an iterative, almost accordion-like framework to guide decisions about when and how to collect needed information from all groups affected by an innovation.) and multiple internal markets are some of the challenges the management must tackle successfully for better results.

Team Management. (Trust, team roles, shared goals and expectations synergy.)

In order to work together as a team with harmony, the teams should possess a common purpose and goal, trust each other, clarify their roles from the start, communicate openly and effectively, appreciate a diversity of ideas, balance the team focus, leverage any heritage relationships.

In modern organizational theory, synergy means much more than “working together.” Synergy is actually a systemic principle that explains how a team's collective performance is unpredictable based solely on its member's individual performances. Therefore, a team's collective performance can be either better or worse than the sum of its members' individual performances. There are three different ways to increase team synergy at work place. They are: take responsibility Conscious leaders take responsibility. Yet how many people recognize themselves to be a conscious leader. Chances are you already are, but what does this look like in terms of your business. One aspect is taking responsibility. Systems change expert Peter Senge talks about people having an “inflated sense of independence” in nearly every aspect of their lives when in actuality, everything is mostly *independent*. This is often the “gap” teams experience when they are not functioning at a level greater than the sum of their parts. Within a high-functioning team, however, everyone takes ownership for the shortcomings and the success of the team), know your team (A responsible team member knows and understanding *every team member*. There are many tools out there that can support a deeper understanding of each other. Regardless of what methodology you use, be sure to apply the recommendations consistently. Test them out to find what is useful and effective for you), and prepare for stress (Learn and understand how people react to stress and challenges beforehand. This builds off knowing your team by not waiting for a critical situation to learn how everyone handles pressure. In these situations some people take action quickly. Others become paralyzed or frenetic and are ineffective while others take a slower whole-picture approach, which can look like inaction).



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In strategic communication, message development, or the process of creating key points or ideas, requires high levels of planning and research. These messages are targeted, or created with a specific audience in mind, and help to position an organization's communication goals with its structural goals. As the world becomes increasingly interconnected through new forms of communication, the role of strategic communications is to help organizations understand how to effectively deliver their message to key audiences. Communication is very important in every aspect of our lives. In order for any relationship to work properly we have to learn to communicate effectively with each other. The importance of communication hasn't changed from the time in which John Brennan wrote *The Conscious Communicator* in 1974 to the time Holtz wrote *Corporate Conversations* in 2004. The fact still remains that for any business whether entrepreneur, partnerships or corporate offices to succeed we have to communicate with someone to voice our ideas and/or concerns.

The literature review addressed the importance of communication. It provided the researcher with background information on the different ways and the different styles of communication. Needless to say, face-to-face communication seemed to remain the number one style of communicating within organizations. Research has also found that a lack of communication within an organization can decrease productivity, lower moral and be the cause of other serious workplace issues. This research found that the outcome of the survey was the complete opposite to what was overheard in previous conversations. Based upon the answers given on the survey, more people were neutral and/or thought that the communication was satisfactory within the organization. Majority of the participants also felt that their supervisor communication skills were very good. Although they agreed that the supervisors communicated effectively, more customer service representatives and/or unit leaders admitted to hearing most of their information through the grapevine. As the number of years increased in experience within the organization, it appears as though this particular group had a negative view of internal communication. The participants were consistent in saying that they wanted more information about the policy changes and/or procedures, the contracts and they wanted adequate training for the different computer programs. Some of the employees vent about a lack of communication when they feel as though their voice is not been heard; also, when they continue to find out about information through the grapevine versus from their supervisor.

**RECOMMENDATIONS**

The researcher would recommend for future research that the survey exclude any neutral options. Although by eliminating this option it forces the participants to answer one way or the other. The researcher believes that you will get more precise answers. The supervisors can also following communication techniques can be used by any leader to increase the level of internal communication in the company and therefore the level of the company's efficiency (Fishman, 2000).

1) Find out if those listening to you hear what you say and interpret it correctly. One way of doing this is to ask questions that will show the understanding level of those with whom you are speaking. If you are addressing a group meeting, allow time at the end of the meeting for questions.

2) Share ideas whenever possible. One of the most sensitive areas in management involves how much company information should be shared with employees. Many feel that information should be given on a need-to-know basis. Their reason is that information given loosely can result in company secrets getting out to the competitors. Teachers can also share information with the students through weekly and or biweekly meetings. The supervisor should include in their meetings any information that is bringing about a change in the language acquisition. If students have questions about other personnel issues towards the understanding of the language should be clarified.





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## Developing Vaccine for New Infectious Diseases

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### ABSTRACT

Vaccines against bacterial infectious diseases must be produced with the goal of reaching a global audience. These should be inexpensive to create, stable in the absence of freezing, effective and safe, and capable to be given orally rather than intravenously. Discuss how to manufacture live attenuated bacterial vaccines and how to use recombinant attenuated bacteria to induce resistance mechanisms against heterogenous infectious diseases in this section. A discussion of the use of attenuated bacterial vaccination vectors for DNA vaccine delivery, in which problems with the viral, parasite and fungal antigen processing in bacteria are handled by production and modifications of these antigens within the eukaryotic cell, will be omitted as well. Finally, describe developments in the creation of subunit and conjugate vaccines, while acknowledging their value, particularly in rich nations. On the other hand, studies of these vaccinations frequently offer significant information on the discovery and characterization of protective antigens that may be created in live recombinant attenuated bacterial vaccines of the kind.

**Keywords:** Infectious diseases, Antigens, Attenuated bacterial vaccine

### INTRODUCTION

New infectious illnesses have been observed for millennia, long before causal infectious agents were discovered. Despite breakthroughs in the development of counter measures (diagnostics, treatments, and vaccinations), greater global interconnectedness and worldwide travel have added levels of complexity to the control of infectious illnesses. EIDs are a hazard to human health and world stability [1,2]. A historical overview of pandemic illnesses



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provides insight into the origin and features of corona virus epidemics, with a focus on the SARS-CoV-2 pandemic [3,4]. As human civilizations develop in volume and scale, infectious agents will have an ever-increasing number of possibilities to emerge into the ecological niches we continue to create. Yellow fever and dengue fever are two additional significant mosquito-borne viral illnesses that are not yet developing. Yellow fever, a mosquito-borne illness that has been around for generations, is widespread in more than 40 countries spanning Africa and Central America. Several yellow fever outbreaks have occurred since 2016, including in Angola, the Democratic Republic of Congo, Nigeria, and Brazil, to name a few [5], creating serious worries regarding yellow fever vaccine supplies. There are four live-attenuated vaccines on the market (6), all of which are made from the live attenuated yellow fever strain (17D)[7] and been prequalified by the World Health Organization (WHO).

In most dengue-endemic regions, the four dengue virus strains (DENV1–4) are presently co circulating, creating an increasing worldwide public health threat. Dengue fever infections and illnesses have been continuously rising as a result of population growth, the expansion of *Aedes* mosquito breeding grounds, and the easy travel. Dengue fever is a disease that may be seen in over 100 nations throughout the globe. Each year, up to 400 million people are infected with dengue disease. Dengue fever infects almost 101 million people, with 21,000 people dying from the disease. The Americas and the Western Pacific are the areas most affected by epidemics; Asia bears 70% of the global illness burden. Several vaccines have been produced [8]. Dengvaxia, a single dengue vaccine based on the yellow fever 17D backbone developed by Sanofi Pasteur, has been approved in 19 countries, although uptake has remained low. A dengue-seronegative vaccine recipient's protection signal prompted a global review of the vaccine's business ' performance, new WHO recommendations for use, and a controversy in the Philippines involving the government, government regulators, Sanofi Pasteur, clinicians in charge of diagnostics and administering the vaccine, and parents of vaccinated kids [9]. Two bacterial infections, both long-standing human scourges, are endemic, generating recurrent outbreaks, and are growing increasingly resistant to antibiotics. Cholera, which is caused by pathogenic *Vibrio cholerae* strains, has been around since 1816, with the seventh pandemic starting in 1960. [10]. Cholera mortality is still high over the world, mainly to delays in rehydrating patients. Cholera is thought to cause from 1.3 and 4.2 million cases per year worldwide, and 21,000–143,000 deaths, mostly in Africa and Asia. Yemen and Haiti have also seen devastating outbreaks. In addition to rehydration therapy, antibiotics have been employed in the treatment of cholera to shorten the duration of diarrhoea and prevent bacterial transmission. Antimicrobial resistance has developed in Africa and Asia to several useful antibiotics, including chloramphenicol, furazolidone, nalidixic acid, tetracycline, and fluoroquinolones.

*Salmonella enterica* subspecies *enteric serovar Typhi*, a Gram-negative bacterium, causes typhoid fever, a dangerous infection (*S. Typhi*). Antibiotic-resistant strains of *S. Typhi* are becoming increasingly prevalent. The origins and spread of a novel extensively drug-resistant (XDR) *S. Typhi* clone were first discovered in Sindh, Pakistan(11,12), and have subsequently spread to India, Nepal, Bangladesh, the Philippines, and Guatemala (13,14). The world is at a crossroads as XDR *S. Typhi* has appeared in densely populated areas. Improved typhoid vaccinations with improved immunogenicity and efficiency, even in children under the age of two, would help with typhoid management, especially in XDR regions, by lowering the number of typhoid fever cases that require antibiotics therapy [15,16].

**Characteristics of live bacterial vaccinations that are both safe and effective****The antigen delivery vector or bacterial vaccination**

Attenuation should be sufficient to lessen, if not completely eliminate, the emergence of undesirable sickness symptoms. In this regard, the nutritional status and health of the people to just be vaccinated should have been considered. Attenuation of bacterial vaccines should be a built-in feature rather than relying on fully functional host defenses and immune system response capabilities. Diet or host-changed diet elements should never be able to reverse the attenuation, especially by host-resident micro flora. The vaccine should not form a permanent carrier state as a result of the attenuation. However, it's possible that a long-lasting live vaccination may be advantageous in some circumstances. The attenuated vaccine should be invasive and long-lasting enough to induce considerable primary and good memory immune function. A vaccine should be created to prevent damage of tissue that isn't necessary for an effective immune response. To reach the gut-associated lymphoid tissue, vaccines targeting enteric



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pathogens, for example, must infiltrate and transcytose through M cells. Attachment to and penetration of enterocytes, on the other hand, may cause unpleasant diarrheal episodes that do not help the immune system respond as it should. Since even attenuated vaccine variants can cause illness in a few unlucky persons, every live bacterial immunization must be treatment resistant across the board.

**Component of the plasmid vector**

The efficiency of the recombinant vaccination is determined by the stability of protecting antigen expression in vivo. Antigen expression is frequently inadequate to induce a significant immune response, despite gene insertion into the chromosome. Because the degree of protein synthesis in bacteria is heavily contingent on the number of gene copies, utilizing copy number plasmid vectors can dramatically increase antigen production. Because the plasmid carries a gene that complements a chromosomal deletions mutation of a key gene, like as for cell wall formation, DNA stability, or replication, using a balanced-lethal host-vector system ensures that the plasmid is kept in this circumstance [17]. Another alternative for ensuring plasmid vector retention is the "HokSok" procedure, which also results in cell lysis if the plasmids are lost (18). When a high-copy-number plasmid vector is used, the rate of expression of genes encoding the vector-selective marker can be far greater than the rate necessary to maintain the vector. Up regulation of such transgenic inhibits immunization in these circumstances, most likely due to the hybrid vaccine's increased energy drain. The selective marker genes may well be built without a promoter but with a ribosome-binding recognition region to alleviate this problem [19]. Antigen production can be reduced when a Th1 cell-mediated immune response is desired, but it must be greatly increased if Th2 mucosal and systemically antibody responses are required. Despite the fact that the promoters that drive the production of foreign antigens are typically constitutive [20], constant antigen synthesis may impair vaccination fitness, resulting in greater attenuation and immunogenicity. The Salmonella promoters nirB [21] and pagC [22] have been shown to enhance outcomes by activating transcription at higher levels in vivo.

**The host-vector pairing**

Pathogen antigen synthesis by recombinant attenuate host-vector antigen delivery methods, which can lead to higher attenuation and decreased immunogenicity, is another important feature in vaccine formulation [23]. To maximize the chances of appropriate colonization and retention in lymphoid cells to develop resistance mechanisms, the vaccine constructs growth characteristics must mimic that of the host-vector controls that do not express the antigen.

**Vaccines against bacteria that have been attenuated**

Mycobacterium bovis Bacillus Calmette-Guérin (BCG), which was meant to prevent Mycobacterium tuberculosis infection, was the first and most widely used live bacterial vaccine. M. tuberculosis, despite this, infects a third of the country's population and kills two million people each year. The BCG vaccination strains were recently characterized [24] and shown to be deficient in the expression of certain antigens seen in M. TB that might be important for acquired immunity. The use of repeated culture passage to accomplish attenuation undoubtedly resulted in a number of genetic changes that not only help with attenuation but also reduce immunogenicity. Because Mycobacterium tuberculosis infection usually results in a carrier state that can be reactivated decades later, it's critical to avoid designing a vaccine that can survive in a hidden form as long as Mycobacterium tuberculosis. *Salmonella typhi* Ty21a is a widely used authorized live vaccine that is exceedingly safe, albeit it takes 3 to 4 doses for two-thirds of people who are inoculated to establish long-term protective immunity (at least 6 to 8 years) [25]. Newer and more immunogenic live *S. typhi* vaccines are now being explored in clinical trials with the goal of developing an attenuated *S. typhi* vaccine that might provide protective protection to a significant proportion of persons with a standard dose. With one exception, most attenuation strategies that were effective in attenuating *S. typhimurium* and creating it highly immunogenic in mice do not significantly attenuate *S. typhi* in people [26, 27]. For example, *S. typhi* strains with the double specified deletions mutation in *aro* genes require vitamin cofactors that are possibly unavailable to vertebrates. As a result, these strains should be incapable of surviving in the wild for more than 7 to 14 generations. Positive blood cultures with flu symptoms are obtained when big doses of the dual *aro* vaccine are administered to human volunteers [28]. To correct this excessive quantity of reactivity, another mutation, *htrA*,



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was employed, which removes a heat shock protease [29] and provides greater attenuation without sacrificing too much immunogenicity [30]. Clinical studies for two of these dual aroHr A vaccination alternatives are now underway [31]. The live attenuated *B. anthracis* strain Sterne, which was authorized as a veterinarian vaccine, was used for human immunization in the former Soviet Union but was determined to be too reactogenic [32]. In guinea pigs, new, improved live attenuated *B. anthracis* vaccines have showed promise in eliciting protective immune responses [33, 34], but human clinical trials have yet to be completed. Two live attenuated *V. cholera* vaccine candidates have been produced and medically evaluated, with CVD 103-HgR being one of them [35]. Both vaccines feature deletions mutations that prevent them from producing cholera toxin and other accessory toxins that contribute to the diarrhea caused by *v. cholera*. Despite the fact that these strains were developed with great care, it's difficult to see how these non-invasive candidates vaccines can result in lengthy mucosal or systemic immunological response.

**Recombinant bacterial host-vector systems that have been attenuated**

BCG was established as an antigen delivery vector after *S. typhimurium* and *S. typhi* strains were employed as recombinant vectors for antigen administration [36]. Recombinant vaccine delivery vaccines based on attenuated variants of *S. flexneri*, *L. monocytogenes*, and *Bacillus anthracis* have recently been tested. The use of attenuated *S. typhimurium* and *S. typhi* antigen delivery vaccines has been explored for over fifteen years, with a significant and ever-increasing amount of literature published. Despite the fact that recombinant attenuated *S. typhimurium* strains expressing antigens from a variety of pathogens have frequently stimulated resistance mechanisms in mice and a variety of agronomically important animals, transgene attenuated *S. typhi* Ty2 strains tested in healthy volunteers stimulated lowered immune systems to the Salmonella vector and unimportant or lacking immune responses to demonstrated antigens from many pathogenic organisms [37–39]. The selection of the *S. typhi* vaccine delivery strain, Ty2, might be a major concern. There are a number of possible explanations, but one important factor might be the *S. typhi* vaccine delivery strain, Ty2. Penetration and colonization of M cells covering the GALT in *S. typhimurium* require chromosomal RpoS-regulated genes, according to our findings [40]. As others have demonstrated, rpoS mutants of *S. typhimurium* exhibit decreased immunogenicity even without the virulent plasmids that contain RpoS-regulated genes that do not play a role in the colonization of the GALT [41]. The development of a transgenic attenuated multivalent vaccination to replace injectable DPT vaccines is one of the more enticing problems [42]. Using a codon-optimized sequence, *C. tetani* fragment C was produced in attenuated Salmonella in rats and elicited protective immunity against *C. tetani* toxin challenge. It is the sole antigen given by an attenuated *S. typhi* Ty2 strain that causes human volunteers to develop a small amount of immunity [43]. BCG or even other attenuated mycobacterial strains do not great promise as antigen delivery vectors because phagocytic cells can not easily lyse mycobacterial cells, unless the produced antigens can be released from the cells. This method has effectively generated protection in mice using *Borrelia burgdorferi* protective antigens, but it has failed to produce immune reaction to the Borrelia Osp A antigen in healthy volunteers [44]. In guinea pigs, production of *M. tuberculosis* antigens by BCG was likewise successful in inducing defense against *M. tuberculosis* challenge [45].

**Selection of antigens**

It is difficult to find pathogen protective antigens to express in a recombinant attenuated bacterial vaccination. Antibodies found in an infected host can provide information. A strong antibody response, on the other hand, does not always imply protection. Obtaining a mAb to an antigen that may effectively defend against disease is, of course, a strong indicator that the antigen may trigger a defensive immunity. Similarly, finding antigen-specific T cell groups that may elicit protective immunity via passive transfer would lead to the discovery of a vaccine candidate antigen. Evidence that the inability to express an antigen due to mutation is connected to avirulence, particularly if the antigen is surface localized or secreted, is another useful criterion for antigen selection. Many defensive antigens get access to antigen-presenting pathways, and genomics analysis paired with algorithms may be utilized to identify subsets of proteins generated by distinct secretion routes or proteins that are surface-localized. Pathogens with the type III secretion system, such as *Yersinia* and *Salmonella* deliver antigens to the cytoplasm of the host organism, eliciting a CD8-restricted CTL response [46]. A similar result might be reached if other infections, such as *Mycobacterium* species, create proteins in the cytoplasm of the cell inside the infected person. It's possible that a



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defensive antigen is only created in vivo, and that the gene that codes for it reacting to stress or message is likewise only produced in vivo. Antigens of this kind are not produced in vitro. Genetic screens such as selective Capture of Transcribed Sequences (SCOTS) [49], Signature-Tagged Mutagenesis (STM) [48], and In Vivo Expression Technology (IVET) [47] can identify in vivo-expressed genes encoding proteins critical for pathogen survival in vivo. Proteomic analysis can detect the proteins generated in the highest numbers when the pathogens is in an in vivo compartments or in cells in culture. Such proteins are more likely to elicit immunological responses, which may or may not be protecting.

### Vaccine development and biotechnology

Biotechnological approaches to optimize the productivity of the recombinant attenuated vaccine delivery vaccine are rarely mentioned in literature about the creation of recombinant attenuated vaccines. One prominent exception is the attention given to the promoter sequence used to trigger the synthesis of a plasmid-encoded protective antigen. In this regard, the use of the nirB promoter, which works best in anaerobic circumstances like those encountered in vivo, has shown outstanding results in recombinant attenuated *Salmonella* vaccine designs (21). Codon use varies by species, and codons in genes coding for antigens from heterologous organisms often need to be modified for elevated expression in the vaccination strains, which is an often ignored component of vaccines. The stability of the generated antigen in the bacterial antigen delivery strain must be evaluated in order to reduce the toxicity of degradation products and to maximize induction of the desired form of the immune response following delivery to the vaccinated host. T cell antigens, which should be degraded by the proteome prior to innate immunity, may benefit from changes that diminish their stability. Antigens that induce a humoral immune response, on the other hand, should be designed for greater stability in the vaccinated host. Paying close attention to the N-end rule for protein denaturation (50), as well as the presence of PEST regions (51) and other protease breakdown sites in the antigen, might help with design considerations. Delete Cys-encoding sequences, change the antigen delivery strain's environment in terms of Eh capability, add a chaperone to the produced antigen, or change the dsb mechanism for isomerization of proteins containing disulfide bridges if the foreign antigen contains cysteine residues (52).

### Evaluation in animals for human testing

Animal research can both help and hamper the ultimate objective of developing vaccinations that are both safe and effective in humans. The use of *Salmonella typhimurium* in mice as a surrogate for *Salmonella typhi* in people, for example, offers several benefits. The sickness induced by *S. typhimurium* infection in mice, on the other hand, is not the same as the disease caused by *S. typhi* infection in people. To make matters worse, most researchers use inbred rather than outbred mice, which have a distinct vulnerability to *Salmonella typhimurium* infection. It's also possible that using out breeding mice to test potential hybrid attenuated *S. typhi* vaccines is misleading. *Salmonella typhi* attenuation has previously been assessed by intra peritoneal injection of out breeding mice in the context of hog stomach mucus (53). This assay appears to work well for attenuated varieties with aro mutations, which prevent *S. typhi* from growing, but it leads one to start believing that bacteria with phoPQ deletions are just as infective as wild-type bacteria, because their development is unaffected and the mice die from endotoxic shock after *S. typhi* growth (54). Because *S. typhi* is known to be unable to stay alive in a variety of activated macrophages, the humoral immunity of *Salmonella typhi* concepts after intranasal inoculation in to the mice model is likely comparable to that of other pathogens that are unable to cause lethal infection in mice regardless of whether attenuating genetic changes are present. The development of mouse strains with greater sensitivity to *Salmonella typhi* might aid in the resolution of these problems. In this regard, the recent creation of transgenic mice with a receptor that permits *Listeria monocytogenes* infection by oral inoculation (55) might be a better model for the development of human recombinant attenuated *Listeria monocytogenes* vaccines. For the creation of improved *M. tuberculosis*-derived recombination vaccines, it is necessary to identify attenuated M. TB strains that are incapable of developing latent infections.



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## CONCLUSION

The development of attenuated bacterial vaccines to prevent diseases caused by these bacterial infections in humans has progressed significantly. However, employing several of these attenuated bacterial vaccines, or modified forms of them, to express antigens from other diseases in order to produce protective immunity against other infections, is considered to be the ultimate advantage. Using live recombinant attenuated bacterial antigen delivery systems is analogous to immunizing the individual with a vaccine manufacturing since the protective antigen is manufactured and delivered to the vaccinated individual in vivo after vaccination. Manufacturing such vaccines are affordable because they may be lyophilized and reconstituted at the point of application, reducing the need for refrigeration. Their oral or intranasal delivery removes the need for syringes, which come with a hefty price tag and a slew of unpleasant side effects. Potential issues connected with the use of the same or comparable antigen delivery vectors for the distribution of various protective antigens should be investigated further, and surface antigen characteristics on the antigen delivery vectors may need to be modified.

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## Augmenting Connectivity for Aboriginals of Kusumi Block: Mayurbhanj District

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### ABSTRACT

Road networks are a key component for the economic growth of any country. It is essential to develop a planned and sustained extension and sufficient maintenance of these networks to ensure quality linkages between the various regions of a country. The requirement for an appropriate road network for the growth of the country was understood quite early in India. For rural development, the establishment of a rural road network is a key factor to empower the rural population to have access to educational institutions, healthcare centers, and markets. Rural roads function as an entry point for poverty mitigation since the absence of access is considered an essential factor in the prolongation of poverty. Here in this study, the whole process revolves around the monitoring and possible new road proposals for the area in block Kusumi of Mayurbhanj district, by which we can map out the statistics around which the new road plans can be proposed in Kusumi block. In the total study, the year of data to be considered is 2022. The monitoring majorly focuses on the statistical analysis in the length of the road and the flow of the network throughout the block till 2022. The ultimate objective of solving this system is to provide road connectivity in the block at the appropriate level of serviceability to serve as much of the population as possible.

**Keywords:** Road networks , For rural development, entry point for poverty, Kusumi of Mayurbhanj district



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## INTRODUCTION

Mayurbhanj Estate was the latest princely state in Odisha (posthumous; Orissa) to merge with the India. The border district has conjoint borderline with the states West Bengal and Jharkhand. Similipal and Maikala hills range divides the Mayurbhanj district into two parts. About 42% of the district's geographical area is covered under forest. The hilly district and the forests are inaccessible during the rains. A railway has its symbolic presence. It is dominated by tribal, and aboriginal people with 56.50% population and economically backward. Enriched with biodiversity, the federal concerted endeavour has brought development in sectors like health, tourism, mines, and industries in the district and consequently better quality of life. But still sectors like education, communication, irrigation, exploitation natural resources, unemployment, skill development, and rising extremism. The connectivity is the key to the lag in people's economy. The study is done over the block named Kusumi of district Mayurbhanj (19° 42' 38.6208" Lat N 82° 20' 10.9392" Long E) (**Fig 1**). The block is situated in the north-western region of the district. The block shares its boundary with neighbouring state Jharkhand. In this block at first the satellite imagery is first taken into study, the year of study of satellite imageries is 2022. At first in the block the names of the villages are mapped by the tehsil authenticated maps as the boundary of the villages are mapped the road mapping part starts and the tracing of existing roads are done. Initially the road network of Kusumi block is to be mapped out like NH,SH,MDR,ODR,PMGSY & other roads connecting different villages of the block with the dimensional & statistical observation of the road. The proposals for the new roads are to be induced where there is a shortage of road connectivity in the interior parts of the block. As the terrain of Mayurbhanj district is kind of hilly & forest prone, hence there are interior villages are still untouched by the mainframe road network. So, by using of GIS software and various topographical & spatial data we are going to monitor the existing road network till 2022 and to induce new roads inside the block which will enhance transportation, growth and will increase the on-going developmental growth rate in the district Mayurbhanj. The socioeconomic status of the block is in Table 1.

## LITERATURE REVIEW

Kusumi block lies in the Chotta Nagpur plateau depicting Precambrian Geology and a part of Baripada Marine Beds (BMB) (Ghosh et al., 1959, Nandi et al., 2017, Bhaumik et al., 2017, Mukhopadhyaya et al., 2020, Kar et al., 2022.). Mayurbhanj district is gifted with luxurious flora, diverse fauna/avifauna, and amusing tribal cultural heritage (GoO 2016, Panda et al., 2020). The peaks of Khairiburu (1178 m.), and Meghasani (1158 m.) mountains are of emerald heights in the Mayurbhanj district (Dist stat handbook 2015). The Kusumi block houses the Badampahar Iron Ore Block Deposit which constitutes Precambrian sedimentary formations. The excavation of iron ore needs roads to carry it to the nearest steel plant (GM Iron and steel PFR, 2021). Kusumi Block lying in the vicinity of Similipal Biosphere reserve of Mayurbhanj district in Odisha is covering the Savanna climate, with average rainfall ranging from 1700-1900mm. The block is rarely affected by cyclones and droughts. (Source: District Emergency Office, Baripada, Mayurbhanj). The forest, type has been worst affected by the annual forest fire in the years 2006, 2009, 2013, 2016, and 2021 destroying huge forest cover found through imagery Resources at-1 data, Mishra B. K. 2010, Saranya et al 2014, Swain et al 2019. Similipal possesses hill-inland topography and ecosystem solely dependent on the forests out of which 71% belongs to aboriginal and ethnic group. The importance of the forests is its ethnomedicinal plants. The forest conflagration 2021 has lost the livelihoods of the Lodha and Mankadia tribal people, who are part to the vulnerable tribal group (PVTG) in Odisha, (Panda et al., 2011, Senapati, 2021). Not only STR was blazed, but also Bandhavgarh Tiger Reserve (BTR) in MP, had a fire incident in April 2021 (<https://india.mongabay.com/2021/05/with-more-forest-fires>). The state and the nation is giving importance to the National Highways, Expressways, and smart city roads, and the poor connectivity of the remote blocks are not given importance. The Kusumi block in the Mayurbhanj district is such an area that has been neglected. Also, it is a herculean task to collect the road network data of the block, the lagging deficiency of adequate roads, and their design as per traffic needs.





## OBJECTIVE

The present search envisages a detailed study of the road network that is neglected in the Kusumi block in a hilly district like Mayurbhanj. Proposals have been placed for ameliorating the lag in the connectivity setup of the block. The study has the objective:

- i. Preparation of the Land Use and Land Cover (LULC) pattern, geography, and geomorphology of the block using the GIS (Geographical information system) and remote sensing data.
- ii. The existing road network from the connectivity map received from the Google map
- iii. The wanting road list collection from the country/ administrative source
- iv. The proposed road plan and map preparation for future use at the federal level

## METHODOLOGY

The Kusumi block in the Mayurbhanj district of Odisha is a very small area and does not even have a large township. The area is hilly and on the outskirts of the Similipal Biospheres reserve with aboriginal peoples of Odisha. The place is remote and there is less road network for easily accessible modern living standards to these tribal populations. The present study is an attempt to study the lacunae in connectivity in the hilly terrain and preparation of a well-judged plan to address the problem of accessibility. GIS methodology with the help of remote sensing proved to be the most effective tool to assess the land use, and land cover (LULC), and connectivity of areas of the place. The digital elevation model and raster data available for the area make it easy for the geospatial studies of the area. At first proposed roads to be traced on the satellite imagery using “Editing” feature in ArcMap software by considering various parameters. Then the plots on which these new roads are to be constructed, those plots should be mapped out from the tehsil approved revenue maps by vector digitization method. This process involves various geospatial techniques and methods. Then geometrical calculations should be performed on those roads and plots by using the “Calculate Geometry” function in the GIS software. The roads must be calculated in Kms., and the plots must be in Acres (Fig 3(a) and Fig 3(b)).

The methodology applied is given as:

- Mapping of AOI (area of interest).
- Tracing and mapping of the 2022 year data along with the statistical design of different types of roads.
- Statistical and dimensional analysis of existing road network plan.
- Proposal of new road plans with the villages and with major roads.
- Statistical design and area allotment of new road plan.
- A road plan to make the inaccessibility of the area, the modern civilization.

### Mapping of AOI (Area of Interest)

Mayurbhanj is a land-locked, topographically undulated district of Odisha stratified by high hills, isolated hillocks, or dome-shaped granitic formations. The area of interest lies inside the Mayurbhanj district called Kusumi. Kusumi is a block in the Mayurbhanj district where the whole process is to be carried out. Kusumi block is having 12 no. of gram panchayats, and 117 no. of revenue villages. The district has 3966 Villages, 404 Gram Panchayats, 26 Tahsils, 26 blocks, 2 NACs namely Udala, Karanjia, and 2 municipalities namely Baripada, and Rairangpur (Census India 2011).

### The Kusumi block

Mayurbhanj district (85°40' to 87°11' E. long. and 21°16' to 22°34' N. lat.) in Odisha, the boundary is connected to states Jharkhand in the north, Balasore in the south, West Bengal in the east. The block has luxuriant vegetation, various flora, fauna, and avifauna, with ample mining activities and rich cultural heritage as nearer to the Similipal Biosphere, and Barahipani waterfall. The Iron-ore (hematite) mines, vanadiferous/ titaniferous magnetic, China clay, galena (lead ore), Kyanite, asbestos, steatite (soapstone), and quartzite are the major mineral resources in the district. The iron-ore deposits are in Gorumahisani, Badampahar, and Suleipat mines.





The structurally controlled dendritic drainage pattern originates from drains from the Similipal Hills range are rivers of Kharkai, Budhabalanga, and Jamira rivers, and no main rivers flowing through the Kusumi block.

### Climate

The climate of the block is influenced by humid summer from April to May and pinching cold from November to December. The southwest (SW) monsoon onset over the block during June. Average annual rainfall: 1197, maximum temperature: 50.0°C, Minimum Temperature: 4.5°C, Relative Humidity: 26 to 84 (CGWB booklet-2013).

### Connectivity status

The Kusumi block is connected to KuChinda (NH 49) from one side and the other side with the Bonaigarh (NH 143). Kusumi possesses three other district roads connecting Rairangpur (O.D.R) to Ghadadega and Dudhijhar of 6.93km, 1.3km, Changbaria, Badajaidhan Poshi, and Dighia, respectively whereas connected to Rairangpur via Dhakata road 4.7km as RD road (Table 2). The Major ODR road passing through Kusumi Block is the connecting road from Kuchinda to Bonai. NH joining Kusumi block are NH320G at a distance of 42.2 KM; Hat Gamaria - Jagannathpur Road., NH -18 at a distance of 54.00 KM (Posthumus NH5) and NH-18 and NH-49 are joining at a distance of 61.4 KM (near Jamsola)

### The geomorphology and Soil classes

The geomorphology of the block consists of Denudational/ structural hills (small or Large), Habitation, Intermontane/ Structural valley (large or Small), Pediment, various Pediplains, Valley or Valley fill floors, Plateaus, Water bodies (Very small areas) (Nandi et al., 2017). The soil of the block mainly is mixed Grey Soil (Inceptisols), Mature, Red & Lateritic Soil (Alfisols), settled, and water bodies are 114.4, 118.03, 29.27, and 44.44Km<sup>2</sup> respectively. The terrain has a slope of 0-3% and most of the areas are rain-fed (CGWB booklet 2013).

### GIS/RS studies

Tracing and mapping of the 2022 year data along with the statistical design of different types of roads are done. The tracing of roads is done over the satellite imagery of the year 2022 by which different types of roads like Major roads, District roads, PMGSY roads, and village roads like Pucca, Kuccha & Footpaths are traced out by digitization by using Arc GIS. The requirement of various wanting roads of the Kusumi block has been collected and a comprehensive list has been prepared which is in Table-3. From the wanting list, a proposal of new road plans with the villages and with major roads has been prepared it is found that 94 roads (abridged) were wanting roads in the block of area 10418km<sup>2</sup> with population density about 249persons/Km<sup>2</sup>. A new road proposal has been chalked out and presented for smooth communication for the tribal dense area of the Kusumi district.

### Proposed new road plan

The tracing of roads is done over the satellite imagery of the year 2022 by which different types of roads like District roads, PMGSY roads, and village roads like pucca, kulcha & footpaths are traced out by digitization by using Arc GIS. The road features are mapped in polyline features with 45 UTM projections. The new projected connectivity plan for the SH, ODR, and village roads has been prepared and shown in Fig 5(a) and Fig 5(b)

## DISCUSSION

Road networks can improve internal connectivity (Taaffey et al., 1973). Human resources, budget allocation, and management based on economic, social, and political forces are the players in the expansion of the sporadic road network process. Modern connectivity can bring vicious changes in the developmental process of the many emergent countries like Brazil, Ghana, India, Kenya, Nigeria, Malaya, and Tanganyika of the globe. The modern network of roads has provided disease surveillance and control strategies through the early health care system, to the areas of high connectivity (Strano et al, 2018). To bridge the gap between the poor economy and the health care status of the people, road communication is essential. Still, in the 21<sup>st</sup> century, the tribes of Kusumi block are carrying their pre-





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antenatal cases, emergency patients in a jhoola (swing) or over charpai (Bunk and Cot) for want of proper road, bridges over the drains. Trained personnel cannot carter to deliver elegant healthcare, otherwise fall prey to the local impostors, and herbal healers. The local Tribal boys and girls could not achieve education, or job-oriented skills training for the economic growth of the aboriginal or tribal community of the block (Kumar M. et al., 2020, Nayak et al., 2020). Budget speech (2022-23), the Finance Minister of India made the declaration on the roads sector that the Prime Minister Gati Shakti Master Plan shall stress the development of the Expressways, NH and will be formulated and mobilized through innovative ways for the financial year 2022-23. Road, bridges over the drains. Trained personnel cannot carter to deliver elegant healthcare, otherwise fall prey to the local impostors, and herbal healers. The local Tribal boys and girls could not achieve education, or job-oriented skills training for the economic growth of the aboriginal or tribal community of the block (Kumar M. et al., 2020, Nayak et al., 2020). Budget speech (2022-23), the Finance Minister of India made the declaration on the roads sector that the Prime Minister Gati Shakti Master Plan shall stress the development of the Expressways, NH and will be formulated and mobilized through innovative ways for the financial year 2022-23.

After attending to public grievances and completion of the project, all the villages shall tentatively be interconnected and the following advantages shall occur to the area:

- To have early accessibility to health care for all
- To have education for all including skill development
- Availability of transport for conveyance of local produces
- Preventive controls against malaria, pandemic vaccines, immediate healthcare, market, malnutrition, child mortality, safe antenatal health of pregnant women, timely attendance against snake/ animal bites, accidents, and family planning services. (Kumar et al., 2020)
- The 50% of the population in Kusumi block, the tribes are the vulnerable group and living below poverty line. The government help and assistances rarely reach the people and shallowed by the middle group as the PDS shops are beyond their easy accesses so are lag in getting subsidized wheat, rice, kerosene etc.
- These tribal hamlets are deprived of proper link roads so the modern utilities and the communication modes like cell-phone, mobile, internet etc. are yet within their scope in these remote communities.
- The villages are not bizarre and untidy environments.
- The Gram Sabha meetings are irregular, and the follow up accomplishment lack.
- The developing functionaries rarely visit the assessable villages. The voluntary/ beneficiary interventional activities are almost zero.
- Use of firewood, conventional PODU cultivation, increase of CO<sub>2</sub>, cows maintained only for cow dung, over exploitation of forest commodities, Poaching are the regular phenomenon in the area.
- Mining and Industrial activities in the mining belt have regular creation of dust pollution and deforestation with excess motorized activities.

All the ecological disorders and continuous deterioration of the environment only have substantial amelioration if all the village are well connected with the block headquarters and the outskirt national Highways. Attempt has been made to plot the new road plan (numbers allocated in Table 8 against road length for the Kusumi block in Mayurbhanj district and shown in plot Fig 9.

## CONCLUSIONS

From the above study it is found that 209.425 Kms. of existing road network is insufficient for the proper development of Kusumi block. New 115 number of roads of length 100.242 Kms. (including major roads, PMGSY roads, village roads) should be constructed in a fast track manner to stimulate economic and social development of Kusumi block. As the area is very crucial from environmental point of view these new roads are not only be beneficial for the human population but also very helpful for its bio conservation programs. These new roads will not only open the doors for economic growth but also be helpful for environmental monitoring and conservation.





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**Table 1: The socio-economic data of the Kusumi block, Mayurbhanj, Odisha.**

| # | The statuesque                          | Odisha       | Mayurbhanj | Kusumi Block |
|---|---|--------------|------------|--------------|
| 1 | Area of the district (Km <sup>2</sup> ) | 155707       | 10418      | 307.57       |
| 2 | Population (2011 census)                | 41974218     | 2683408    | 107201       |
| 3 | No of subdivisions                      | 58 (30dists) | 04         | nil          |
| 4 | No of Municipalities                    | 3 (MC)+47    | 02         | Nil          |
| 5 | No of NACS/ Urbans                      | 116          | 02         | Nil          |
| 6 | No of Blocks                            | 314          | 26         | one          |
| 7 | No of GP's                              | 6232         | 32         | 12           |
| 8 | No of villages                          | 51313        | 3966       | 116          |

Dists: Districts ; MCs: Municipal Corporations; NAC : Notified Area Council

The total population of the district as per 2011 census is 2513895 with a population density of 241 persons/ sq.km as shown in Fig 2.

**Table 2: The village details of Kusumi Block in the Mayurbhanj district of Odisha**

| VILLAGE DETAILS IN BLOCK KUSUMI |                  |         |            |        |                       |             |         |            |
|---------------------------------|------------------|---------|------------|--------|-----------------------|-------------|---------|------------|
| SL.NO.                          | VILL_NAME        | TYPE    | BLOCK_NAME | SL.NO. | VILL_NAME             | DIST_NAME   | TYPE    | BLOCK_NAME |
| 1                               | Badahatanbeda-13 | Village | KUSUMI     | 60     | Dighia-40             | Mayurbhanja | Village | KUSUMI     |
| 2                               | Baliadhipa-48    | Village | KUSUMI     | 61     | Dudhajharan-47        | Mayurbhanja | Village | KUSUMI     |
| 3                               | Bandhuda-02      | Village | KUSUMI     | 62     | Dumuria-63            | Mayurbhanja | Village | KUSUMI     |
| 4                               | Barisaghutu-12   | Village | KUSUMI     | 63     | Gadadharpur-68        | Mayurbhanja | Village | KUSUMI     |
| 5                               | Basila-07        | Village | KUSUMI     | 64     | Ghoradega-58-Y1984-85 | Mayurbhanja | Village | KUSUMI     |
| 6                               | Chahalapada-47   | Village | KUSUMI     | 65     | Ghungupahri-68        | Mayurbhanja | Village | KUSUMI     |
| 7                               | Chengabaria-08   | Village | KUSUMI     | 66     | Ghusuriahill-53       | Mayurbhanja | Village | KUSUMI     |
| 8                               | Dhadichua-15-    | Village | KUSUMI     | 67     | Gobindapur-28         | Mayurbhanja | Village | KUSUMI     |
| 9                               | Dhakata-09       | Village | KUSUMI     | 68     | Gopalpur-39           | Mayurbhanja | Village | KUSUMI     |
| 10                              | Dobha-04-        | Village | KUSUMI     | 69     | Hatishikuli-59        | Mayurbhanja | Village | KUSUMI     |
| 11                              | Dubulabera-46    | Village | KUSUMI     | 70     | Jadida-22             | Mayurbhanja | Village | KUSUMI     |
| 12                              | Jatasiringi-10   | Village | KUSUMI     | 71     | Jamadihi-27           | Mayurbhanja | Village | KUSUMI     |
| 13                              | Jhipabandh-17    | Village | KUSUMI     | 72     | Joypur-75-            | Mayurbhanja | Village | KUSUMI     |
| 14                              | Kathabaria-19-   | Village | KUSUMI     | 73     | Kaduani-41            | Mayurbhanja | Village | KUSUMI     |
| 15                              | Nuasahi-14       | Village | KUSUMI     | 74     | Kantasola-50          | Mayurbhanja | Village | KUSUMI     |





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|    |                          |            |        |     |                         |             |         |        |
|----|--------------------------|------------|--------|-----|-------------------------|-------------|---------|--------|
| 16 | Pahadapur-03             | Village    | KUSUMI | 75  | Kashiabeda-32           | Mayurbhanja | Village | KUSUMI |
| 17 | Raipara-18               | Village    | KUSUMI | 76  | Kendarai-69             | Mayurbhanja | Village | KUSUMI |
| 18 | Raisahi-16               | Village    | KUSUMI | 77  | Keshargadia-73          | Mayurbhanja | Village | KUSUMI |
| 19 | Sanhatnabera-06          | Village    | KUSUMI | 78  | Khejuria-55-Y1984-85    | Mayurbhanja | Village | KUSUMI |
| 20 | Talapati-05              | Village    | KUSUMI | 79  | khejuripada-51-Y1984-85 | Mayurbhanja | Village | KUSUMI |
| 21 | Thuntipani-11            | Village    | KUSUMI | 80  | Kherna-54-Y1984-85      | Mayurbhanja | Village | KUSUMI |
| 22 | Uperbera-45              | Village    | KUSUMI | 81  | Kuldiha-74              | Mayurbhanja | Village | KUSUMI |
| 23 | Reserve Forest           | Forest_Gap | KUSUMI | 82  | Kumurasul-76            | Mayurbhanja | Village | KUSUMI |
| 24 | Reserve Forest           | Forest_Gap | KUSUMI | 83  | Kusumi-71               | Mayurbhanja | Village | KUSUMI |
| 25 | Reserve Forest           | Forest_Gap | KUSUMI | 84  | Kusunpur-70             | Mayurbhanja | Village | KUSUMI |
| 26 | Reserve Forest           | Forest_Gap | KUSUMI | 85  | Langalsila-81           | Mayurbhanja | Village | KUSUMI |
| 27 | Reserve Forest           | Forest_Gap | KUSUMI | 86  | Mahuldiha-26            | Mayurbhanja | Village | KUSUMI |
| 28 | Aharabandha-57-1984-85   | Village    | KUSUMI | 87  | Majhigaon-35 Y 85-86    | Mayurbhanja | Village | KUSUMI |
| 29 | Andiadukura-53-Y1984-85  | Village    | KUSUMI | 88  | Mayurdar-79-            | Mayurbhanja | Village | KUSUMI |
| 30 | Angarpada-23             | Village    | KUSUMI | 89  | Mohuladiha-69           | Mayurbhanja | Village | KUSUMI |
| 31 | Badajaydhanapasi-43      | Village    | KUSUMI | 90  | Murumdihi-82            | Mayurbhanja | Village | KUSUMI |
| 32 | Badarha-40               | Village    | KUSUMI | 91  | Narendraposi-59-Y1987   | Mayurbhanja | Village | KUSUMI |
| 33 | Badham-49                | Village    | KUSUMI | 92  | Netrajharan-51          | Mayurbhanja | Village | KUSUMI |
| 34 | Bagadega-46              | Village    | KUSUMI | 93  | Nischintpur-77          | Mayurbhanja | Village | KUSUMI |
| 35 | Bakadihi-60              | Village    | KUSUMI | 94  | Pahadpur-42             | Mayurbhanja | Village | KUSUMI |
| 36 | Banakanda-21             | Village    | KUSUMI | 95  | Pandugandi-34           | Mayurbhanja | Village | KUSUMI |
| 37 | Bankati-78               | Village    | KUSUMI | 96  | Pariha-36               | Mayurbhanja | Village | KUSUMI |
| 38 | Banpokharia-65           | Village    | KUSUMI | 97  | Pechadar-30             | Mayurbhanja | Village | KUSUMI |
| 39 | Baramkurarha-62-Y1984-85 | Village    | KUSUMI | 98  | Pokharia-29             | Mayurbhanja | Village | KUSUMI |
| 40 | Bargimara-64             | Village    | KUSUMI | 99  | Purunapani-58           | Mayurbhanja | Village | KUSUMI |
| 41 | Bhadusahi-48             | Village    | KUSUMI | 100 | Purunia-72              | Mayurbhanja | Village | KUSUMI |
| 42 | Bhagabandha-54           | Village    | KUSUMI | 101 | Rahadibeda-24           | Mayurbhanja | Village | KUSUMI |
| 43 | Bhalupahari-52-Y1984-85  | Village    | KUSUMI | 102 | Ramajali-20             | Mayurbhanja | Village | KUSUMI |
| 44 | Bhandan-55               | Village    | KUSUMI | 103 | Rangamatia-43           | Mayurbhanja | Village | KUSUMI |
| 45 | Bholbera-61              | Village    | KUSUMI | 104 | Sanajayadhanapasi-39    | Mayurbhanja | Village | KUSUMI |
| 46 | Bhutukabadi-64           | Village    | KUSUMI | 105 | Saraspada-41            | Mayurbhanja | Village | KUSUMI |
| 47 | Bhuyanbasa-52            | Village    | KUSUMI | 106 | Satpautia-67            | Mayurbhanja | Village | KUSUMI |
| 48 | Burhadar-63              | Village    | KUSUMI | 107 | Shymsundar-73           | Mayurbhanja | Village | KUSUMI |
| 49 | Burudihi-37              | Village    | KUSUMI | 108 | Solakudar-50-Y1984-85   | Mayurbhanja | Village | KUSUMI |
| 50 | Chandida-71              | Village    | KUSUMI | 109 | Suliduma-62             | Mayurbhanja | Village | KUSUMI |
| 51 | Chhanua-57               | Village    | KUSUMI | 110 | Talakapokhari-45        | Mayurbhanja | Village | KUSUMI |
| 52 | Chingiripokhari-42       | Village    | KUSUMI | 111 | Tamadia-72              | Mayurbhanja | Village | KUSUMI |
| 53 | Chuapani-61              | Village    | KUSUMI | 112 | Telaighutu-56 Y 84-85   | Mayurbhanja | Village | KUSUMI |
| 54 | Chulibhanga-56           | Village    | KUSUMI | 113 | Tentaposi-49            | Mayurbhanja | Village | KUSUMI |
| 55 | Dalaki-25                | Village    | KUSUMI | 114 | Timitimida-33           | Mayurbhanja | Village | KUSUMI |
| 56 | Daliki-60                | Village    | KUSUMI | 115 | Tinaposi-44             | Mayurbhanja | Village | KUSUMI |
| 57 | Deogan-66                | Village    | KUSUMI | 116 | Tirilidihi-31           | Mayurbhanja | Village | KUSUMI |
| 58 | Deuli-70                 | Village    | KUSUMI | 117 | Ukam-80                 | Mayurbhanja |         |        |
| 59 | Dhangidimuta-38-         | Village    | KUSUMI |     |                         |             |         |        |





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Table 3: The existing road list in various panchayats in Kusumi Block, Mayurbhanj

| 2022 EXISTING ROAD NETWORK |                      |             |        |                                      |             |
|----------------------------|----------------------|-------------|--------|--------------------------------------|-------------|
| SL.NO.                     | ROAD NAME            | LENGTH (KM) | SL.NO. | ROAD NAME                            | LENGTH (KM) |
| 1                          | District road        | 16.331      | 63     | Village road (Pucca)                 | 4.817       |
| 2                          | District road        | 0.728       | 64     | Village road (Pucca)                 | 1.893       |
| 3                          | District road        | 0.1         | 65     | Village road (Pucca)                 | 1.346       |
| 4                          | District road        | 0.632       | 66     | Village road (Pucca)                 | 1.205       |
| 5                          | District road        | 0.677       | 67     | Village road (Pucca)                 | 0.249       |
| 6                          | District road        | 1.089       | 68     | Village road (Pucca)                 | 0.948       |
| 7                          | Village road (Pucca) | 0.23        | 69     | Village road (Pucca)                 | 4.42        |
| 8                          | Village road (Pucca) | 1.711       | 70     | Gunuria to Bhitaramada Road          | 0.012       |
| 9                          | Village road (Pucca) | 0.041       | 71     | Jamda to Basantapur                  | 0.524       |
| 10                         | Village road (Pucca) | 0.494       | 72     | Deuli to Shyamsundar road            | 2.275       |
| 11                         | Village road (Pucca) | 0.011       | 73     | Kusumi toBholbeda road               | 7.534       |
| 12                         | Village road (Pucca) | 0.132       | 74     | Kusumi to Suliduma                   | 2.24        |
| 13                         | Village road (Pucca) | 7.124       | 75     | Kathbharia toJhatisiring             | 6.36        |
| 14                         | Village road (Pucca) | 17.456      | 76     | Jhipabandh to Raisahi                | 3.389       |
| 15                         | Village road (Pucca) | 0.728       | 77     | Bhutkabadi to Murumdihi road         | 12.016      |
| 16                         | Village road (Pucca) | 0.862       | 78     | Kuldiha Railway Station toTamudiha   | 6.177       |
| 17                         | Village road (Pucca) | 3.322       | 79     | Badada to Purunapani                 | 12.547      |
| 18                         | Village road (Pucca) | 5.437       | 80     | SH 49 Kusumi Block to Jhaldungri     | 16.274      |
| 19                         | Village road (Pucca) | 2.359       | 81     | Nishchintpur to Chandida Road        | 2.897       |
| 20                         | Village road (Pucca) | 2.706       | 82     | S H 49 to Kathbhania road            | 6.792       |
| 21                         | Village road (Pucca) | 1.477       | 83     | Pandugundi to Pokharia               | 4.5         |
| 22                         | Village road (Pucca) | 1.708       | 84     | Jhipabandh to Thutipani              | 8.894       |
| 23                         | Village road (Pucca) | 3.832       | 85     | SH 49 to Uparbeda road               | 14.277      |
| 24                         | Village road (Pucca) | 5.396       | 86     | Jadida toRamjali road                | 2.719       |
| 25                         | Village road (Pucca) | 6.921       | 87     | Duva toRalibeda road                 | 8.625       |
| 26                         | Village road (Pucca) | 0.639       | 88     | RD road to Tentaposi road            | 3.831       |
| 27                         | Village road (Pucca) | 1.655       | 89     | SH 49 to Tileghutu road              | 5.649       |
| 28                         | Village road (Pucca) | 4.279       | 90     | SH 49 to Andiadukura                 | 1.8         |
| 29                         | Village road (Pucca) | 2.563       | 91     | SH 49 to Aharbandh road              | 4.833       |
| 30                         | Village road (Pucca) | 7.139       | 92     | Deogaon to Banpakhoria road          | 2.668       |
| 31                         | Village road (Pucca) | 1.498       | 93     | RD road toTtirildihi road            | 1.795       |
| 32                         | Village road (Pucca) | 3.618       | 94     | ODR to Dudhijharan road              | 1.952       |
| 33                         | Village road (Pucca) | 2.074       | 95     | ODR to Burudihi                      | 1.311       |
| 34                         | Village road (Pucca) | 3.063       | 96     | ODR to Kasiabeda                     | 1.903       |
| 35                         | Village road (Pucca) | 12.237      | 97     | Bankati to Kuldiha Road              | 1.361       |
| 36                         | Village road (Pucca) | 2.306       | 98     | RD road to Nagalsila                 | 1.637       |
| 37                         | Village road (Pucca) | 5.891       | 99     | Kuldiha railway station to Dalki     | 4.886       |
| 38                         | Village road (Pucca) | 3.013       | 100    | Joyppore to Purunia road             | 3.014       |
| 39                         | Village road (Pucca) | 11.041      | 101    | Budadhar to Chuapani                 | 0.448       |
| 40                         | Village road (Pucca) | 0.132       | 102    | RD road to Bargimora                 | 0.895       |
| 41                         | Village road (Pucca) | 1.286       | 103    | Purunapani to Chhanua                | 2.903       |
| 42                         | Village road (Pucca) | 1.067       | 104    | Purunapani to Hatisikuli             | 2.782       |
| 43                         | Village road (Pucca) | 1.838       | 105    | ODR TO Bhagabandi road               | 2.701       |
| 44                         | Village road (Pucca) | 1.388       | 106    | ODR to Chulibhanga road              | 4.939       |
| 45                         | Village road (Pucca) | 4.826       | 107    | ODR to Godadega road                 | 5.107       |
| 46                         | Village road (Pucca) | 2.837       | 108    | ODR to Pahadpur                      | 3.46        |
| 47                         | Village road (Pucca) | 2.108       | 109    | ODR to Talakpokhori road             | 3.307       |
| 48                         | Village road (Pucca) | 4.822       | 110    | ODR to Digha                         | 2.461       |
| 49                         | Village road (Pucca) | 2.318       | 111    | SH 49 to Gobindapur                  | 1.521       |
| 50                         | Village road (Pucca) | 0.452       | 112    | SH49 to Dalki road                   | 1.572       |
| 51                         | Village road (Pucca) | 1.509       | 113    | SH 49 to Angarpada road              | 2.433       |
| 52                         | Village road (Pucca) | 1.045       | 114    | RD road toRahidibeda                 | 1.156       |
| 53                         | Village road (Pucca) | 2.522       | 115    | Duva to Talapati road                | 2.107       |
| 54                         | Village road (Pucca) | 5.161       | 116    | RD road toSolakudar                  | 1.209       |
| 55                         | Village road (Pucca) | 4.1         | 117    | SH 49 to Edelbeda road               | 1.977       |
| 56                         | Village road (Pucca) | 7.177       | 118    | SH 49 to Bhalupahadi                 | 3.419       |
| 57                         | Village road (Pucca) | 1.707       | 119    | Irrigation road to Dumuria           | 1.195       |
| 58                         | Village road (Pucca) | 2.544       | 120    | Irrigation road to Ghungupahadi road | 2.61        |
| 59                         | Village road (Pucca) | 1.767       | 121    | SH 49 to Bhuyabasa                   | 14.209      |
| 60                         | Village road (Pucca) | 3.23        | 122    | Nuajoda to Dandbose road             | 0.048       |
| 61                         | Village road (Pucca) | 8.413       | 123    | SH 49 to Uparbeda road (L50)         | 2.873       |
| 62                         | Village road (Pucca) | 4.656       |        | TOTAL                                | 209.425     |





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| Table 4: The wanting roads in 2019 in Kusumi block, Mayurbhanj district, Odisha |               |   |
|---|---------------|---|
| Vil. Nos  | Panchayat     | Wanting list of Roads   |
| 7   | Aahar bandh   | (1). Chunkbhati to Nadu Sahi,(2). Narendraposi to Jodapokhari,(3) Narendraposi to Joda pokhari; (4). Saraspada to Banagada; (5). Canal road to Moharabandha; (6). Teleghtu Narayan beda to Dharman beda;(7) Aharbandha to Jodapokhari PS  |
| 18  | Bhutka badi   | (1)Banagajal canal to Nischintpur Dumuria (2). Kapilash to Shyma Sunder pur, (3). Kapilash to Dhadaban,(4). Dumuria Banagajal to Chhallagoda, (5). Piru House to Ghashi at Tumudia, (6). Majhi Akhala to Masani, (7). Naki TO Nidirsahi, (8). Siv Mandir to Bandho, (9) Rakhasahi Main Road to Masani, (10) Dumuria to River, (11). Chhallagoda to Banagajal (12). Tamudia ghashi dhala to River, (13). Main Road to Karamsahi, (14) Kapilash main road to Karamsahi, (15). Mohul diha School to Football Field, (16) Ghungupahadi club house to Shyam sundar, (17) Naki Teli Sahi to Nidirsahi of Bhutkabadi village, (18) Bhagya House to School. |
| 7   | Chuapani      | (1). Chulibhanga village to Chulibhanga,(2). Chhanua Majhi Sahi to Murmu Sahi, Karjisahi, (3) Dehurisahi to Bhuyanbasa, (4) Dalki dhabi Sahi to Chupani, (5) Khejuribandha to school, RD Road to Mohanta sahi, Matigodia to Sikha Dunguri.  |
| 5   | Dhangiri muta | (1). Timtima Chhaka to Mahadevasala, (2) Dhangidimuta petrol pump to sports field, (3) Dhirba sahi to Jharana sahi, (4) Joja sahi to PWD road of Kasiabeda village, (5) Tabad sahi to kashiabeda.   |
| 14  | Hatbadra      | (1). Gopalpur to Basantpur at Gopalpur, (2) Chingudipokhari Desua bandha to s.h road, (3) Chingudipokhari dulha sahi to Jodapokhari, (4) Bakedihi jahira chhak to smasan, (5) Chingudipokhari desuabandh to sh-49, (6) Chingudipokhari dulhasahi to Jodapokhari, (7) Chingudipokhari sahadeb hansdah land to Kanhu nadi, (8) Gopalpur chhak to Bangoda; (9) Hatbadra ups to kanisahio bangoda, (10) Khejuria majhisahi to Baladpada, (11) Hatbadra ups to Kanisahi, (12) Hatbadra ups to Kanisahi, (13) Kaduani rd road jahira to Chingudipokhari beda, (14) Gopalpur to Naujoda road, (15) Baladpada to Khejuria Majhi sahi .                      |
| 10  | Jaipur        | (1). Purunia to Banagajal, (2) Main Road to Deuli badsahi masani, (3) Anm to Masani, (4) Janamghutu club to Station, (5) Janamghutu club to Station, (6) Janam ghutu club to Station, (7) Beldahar to Jaypur, (8) Main canal to Baru sahi, (9) Khela house to poda sahi, (10) Main Road to Deuli badsahi and to podasahi  |
| 9   | Jarda         | (1). PMGSY Road to mahuldiha' (2). Majhi Sahi to Ramjhali ; (3). PMGSY Road to Andiadukura, (4). PMGSY Road to Bhalupahadi,; (5) NAIKE SAHI to Solakudar;(6). PMGSY road from Hudisahi of Khujuripada village, (7). Jamudihi to Gobindpur;(8) Angarpada to Rahadigoda;(9). Andiadukura rd road to Baidyanath Sahi.  |
| 7   | Jhipa bandha  | (1) D.M. Sahi to Pokharia village;(2). Patala sahi to jhipabandha;(3). Raisahi to Bandhusahi ; (4). DM sahi to Pokharia; (5). RD road to Dhampusahi; (6). RD road to Dhampusahi; (7). RD road to Dhampu Sahi.   |
| 11  | Mayur dar     | (1).Nischintpur to Kumdasol (2) Ukam dwari Mohanta house to Ukam; (3). Nischintpur to Nimidi, (4). Main canal to Dahisahi at ukam, (5). RD road to river side, (6). Ukam Canal to Dahisahi vill Ukam,(7). Nakiuthani to Karamghutu, (8) Mandira, to Chandida, (8). Goanmunda to Bankati.  |
| 6   | Talapati      | (1). Patrashi to Sanhtnabeda, (2). Talapati to Pahadpur,(3), Dhakata to Sanhtna beda, (4). Bbarugoda to Pahadpur,(5). Dova kedumudi to Kudarsahi,(6). Basila Tagurusahi to Basila.  |







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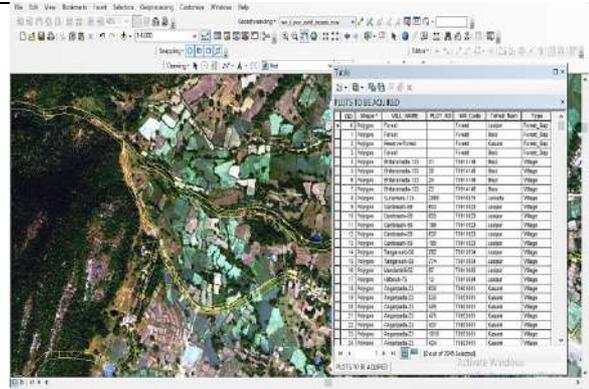


Fig 6 (a-e): Statistical design and area allotment of new road plan.

Fig 7: Proposed township area of the Kusumi block small township

| NEW PLAN STATISTICS |             |            |             |
|---------------------|-------------|------------|-------------|
| ROAD NAME           | LENGTH (KM) | ROAD NAME  | LENGTH (KM) |
| 1                   | 3.815       | 59         | 1.237       |
| 2                   | 0.001       | 60         | 0.741       |
| 3                   | 0.117       | 61         | 0.288       |
| 4                   | 0.013       | 62         | 0.102       |
| 5                   | 0.381       | 63         | 1.695       |
| 6                   | 1.165       | 64         | 0.327       |
| 7                   | 0.125       | 65         | 3.048       |
| 8                   | 0.101       | 66         | 0.813       |
| 9                   | 0.538       | 67         | 0.811       |
| 10                  | 6.48        | 68         | 1.847       |
| 11                  | 4.913       | 69         | 1.452       |
| 12                  | 2.223       | 70         | 0.6         |
| 13                  | 4.537       | 71         | 0.959       |
| 14                  | 5.622       | 72         | 0.252       |
| 15                  | 0.062       | 73         | 3.895       |
| 16                  | 2.318       | 74         | 1.244       |
| 17                  | 0.679       | 75         | 0.448       |
| 18                  | 0.191       | 76         | 0.436       |
| 19                  | 2.912       | 77         | 1.949       |
| 20                  | 1.977       | 78         | 1.171       |
| 21                  | 1.911       | 79         | 1.587       |
| 22                  | 0.272       | 80         | 0.347       |
| 23                  | 0.28        | 81         | 3.954       |
| 24                  | 0.692       | 82         | 1.789       |
| 25                  | 0.613       | 83         | 3.204       |
| 26                  | 0.761       | 84         | 1.427       |
| 27                  | 1.27        | 85         | 0.846       |
| 28                  | 2.651       | 86         | 0.255       |
| 29                  | 4.39        | 87         | 2.242       |
| 30                  | 0.577       | 88         | 0.219       |
| 31                  | 0.654       | 89         | 1.166       |
| 32                  | 1.828       | 90         | 0.592       |
| 33                  | 1.534       | 91         | 0.53        |
| 34                  | 2.374       | 92         | 0.845       |
| 35                  | 1.048       | 93         | 0.742       |
| 36                  | 1.559       | 94         | 0.676       |
| 37                  | 1.011       | 95         | 0.99        |
| 38                  | 3.079       | 96         | 1.269       |
| 39                  | 2.09        | 97         | 0.313       |
| 40                  | 0.281       | 98         | 0.127       |
| 41                  | 3.584       | 99         | 2.042       |
| 42                  | 1.187       | 100        | 1.832       |
| 43                  | 4.909       | 101        | 2.973       |
| 44                  | 2.587       | 102        | 1.384       |
| 45                  | 5.858       | 103        | 0.925       |
| 46                  | 0.861       | 104        | 2.145       |
| 47                  | 2.834       | 105        | 2.259       |
| 48                  | 0.568       | 106        | 0.783       |
| 49                  | 0.433       | 107        | 0.127       |
| 50                  | 0.693       | 108        | 0.918       |
| 51                  | 0.199       | 109        | 1.748       |
| 52                  | 1.201       | 110        | 0.428       |
| 53                  | 1.616       | 111        | 0.764       |
| 54                  | 2.46        | 112        | 1.284       |
| 55                  | 0.281       | 113        | 0.299       |
| 56                  | 1.674       | 114        | 0.266       |
| 57                  | 1.741       | 115        | 0.601       |
| 58                  | 0.511       | TOTAL AREA | 100.242     |

Fig 8: The listing of new proposed roads with road name





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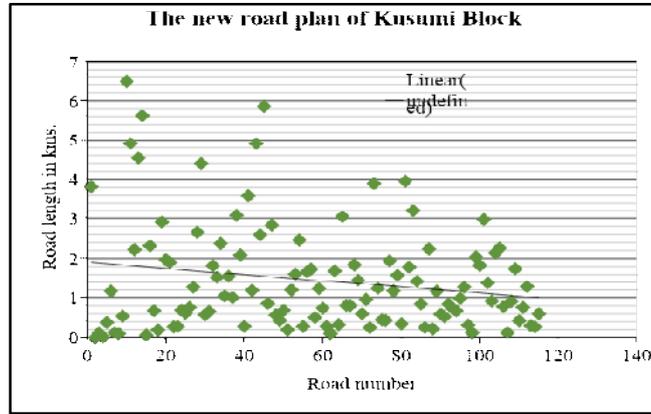


Figure 9: The new road plan against road length for the Kusumi block in mayurbhanj district





## Efficacy of Strengthening Exercises versus Aerobic Exercises on Physical and Mental Health among Post-Menopausal Women

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### ABSTRACT

The term menopause indicates the last menstrual flow experienced by a woman; menopause occurs between 45 to 65 years for most women. A few women experience very premature menopause before 40 years. During menopause, approximately 85 % of women report menopause symptoms that include physical pain and stress, psychological depression, anxiety, stress, vasomotor symptoms, and osteoporosis. Physical exercises are thought to improve cognitive function, enhance mood & promote daytime alertness and nocturnal sleepiness besides reducing the risk of heart disease, blood pressure, and psychological – anxiety, stress, and depression. Since there is an urge to improve the lifestyle of post-menopausal women, improvement of their physical and mental health through a structured exercise program is required. This study is intended to analyze the effects of Strengthening and Aerobic exercises in post-menopausal women. 30 subjects aged between 40-70 years participated in this study. Subjects in group A performed aerobic exercises and subjects in group B performed strengthening exercises for a period of 8 weeks. DASS-21 and Borg's scale were used to assess the depression, anxiety, and stress & physical activity intensity level respectively in pre and post-intervention periods. We found that both Aerobic exercise and strengthening exercise are important in reducing menopausal-related health problems and strengthening exercise is more effective in improving the physical and mental fitness of postmenopausal women than aerobic exercise programs.

**Keywords:** Post menopause, strengthening exercise, aerobic exercise, DASS-21, BORG'S scale.



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## INTRODUCTION

Menarche the first menstruation and menopause the end of menstruation are two major components in the reproductive life of women. [1] Menopause is derived from the Greek word 'menos' means month and 'pause' means to stop - which refers to the 'last menstrual period' and the cause of natural menopause is 'burning out' of the ovaries. [2] Menopause is diagnosed after 12 months of amenorrhoea resulting due to permanent cessation of ovarian function. [3] During this period, the decrease in estrogen level causes a wide range of symptoms. In all over the world, there are wide variation in the age and symptomatology of menopause among women. [4] Generally, physiological menopause may occur from 40 to 60 years of age, but the decrease in the natural fertility of women starts 10-13 years prior to menopause [5].

In the year 2006, there were about sixty-five million Indian women over the age of forty-five years got menopause as revealed by Indian menopausal Society. Hence, menopausal health demands even higher priority and awareness in Indian women [6]. Regardless of these factors, perimenopause is a period of time beginning with the onset of irregular menstrual cycles until the last menstrual period, and is marked by fluctuations in reproductive hormones [7]. Less women experience a very premature menopause before 40 years. [8] Prior to actual menopause, when menstrual cycles are variable, a woman referred to as premenopausal and following the menopause as postmenopausal.[9]

India has wider population, which has already crossed 1 billion with 71 million of people over 60 years of age and the number of menopausal women are about 43 million. In 2026, it is estimated that the population in India will be 1.4 billion, in people over 60 years of age and the menopausal population will be 173 million and 103 million respectively. Average age of menopause is 47.5 years in Indian women with a 71 years of average life expectancy. [10]. Therefore, there is an urgent need to focus on the health problems faced by the postmenopausal women. The prevalence of the metabolic syndrome is reported to be considerably higher in postmenopausal women in India [11].

The physical and physiological symptom during menopause are frequent hot flushes, night sweats, vaginal soreness, dyspareunia, urinary disorders, dry skin, reduced concentration, cardio vascular diseases, vasomotor symptoms, muscle and joint pain, loss of memory, inability to make decision, anxiety, mood swings, irritability, tiredness, and depression. [12] Low bone density is associated with a higher fracture rate, and several studies show a relationship between early menopause, oophorectomy and increase in osteoporotic fractures (early menopause is a risk factor for osteoporosis). [13] Estrogen deficiency after menopause accelerates the age-related loss of bone, both bone density and bone structure are clinically important, since fractures due to the fragility of bones are independently associated with both low bone mass and reduced bone size [14]. Decline in both lumbar spine and femoral neck bone density are also common in perimenopausal women. [15] Women who experience menopause before age 40 years (premature menopause) or between ages 40 and 45 years (early menopause) would have increased risk of overall mortality, psychiatric diseases, osteoporosis, cardiovascular diseases, neurological diseases, and some other conditions [16].

Women who engage in regular exercise seems to have lesser risk factor and complications, it is because exercise results in improvement of cardiovascular function, bone density, muscle strength. [17] Strengthening exercise can increase muscle strength, improve flexibility and balance, reduce the risk of falls, prevent osteoporosis. [18] Exercise can help to minimize midlife weight gain and create calorie deficit [19]. Aerobic exercise has been reported to reduce the risk of heart disease, blood pressure and psychological – anxiety, stress and depression. Improved bone and muscle health- reduce risk of osteoporosis, obesity, improve the muscle function [20]. Borg's scale is called as Borg's rating of perceived exertion (RPE). By using this scale, physical activity intensity level can be measured. The rating scale ranges from 6 to 20 and modified RPE range from 1 to 10. It is based on the physical sensation of a person's experiencing in physical activity including tachycardia, tachypnea, hyperhidrosis, and muscle fatigue. Although this is often a subjective measure; a person exertion rating may provide a fair estimation of the acute heart rate during physical activity [21,22].



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Fluctuating hormone levels during post menopause will increase stress, depression and anxiety. The depression anxiety and stress scale-21 (DASS- 21), is a set of 3 report scales designed to measure the emotional status. Stress scale assess difficulty relaxing, nervous arousal, being easily upset, agitated, irritable, over reactive and impatient [23]. This study was carried out to establish the effectiveness of strengthening exercise and aerobic exercise in postmenopausal women by using Borg's scale to measure physical fitness and Depression Anxiety and stress scale-21(DASS-21) to measure mental fitness.

## MATERIALS AND METHODS

This experimental study was carried out at Faculty of physiotherapy department, Dr. M.G.R. Educational and Research Institute for 8 weeks after the approval of this proposal by Institutional Review Board. Subjects of 40-70 years with post-menopausal and those who can follow instructions were included in the study after obtaining the consent for participation. Subjects without-natural menopause, e.g., surgical or radiotherapy for cervix cancer. And medications such as anxiolytics, anti-depressants, having serious disease or mental retardation were excluded from the study. Subjects were divided into two groups, Group-A and Group-B. Blood pressure of all the subjects were assessed with sphygmomanometer before and after the intervention. Group A received aerobic exercise and Group B received strengthening exercises for 8 weeks. Borg's scale and DASS-21 questionnaires were used to assess the pre and post interventional physical and psychological status of the subjects.

### GROUP A (AEROBIC EXERCISE)

Aerobic exercise training was performed (3 times/week) for 8 consecutive weeks by the subjects in Group – A. It consisted of 30 minutes of walking session with a speed of 5.5km/hour in treadmill.

### GROUP B (STRENGTHENING EXERCISES)

Strengthening exercises was performed (3 times/week) for 8 consecutive weeks by the subjects in Group-B. The subjects were instructed to perform these following exercises for 10-15 repetition with 5 minutes relaxation between each exercise. Pelvic bridging, strengthening dorsiflexion of both ankles in sitting position, sitting strengthening abduction of both the thigh, strengthening extension of both knee in sitting position, sitting strengthening flexion of both forearms, sitting strengthening extension of the shoulders, standing strengthening abduction of shoulders with band, cat and camel, superman, standing calf raises, lying leg curls, dumbbell squats, hamstring curls, straight leg raises.

## RESULTS

On comparing Pre-test and Post-test within Group A & Group B on Borg's scale & DASS score shows highly significant difference in Mean values at  $P \leq 0.001$ . On comparing the Mean values of Group, A & Group B on Borg's Scale score, it shows that significant decrease in the post test Mean values of both the Groups. Group - A (Aerobics) shows (7.66) & Group B (strengthening) shows (7.13). Both the groups are significantly effective in Borg's Scale at  $P \leq 0.001$ . Hence Alternative Hypothesis is rejected. On comparing the mean values of Group, A & Group B on DASS significant decrease in the post test Mean values was found but (Group B - Strengthening) shows (11.02) which has the lower Mean value is more effective than (Group A- Aerobic) (13.06) at  $P \leq 0.001$ . Hence Null Hypothesis is rejected.

## DISCUSSION

The study is conducted to find the effectiveness of strengthening exercise and aerobic exercise in postmenopausal women. PK Dalal et al stated that Menopausal is a physiological process during which women go through a new



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biological and psychological changes which reduces the quality of the life of the women. A gradual decline of quality of life in pre to post-menopausal women [24]. After 8 weeks of interventional period both the groups showed significant improvement in the physical and mental fitness. Subjects in group A received aerobic exercise in the form of treadmill training which involved the cardiovascular fitness and lower limb muscle work. It was found that after 8 weeks of treadmill training the mean Borg's score reduced from 10.6 to 7.66 and mean DASS score 18.2 to 13.06. AJ Daley et al suggested that appropriate patterns of aerobic exercises assist in alleviating psychological distress as well as providing physical benefits [25].

Subjects in group B received strengthening exercises which involve whole body for 8 weeks and showed significant reduction in mean Borg's score from 12.8 to 7.13 and mean DASS 21 score from 18.6 to 11.02. JP Greeves et al Stated that strength training exercises involving arm and leg muscles in postmenopausal women showed substantial improvement in muscle strength which may have resulted from muscle hypertrophy. [26]MA Grealy et al stated that improved strength may additionally aid purposeful functional activities like rising from a chair and climbing stairs and may also have psychological benefits as alleviation of feeling of depression, loneliness and improvement in cognitive function [27].

In our study we found that group B subjects who underwent strengthening exercises showed greater reduction in Borg's score and DASS21 score then group A with aerobic exercises. This could be because the strength training program involved all the muscle of the body when compared to the aerobic exercise program. Piyusha Milani Atapatu et al stated that physical activity and exercise training are beneficial in postmenopausal women as they exert menopause related health problems, especially body composition changes, increased CVD risk and osteoporosis. [28]. Teoman N et al concluded that by performing a regular and controlled exercise program of 6 weeks would improve the fitness level and the quality of life on postmenopausal women [29].

Resistant training preferentially increase muscle and bone mass, promotes strength development and improves functional capacity whereas aerobic exercise is more beneficial for the reduction of cardiovascular disease risk. Hence it can be inferred that for promoting physical and mental fitness of postmenopausal women strengthening exercise is effective than aerobic exercise training.

## CONCLUSION

That it is our statistical analysis suggested that physical activity in the form of either aerobic exercise or strengthening exercise is important in reducing menopausal related health problems and strengthening exercise is more effective in improving physical and mental fitness of postmenopausal women than aerobic exercise program.

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## CONFLICT OF INTEREST

NIL

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**Table 1. Comparison of Borg’s Scale Within Group – A And Group – B Between In Pre And Post Test Values**

| # BORG'S SCALE | PRE-TEST |      | POST TEST |      | t – TEST | df | SIGNIFICANCE |
|----------------|----------|------|-----------|------|----------|----|--------------|
|                | MEAN     | S. D | MEAN      | S. D |          |    |              |
| GROUP- A       | 10.6     | 1.59 | 7.66      | 1.12 | 1.34     | 29 | 0.000***     |
| GROUP- B       | 12.8     | 1.12 | 7.133     | 1.06 | 2.897    | 29 | 0.000***     |

GROUP A – AE    GROUP B – SE

**Table 2. Comparison of Dass Sacle Within Group – A And Group – B Between Pre And Post Test Values**

| # DASS SCALE | PRE-TEST |      | POST TEST |      | t - TEST | SIGNIFICANCE |
|--------------|----------|------|-----------|------|----------|--------------|
|              | MEAN     | S. D | MEAN      | S. D |          |              |
| GROUP- A     | 18.2     | 1.69 | 13.06     | 1.90 | 7.78     | 0.000***     |
| GROUP- B     | 18.6     | 1.71 | 11.02     | 1.47 | 12.77    | 0.000***     |

GROUP A – AE, GROUP B – SE





## Customers' Segmentation using RFM Model with k-means

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### ABSTRACT

Customer segmentation is the process of dividing a company's customers into groups based on the similarity, commonalities and common characteristics amongst customers in each group. The objective of segmenting the customers is to handpicked how to rely to customers in each segment in order to optimize the value in the context of Return on Investment (ROI) to the business for each customer. One of the behavioral models is RFM segmentation. RFM stands for recency, frequency and monetary. RFM segmentation allow marketers to target precise clusters of customers with interactions that are much more significant for their particular behavior – and thus produce much higher rates of reply, plus increased allegiance and customer lifetime worth. In this study segmentation is done on the different criterion like Recency, Frequency and Monetary first. Then segmentation is done based on the Recency & Frequency, Frequency & Monetary and Frequency & Monetary.

**Keywords:** Customer Segmentation, RFM, RoI, E-Commerce.

## INTRODUCTION

Web mining techniques are enthused from data mining techniques. The heterogeneous information available in the web and characteristics provide great opportunity as well as challenges for the researchers for data mining. A few characteristics are as below:

- i. Very huge and growing rapidly.
- ii. Available in different formats and presentation.
- iii. Web servers log data.
- iv. Presenting information available in different formats into single format to the users of the web is very big challenge for the search engines.





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- v. Interlinked with hyperlinks.
- vi. Available information is noisy.
- vii. Information available is dynamic.

### CUSTOMER SEGMENTATION

Customer segmentation is the process of dividing a company's customers into groups based on the similarity, commonalities and common characteristics amongst customers in each group. The objective of segmenting the customers is to handpicked how to relay to customers in each segment in order to optimize the value in the context of Return on Investment (ROI) to the business for each customer. These types can assortment from things such as a user's age, location or income to their needs, wants, behaviours and values. Active and potential customers for your variety can be marked in valuable sub groups. Segmentation also means to split the market into parts, or segments, which are available, definable, actionable, and cost-effective and have a growth prospective. Or we can say, a business would find it unfeasible to target the entire market, because of cost, time and effort limitations. A group of people who can be recognized and besieged with reasonable cost, effort and time, means we want a 'definable' segment.

Following table shows the criteria different customer segmentation models:

| Segmentation Model         | How to Segment the Customers                                    |
|----------------------------|---|
| Demographic Segmentation   | Age, Gender, Income, Education, Marital Status                  |
| Geographic Segmentation    | Country, State, City, Town                                      |
| Psychographic Segmentation | Personality, Attitude, Values, Interest                         |
| Technographic Segmentation | Mobile-Use, Desktop-Use, Apps, S/W                              |
| Behavioral Segmentation    | Tendencies and Frequent actions, Feature or Product Use, Habits |
| Need-Based Segmentation    | Product/Service must-haves, Needs of specific customer groups   |
| Value-Based Segmentation   | Economic value of specific customer groups on the business      |

### RFM SEGMENTATION

One of the behavioral models is RFM segmentation. RFM stands for recency, frequency and monetary. RFM segmentation allow marketers to target precise clusters of customers with interactions that are much more significant for their particular behavior – and thus produce much higher rates of reply, plus increased allegiance and customer lifetime worth.

- **Recency:** How much time has elapsed since a customer's last activity or transaction with the brand? Activity is usually a sell, however, sometimes it may be, like, use of a mobile app or, the last visit to a website. In most of the cases, a customer has interacted or transacted with a brand recently, customer will be responsive to interactions from the brand more likely.
- **Frequency:** How often has a customer transacted or interacted with the brand during a particular period of time? Clearly, customers with recurrent activities are probably more loyal and more engaged, than a customer who do not do so.
- **Monetary:** Also referred to as "monetary value," this factor reflects how much a customer has spent with the brand during a particular period of time. Large spenders should generally be treated in a different way than little spender customers.

### RFM analysis is popular for three reasons

- It utilizes objective, numerical scales that yield a concise and informative high-level depiction of customers.
- It is simple – marketers can use it effectively without the need for data scientists or sophisticated software.





- It is intuitive – the output of this segmentation method is easy to understand and interpret.

### ABOUT DATASET

We have taken Brazilian E-Commerce Public Dataset by Olist available free on web, for analysis of customer segmentation. Brazilian ecommerce public dataset is a dataset of orders made at Olist Store. The dataset has information of approximately one lacs of orders from the year 2016 to year 2018 completed at numerous marketplaces in Brazil. Its features/attribute allow viewing an order from several dimensions such as price, payment, order position, and shipment performance to customer position, product attributes and finally feedback given by a customer. This is real commercial data.

### DATASET DESCRIPTION

Each feature or columns of different seven csv files of the dataset are described below:

(i) The file **olist\_customers\_dataset.csv** contain following features:

| Attributes                      | Description   |
|---------------------------------|---|
| <b>customer_id</b>              | Id of the consumer who made the purchase.             |
| <b>customer_unique_id</b>       | Unique Id of the consumer.                            |
| <b>customer_zip_code_prefix</b> | Zip Code of the location of the consumer.             |
| <b>customer_city</b>            | Name of the City from where order is made.            |
| <b>customer_state</b>           | State Code from where order is made(Ex- saopaulo-SP). |

(ii) The file **olist\_sellers\_dataset.csv** contains following features:

| Attributes                    | Description                                  |
|-------------------------------|--|
| <b>seller_id</b>              | Unique Id of the seller registered in olist. |
| <b>seller_zip_code_prefix</b> | Zip Code of the location of the seller.      |
| <b>seller_city</b>            | Name of the City of the seller.              |
| <b>seller_state</b>           | State Code (Ex- saopaulo-SP)                 |

(iii) The **olist\_order\_items\_dataset.csv** contain following features:

| Attributes                 | Description  |
|----------------------------|--|
| <b>order_id</b>            | A unique id of order made by the consumers.                              |
| <b>order_item_id</b>       | A Unique id given to each item ordered in the order.                     |
| <b>product_id</b>          | A unique id given to each product available on the site.                 |
| <b>seller_id</b>           | Unique Id of the seller registered in olist.                             |
| <b>shipping_limit_date</b> | The date before which shipping of the ordered product must be completed. |
| <b>Price</b>               | Actual price of the products ordered .                                   |
| <b>freight_value</b>       | Price rate at which a product is delivered from one point to another.    |

(iv) The file **olist\_order\_payments\_dataset.csv** contain following features:

| Attributes                  | Description                                     |
|-----------------------------|---|
| <b>order_id</b>             | A unique id of order made by the consumers.     |
| <b>payment_sequential</b>   | sequences of the payments made in case of EMI.  |
| <b>payment_type</b>         | mode of payment used.(Ex-Credit Card)           |
| <b>payment_installments</b> | number of installments in case of EMI purchase. |
| <b>payment_value</b>        | Total amount paid for the purchase order.       |





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(v) The file **olist\_orders\_dataset.csv** contain following features:

| Attributes                           | Description  |
|--------------------------------------|--|
| <b>order_id</b>                      | A unique id of order made by the consumers.          |
| <b>customer_id</b>                   | Id of the consumer who made the purchase.            |
| <b>order_status</b>                  | status of the order made i.e delivered, shipped etc. |
| <b>order_purchase_timestamp</b>      | Timestamp of the purchase.                           |
| <b>order_approved_at</b>             | Timestamp of the order approval.                     |
| <b>order_delivered_carrier_date</b>  | delivery date at which carrier made the delivery.    |
| <b>order_delivered_customer_date</b> | date at which customer got the product.              |
| <b>order_estimated_delivery_date</b> | estimated delivery date of the products.             |

(vi) The file **olist\_order\_reviews\_dataset.csv** contain following features:

| Attributes                     | Description  |
|--------------------------------|--|
| <b>review_id</b>               | Id of the review given on the product ordered by the order id.         |
| <b>order_id</b>                | A unique id of order made by the consumers.                            |
| <b>review_score</b>            | review score given by the customer for each order on the scale of 1-5. |
| <b>review_comment_title</b>    | Title of the review  |
| <b>review_comment_message</b>  | Review comments posted by the consumer for each order.                 |
| <b>review_creation_date</b>    | Timestamp of the review when it is created.                            |
| <b>review_answer_timestamp</b> | Timestamp of the review answered.                                      |

(vii) The **olist\_products\_dataset.csv** contain following features:

| Attributes                        | Description  |
|-----------------------------------|--|
| <b>product_id</b>                 | A unique identifier for the proposed project.                              |
| <b>product_category_name</b>      | Name of the product category   |
| <b>product_name_lenght</b>        | length of the string which specify the name given to the products ordered. |
| <b>product_description_lenght</b> | length of the description written for each product ordered on the site.    |
| <b>product_photos_qty</b>         | Number of photos of each product ordered available on the shopping portal. |
| <b>product_weight_g</b>           | Weight of the products ordered in grams.                                   |
| <b>product_length_cm</b>          | Length of the products ordered in centimeters.                             |
| <b>product_height_cm</b>          | Height of the products ordered in centimeters.                             |
| <b>product_width_cm</b>           | width of the product ordered in centimeters.                               |

## STUDY AND ANALYSIS

On the above dataset we will apply the RFM model of segmentation also using k-means algorithm. Actual coding is done/carried out in python/spyder and it is not provided in this paper, only description and the output of the code is given. The function "shape" of python shows each .csv file Customers, Order Items, Payments and Orders of the dataset having the 99441, 112650, 103886, and 99441 rows/records and 5, 7,5 and 8 of the columns/attributes respectively.

## DATA PRE-PROCESSING AND DATA CLEANING

Data Pre-Processing is a very important step involved in the method of analysis of data. If data pre-processing is not done carefully then result may have an error. Data cleaning is also a step involved in this process. Checking for the missing value counts and corresponding percentage against total observations then dropping the missing values using the python's function "isnull" and "dropna".





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### Clustering based on single feature

#### Clustering based on recency

To calculate recency, we need to find out most recent purchase date of each customer and see for how many days they are inactive. After having no. of inactive days for each customer, we will apply K-means clustering to assign a recency score to the customers. We created a dataframe after max purchase date for each customer. Observation point is max purchase date of our dataset. Merging the dataframe on "customer\_unique\_id". Figure 01 shows the Plotting of the distribution of the continuous feature Recency. Now, we will apply K-means clustering to assign a recency score to each customer. But there is need to tell how many clusters, we need to K-means algorithm. To find this out, we will apply Elbow Method. Elbow Method simply tells the optimal cluster number for optimal inertia. Figure 02 shows the elbow plot based on Recency. Here it looks like 4 is the optimal number of clusters. Based on business requirements, we can go ahead with less or more clusters. In this case, we will select 5. Table 01 Displaying the details of each cluster using the "describe" function of python on the merged csv file. From the above output the recency clusters have different characteristics. The customers in Cluster 4 are very recent compared to Cluster 3 and 2. Hence cluster 4 covers the most active customers whereas cluster 0 covers the most inactive customers.

#### Clustering Based On Frequency

To create frequency clusters, we will need to find total number of orders for each customer, after which we can go further and place them in various suitable clusters. Figure 03 shows the Plotting of the distribution of the continuous feature set. As the same notation as recency clusters, high frequency number indicates better customers. Now, applying k-means algorithm and elbow method for Clustering, we get the graph shown in Figure 04. Table 02 Displaying the details of each cluster using the "describe" function of python on the merged csv file.

#### Clustering Based On Monetary

Let's see how our customer base looks like when we cluster them based on the revenue criteria. We will calculate revenue for each of the customer, plot a histogram and apply the same clustering method. Calculate revenue for each customer and plotting the distribution of the continuous feature set, we get the graph shown in Figure 05. Now, applying k-means algorithm and elbow method for Clustering, we get the graph shown in Figure 06. Table 03 Displaying the details of each cluster using the "describe" function of the python.

### Overall Score

After creating various metric scores (cluster numbers) for recency, frequency & monetary. Now, we will proceed to create an overall score out of them. Joining the Recency Cluster, Frequency Cluster and the Monetary Cluster, and then the output of the mean function looks like shown in Table 04. The scoring above clearly shows us that customers with score 12 is our best customers whereas 0 is the worst. To keep things simple, better we name these scores: 0 to 4: Low Value 5 to 7: Mid Value 8+: High Value

Now we categorize or segment on the basis of overall score:

| Overall Score | Segmentation |
|---------------|--------------|
| 0-4           | Low Value    |
| 5-7           | Mid Value    |
| 8+            | High Value   |

### Clustering Based On Two Features

#### Customer Segmentation By Recency And Frequency

Figure 07 shows the Plotting of the distribution of the continuous feature set between Frequency and Recency.

#### Customer Segmentation By Frequency And Monetary: -

Figure 08 shows the Plotting of the distribution of the continuous feature set between Monetary and Frequency.





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**Customer Segmentation By Recency And Monetary**

Figure 09 shows the Plotting of the distribution of the continuous feature set between Monetary and Recency.

**CONCLUSION**

In this study segmentation is done on the different single criterion like Recency, Frequency and Monetary first. Then segmentation is done based on two features like the Recency & Frequency, Frequency & Monetary and Frequency & Monetary. After all the segmentation done, we conclude in the form of 'Low-Value', Mid-Value and 'High-Value' customers. Company should focus on 'High-Value' customer segment, for optimal ROI.

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11. <https://info.hurree.co>
12. <https://slideppts.com>
13. <https://economictimes.indiatimes.com> whereas 0 is the worst. To keep things simple, better we name these scores: 0 to 4: Low Value 5 to 7: Mid Value 8+: High Value

**Table 01: Result of Describe function for Recency Cluster**

| Recency Cluster | Count   | mean       | Std       | min   | 25%   | 50%   | 75%   | Max   |
|-----------------|---------|------------|-----------|-------|-------|-------|-------|-------|
| 0               | 14617.0 | 516.855374 | 49.841024 | 451.0 | 476.0 | 510.0 | 547.0 | 728.0 |
| 1               | 19437.0 | 383.521840 | 35.410075 | 325.0 | 353.0 | 383.0 | 412.0 | 450.0 |
| 2               | 27986.0 | 265.494962 | 31.292600 | 212.0 | 236.0 | 270.0 | 287.0 | 324.0 |
| 3               | 30828.0 | 156.904502 | 31.122448 | 105.0 | 129.0 | 157.0 | 184.0 | 211.0 |
| 4               | 24733.0 | 52.479400  | 27.515776 | 0.0   | 28.0  | 48.0  | 77.0  | 104.0 |

**Table 02: Result of Describe function for Frequency Cluster**

| Frequency Cluster | Count   | mean      | Std      | min  | 25%  | 50%  | 75%  | Max  |
|-------------------|---------|-----------|----------|------|------|------|------|------|
| 0                 | 99875.0 | 1.207900  | 0.405807 | 1.0  | 1.0  | 1.0  | 1.0  | 2.0  |
| 1                 | 12870.0 | 4.039005  | 1.186489 | 3.0  | 3.0  | 4.0  | 5.0  | 7.0  |
| 2                 | 1464.0  | 10.831967 | 2.252463 | 8.0  | 9.0  | 11.0 | 12.0 | 16.0 |
| 3                 | 397.0   | 24.536524 | 6.099081 | 18.0 | 20.0 | 22.0 | 24.0 | 38.0 |
| 4                 | 75.0    | 75.000000 | 0.000000 | 75.0 | 75.0 | 75.0 | 75.0 | 75.0 |





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**Table 03: Result of Describe function for Monetary Cluster**

| Monetary Cluster | count    | Mean          | Std         | Min       | 25%         | 50%        | 75%        | max       |
|------------------|----------|---------------|-------------|-----------|-------------|------------|------------|-----------|
| 0                | 111073.0 | 194.473656    | 194.502473  | 9.59      | 67.6800     | 124.700    | 235.280    | 1057.88   |
| 1                | 5558.0   | 1931.212431   | 841.028308  | 1058.68   | 1286.8975   | 1644.525   | 2264.675   | 4560.48   |
| 2                | 732.0    | 7218.868142   | 2186.235479 | 4564.75   | 5423.3125   | 6702.720   | 8425.440   | 12834.50  |
| 3                | 184.0    | 20278.110435  | 5207.417793 | 14196.28  | 16313.6000  | 19174.380  | 25051.890  | 30186.00  |
| 4                | 46.0     | 43587.292174  | 2837.177072 | 36489.24  | 44048.0000  | 44048.000  | 45256.000  | 45256.00  |
| 5                | 8.0      | 109312.640000 | 0.000000    | 109312.64 | 109312.6400 | 109312.640 | 109312.640 | 109312.64 |

**Table 04: Output of the Mean function of overall score**

| Overall Score | Recency    | Frequency | Monetary     |
|---------------|------------|-----------|--------------|
| 1             | 502.980544 | 1.207798  | 166.198203   |
| 2             | 384.976650 | 1.377002  | 198.923291   |
| 3             | 272.298805 | 1.467620  | 222.145153   |
| 4             | 169.065742 | 1.584230  | 255.185861   |
| 5             | 69.587960  | 1.694626  | 307.455354   |
| 6             | 103.876071 | 5.997859  | 1218.064933  |
| 7             | 90.983883  | 6.699634  | 3049.088952  |
| 8             | 114.378685 | 11.943311 | 6014.895057  |
| 9             | 154.866667 | 12.030303 | 23948.324485 |
| 10            | 96.454545  | 22.181818 | 35259.341818 |

**Table 05: First Five rows of the output**

| customer_unique_id               | Recency | Recency Cluster | Frequency | Frequency Cluster | Monetary | Monetary Cluster | Overall Score | Segment   |
|----------------------------------|---------|-----------------|-----------|-------------------|----------|------------------|---------------|-----------|
| 708ab75d2a007f0564aedd11139c7708 | 125     | 3               | 1         | 0                 | 99.33    | 0                | 3             | Low-Value |
| 6e3c218d5f0434ddc4af3d6a60767bbf | 114     | 3               | 2         | 0                 | 192.24   | 0                | 3             | Low-Value |
| 6e3c218d5f0434ddc4af3d6a60767bbf | 114     | 3               | 2         | 0                 | 192.24   | 0                | 3             | Low-Value |
| 0ae522661311f598df20272643d39ce6 | 160     | 3               | 1         | 0                 | 157.45   | 0                | 3             | Low-Value |
| d386a136dc889cf681443061874caad8 | 113     | 3               | 1         | 0                 | 136.71   | 0                | 3             | Low-Value |





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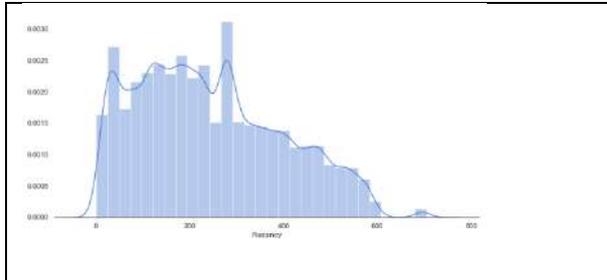


Figure 01: Plotting of the distribution of the continuous feature set for Recency.

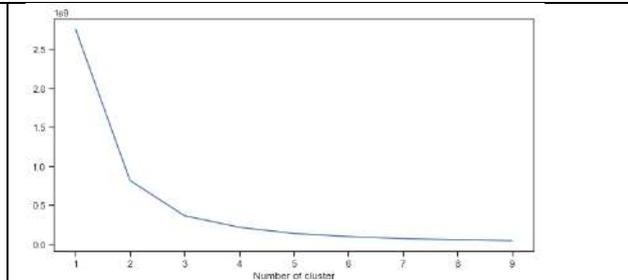


Figure 02: k-means Plotting for Recency.

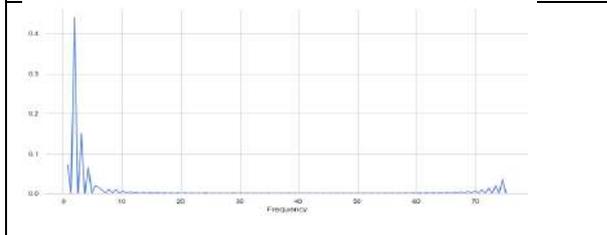


Figure 03: Plotting of the distribution of the continuous feature set for Frequency.

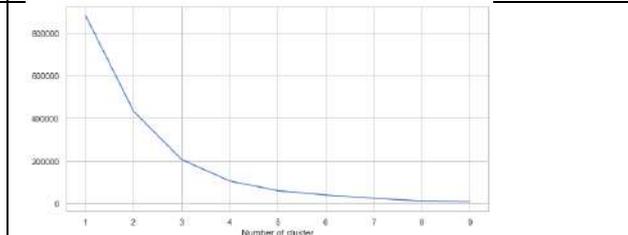


Figure 04: k-means Plotting for Frequency.

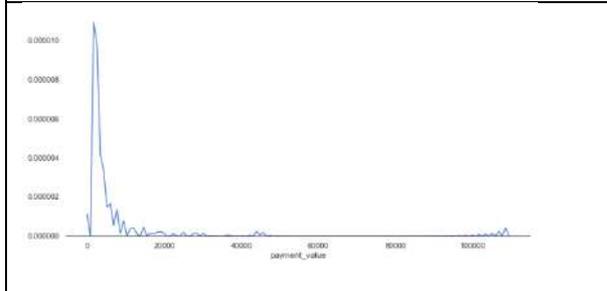


Figure 05: Plotting of the distribution of the continuous feature set for monetary.

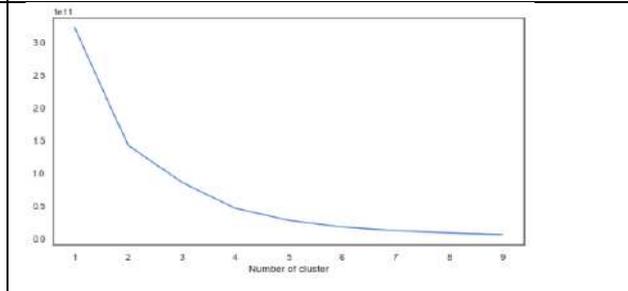


Figure 06: k-means Plotting for Revenue.

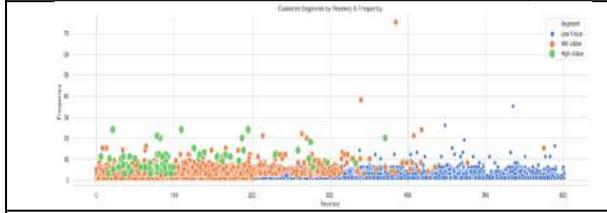


Figure 07: Distribution of the continuous feature set between Frequency and Recency

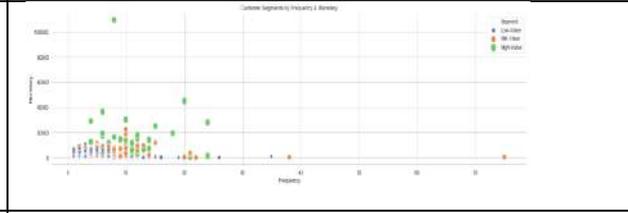


Figure 08: Distribution of the continuous feature set between Frequency and monetary.

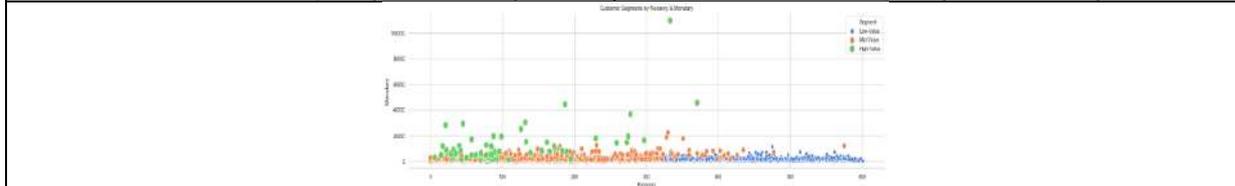


Figure 09: Distribution of the continuous feature set between Recency and monetary





## Spatial Quality Attribute for high Rise Buildings: Literature Review

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### ABSTRACT

There has been a shift in the housing typology worldwide from low-density stand-alone housing towards high rise buildings accommodating large populace density. With the inflated demand for high rise buildings the human quest for better living environment has also increased as when they were built initially, they faced a lot of critique and were quite unacceptable by the society in the beginning. With the high-rise skyline appearing in almost all cities, the researchers and various professional bodies became interested in analyzing the comfort conditions existing in and around high-rise buildings. For this, the quality of life has emerged as the influential factor which determines overall building environment in context of satisfaction and well-being of the users and need to be focused on while designing high rise buildings. The article will contribute in establishing the meaningful definition of Quality of life (QoL) in context of high-rise buildings in India. In addition, the QoL assessment methods used universally for analyzing and describing it are also appraised. A review of extensive variety of literature available worldwide on Quality of Life is presented which will help to understand the concept of indicators, attributes and dimensions required to measure QoL. The article concludes with the projection of certain sets of domains, its indicators and attributes which are directly related to QoL but needs effort to analyze their impact in achieving spatial quality in high-rise buildings.

**Keywords:** Attribute, Dimension, Domain, Parameter, Quality of Life





## INTRODUCTION

In the race to satisfy the quest of being more urbanized and developed the human race has entered into Anthropocene age wherein the impact of anthropogenic activity has devoured mother earth of its resources causing degradation of natural environment and change in atmosphere composition. It will take centuries for humans to revive the natural environment only if the activities harming environment are stopped immediately. The journey of being urbanized started during ancient times with the creation of city states/ polis wherein physical infrastructure facilities required for comfortable living were more in comparison to their rural counterpart. Eventually, the pursuit for achieving comfort and also increased job opportunities at city level encouraged the process of migration of populace from rural to urban areas. Further, with the advancement of technology and invention of new building materials (such as glass and steel) post industrial revolution changed the typology of city expansion from horizontal to vertical. The cities were expanding horizontally to accommodate increased population and infrastructure demand thereby causing pressure on land by changing agrarian land into urban but with the advent of more tensile materials the concept of high-rise buildings emerged as a solution to reduce land pressure thereby promoting sustainable development. Thus, high rise buildings turned out to be more capable structures carrying more density of population within a chunk of land whereas the same populace accommodation will have led to intense land coverage in case of horizontal expansion. As per the projection by experts it is expected that by 2050 almost two third of the world's population will be urban. Holding this pattern in mind, high-rise buildings are being proposed by urban and town planners to save land from erosion. Now, the question arises, does the comfort factor for which shelters were created by human beings exist in this high rise, as when these high-rise buildings were initially constructed, they faced a lot of opposition and were initially very unacceptable to society. As a vital part of the general discourse on the quality of life in the industrialized world, the concern for quality of the built environment has arisen as it plays an important role in stimulating comfort conditions. Later on, after the oil crisis of 1970's suddenly the awareness regarding the importance of natural resources and environment was being propagated worldwide and the only suggested model for accomplishing this was to go for Sustainable Development i.e., to use natural resources in sound ways so that our future generation could also enjoy them. In due course, the acceptance for high rise buildings also developed as it turned out to be the only solution to reduce land pressure while housing the available populace and providing better liveable environment in context of ample number of open spaces, landscape, views, interaction spaces, playgrounds etc. With the high-rise skyline appearing in almost all cities, the researchers and various professional bodies became interested in analysing the comfort conditions existing in and around high-rise buildings. One of the important and noticeable aspects of comfort is Quality of Life (QoL) being studied by researchers all over the world. Through this article, the research and literature related to Quality of Life (QoL) in High Rise buildings done by researchers and academicians worldwide will be reviewed and inferences will be drawn accordingly.

Consequently, the objective of this paper is to analyse the QoL indicators in the framework of space quality to provide healthier comfortable living environment to the residents of green buildings. Till date, research on QoL is widespread but only few scholarly works have used the data related to the building or the nearby areas for evaluating the extent of satisfactory levels in terms of the nearby areas. Moreover, private fulfilment is thought to incorporate a scope of spaces, like actual characteristics of the abode just as highlights of the encompassing area and social conditions (Fornara et al., 2010; Jr & Bentler, 2010). QoL literature is flooded with variety of terms which demand closer analysis and enquiry required to justify their contextual relevance to spatial quality measurement in high rise structures. Similarly, the measurement of QoL involved numerous attributes and parameters framed by varied researchers to assess the Quality of life and spatial quality which need to be defined in simple term so that their relevance is easily understood by everyone. The article also unravels the difficulties in understanding the usage of indicators and indexes while assessing QoL in a building. Since, the literature available is vast same is the case with the existing indicators but effort has been done to examine these indicators in brief so as to develop understanding of the state of the art and to discover ways in which one might use them in the development of Indian high-rise green building.





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### Defining High-Rise Building

The vast literature available on tall buildings does not emphasize on a single precise definition of high rise building but put forward a vast bank of definitions based on different perspectives used by various bodies. So, before addressing the high-rise infrastructure and assessing QoL in these megalomaniac structures, it's imperative to analyze the basics of high-rise buildings. Based on the literature analyzed, this article puts forth the following accepted definitions of high-rise buildings:

- The International Building Code (IBC 2000) and the Building Construction and Safety Code, NFPA 5000TM-2002, Paragraph 3.3.28.7 of the Life Safety Code®, 2006 edition, classified High rise buildings as buildings that are either 75 feet high or more in height when measured from the lowest entry level of fire vehicle to the top most habitable floor (Kavilkar & Patil, 2014).
- As per the Emporis high-rise is "A multi-story structure between 35-100 meters tall, or a building of unknown height from 12-39 floors." (*High-Rise Building | Emporis Standards | EMPORIS*, n.d.)
- The New Shorter Oxford English Dictionary defines a high rise as "a building having many stories".
- "Any structure where the height can have a serious impact on evacuation" (The International Conference on Fire Safety in High-Rise Buildings). (*High-Rise Building - Wikipedia*, n.d.)
- According to German regulations buildings higher than 72feet that can allow people to live there on permanent basis, can be termed as tall buildings. (Ross, n.d.)
- The National Building Code (India) describes high rise as buildings having height 15m or above.
- As per Building Code of Hyderabad, India any construction having height in the range of 15-18 meters or more or any construction having four or more floors can be labeled as high rise buildings.
- According to Bangalore Development Authority, India buildings 24m or more in height are termed as high-rise.
- "Generally, a high rise structure is considered to be one that extends higher than the maximum reach of available fire-fighting equipment, this has been set variously between 7f feet and 100 feet." (Mousavi, 2017)

Therefore, from the above definitions it becomes evident that the Fire and Building codes of a Nation, area or city where the building is erected plays vital role in specifying the height above which the building is considered to be high-rise. Also, the invention of lifts as means of vertical transportation had made high-rise buildings possible. Clustering structures in the form of high-rise buildings in densely populated areas is an incentive to construct green and other common spaces by utilizing land available on the ground floor. With the advent of high-rise buildings, the "public realm" has become a priority for planning authorities in big cities.

### Public approach towards high rise building

The design of the apartment dates back to the 17th century, when Paris started constructing houses in five- to seven-story towers, and then in the 1860s and 1880s, in the United States, much taller iron-skeleton buildings were constructed to accommodate the increasing population in various cities. As per considers, tall upward thrust structures typically motive social segregation due to the fact these individual devices given for every family/ person have a tendency to cordon them off definitely from association with different individuals. This occurs essentially due to the fact of the need of social gathering areas inside the near nearness for the inhabitants of these units to come together and connected. As high-rise flats are highly intently related with commercialization, the builders and the architects usually attempt to in shape in as several devices as possible in one complex. This comes about in a compromise on these open gathering areas and in this way, such spaces are viewed superfluous or an extravagance; something that one will need to pay for, in addition in arrange to avail. This kind of social segregation due to diagram leads to intellectual affects like push, destitute social relations, averted child advancement, behavioral issues, disappointment, fear, and want of supportiveness. Living in a current day world, to instruct these affects is in a way burrowing one's personal grave. Moreover, high-rise constructions too estrange its inhabitants from nature. The constructions might provide a beautiful see concluding that high-rise is as it had been catering to the visible encounter of its clients, whereas authentic engineering is almost a comprehensive involvement counting both unmistakable and intangible elements of nature. It is authentic that these days these high-rise building complexes, prevalently referred to as "Societies" come with a parcel of offices and provide an ease of residing for families and



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humans in their present-day lively and sensational life. As people, social interaction is vital to each point of view of our wellbeing. Investigate appears that having a stable prepare of bolster or stable community bonds domesticate both passionate and bodily wellbeing. With the high-rise buildings appearance, it was immediately observed how living in one of these apartments can socially and professionally impact the lives of people. Over the last few decades, high-rise buildings have become more popular in cities across the globe and have become a study field for academics, as high-rise living is seen as unnatural and a modern way of life. At the outset, detailed research based on the technological aspects of the construction of high-rise buildings was carried out, and later research related to the occupants' perception of high-rise living also attracted the attention of researchers. The acceptance of high-rise buildings among the populace varies from country to country. There are both positive and negative sides of high-rise living and for the optimistic outlook towards high-rise building the good sides need to over-reflect the negative pieces. Any good features of high-rise living are the likelihood of saving the land in neighborhoods, because a number of people have space in a comparatively small area. In new constructed high-rise towers, the sunshine is being used to create a friendly indoor atmosphere. The view from a high-rise building is also enticing (Turkington & R. Wassenberg, 2004). High rises have been suspected of producing numerous negative effects. Among those discussed in this paper are anxiety, frustration, tension, behavioral difficulties, suicide, poor social connections, decreased helpfulness, and disrupted child growth. At the social level, they are accused of burdening existing programmes and growth. At the socioeconomic stage, conflicts and harm to the character of the neighborhoods. Thus, there are many implications for living in high-rise towers. Some can be affected by the building structure itself, but many are moderated by non-architectural influences. The mainstay of these moderating factors is the socio-economic class, the position of the building, the upbringing of small children or not, gender and stage of life. Although they have not been empirically studied in high-rise areas, it is also likely that the choice of housing and indoor population density is also significant (Gupta, 2019). Thus, it important for architects and designers to consider the factors that lead to the establishment of a livable environment, thus improving the overall quality of life within and outside the building site as shown in Figure 2.

Cities in India contribute to two-thirds of country's GDP which is expected to rise to 75% by 2031. At present in India, there are 59 urban agglomerations of more than one million people in the country which is expected to inflate to 78 by 2035. The increase GDP will produce more job opportunities. Therefore, accommodating the growing urban work force will require large investments for developing new urban spaces rather than following the unsustainable approach of accommodating them in the existing urban cores. Progress of urbanization in India is threatened by climate change which has been induced due to increased urban sprawl and unplanned growth of Indian cities shown in figure 2. This unplanned growth demands more built up areas obtained through elimination of open spaces and green covers which stimulate increase in anthropogenic emissions. With reduced space left for evaporative cooling heat accumulation in atmosphere is caused resulting in formation of UHI. A country-based analysis indicates that China has been the most actively-studied country of SUHI research (213), which was followed by the United States (106) and India (38) [8]. Rapid urbanization is resulting in dramatic land use change of which some examples of Metropolitan cities are listed below:

- In last forty years urban area in Delhi increased by 30.6% while agriculture area reduced by 22.8% and dense forest by 5.3%.
- Mumbai has become almost paved and concretized in the span of 40 years
- Kolkata experienced decrease in vegetation area from 33.6% of the city area to 7.4% between 1980 and 2010.
- In Chennai the urban built up area has tripled between 1991 and 2016 while the vegetation area has reduced by 12%.

The above data makes it quite evident that UHI exists in Indian city and needs attention of researchers for understanding the causes of its formation and also the policy framework be given based on analysis so as to reduce the UHI effect.



**Khurram Ashraf et al.,****Defining Terms Centring QoL Assessment****Rationale and Methodology**

When we evaluate overall human well-being or policies to improve them, we typically proceed by making assumptions about the characteristics of a good quality life and strategies for achieving them which bring into account a number of terms whose definition and context need to be understood well to attain the goal of establishing QoL in high rise buildings. One trouble emerges on the grounds that the idea [of quality of life] is instinctive recognizable and consequently seems undeserving of close definition: everybody accepts he knows when he is better or more regrettable off (McDowell & Newell, 1987) . Therefore, the terms centred around measuring QoL indicators should be well understood before proceeding as these terms have been interchangeably used by the researchers in the literature reviewed leading to certain discrepancies in their understanding. Therefore, the exact definition of terms used will avoid confusion in the literature reviewed.

**Indicators and Indexes**

Understanding of the vital terms required for quantifying QoL used in available literature is a useful starting point for making any study a successful attempt. Everyone, individually and collectively, requires good, accessible environmental information on which to base decisions. But, in today's world of information overload, the need is for legitimate, simple to-utilize pointers by which to gauge our environmental presentation and progress towards progressive betterment (Honourable Robert de Cotre, then Federal Minister of the Environment, in Canada, 1991, p.iii). Individual indicators are simply variables which need to be measured. Every indicator point's to or is a token of some condition as paleness may indicate lower haemoglobin levels and high unemployment data corresponds to a sick economy. Indicators are useful in providing comprehensive data right from problems identification to devising its solution. Ideally, they provide accurate data of the situation being assessed or measured. Due to vast availability of literature, the indicators studied are many and varied depending upon the nature of the study. These include reliability, validity, sensitivity to change, ease of administration and scoring, the existence of normative data, and the applicability of the measure to heterogeneous samples (Herbert & Milsum, 1990). They can be either a summary measure, or an ongoing measure used as a tool for monitoring change. Ideally, they provide relevant and accurate data about a given situation, or factors related to the situation. Eventually this led different studies to encompass different criteria considered effective for the study leading to availability of long list of indicators. Exact issue with the available indicators was very well stated by Howard Cherniak-The choice is often made on the basis of what statistics are available, and any weakness in concept (e.g., do divorce rate indicate social instability or enlightened society?) or validity (because of data-collection problems, many available statistics are not very accurate or reliable) are admitted and subsequently ignored as much as possible (Cherniak, 1976). Index is the other term which could be seen flooding the QoL literature. A comprehensive index can serve a myriad of purpose by providing holistic set of baseline data for any development and also by devising a way to evaluate and monitor projects and proposals. Various indexes of QoL have been proposed by Government agencies, Media, Public bodies etc. but still the advantage and liabilities of each have not been systematically evaluated. Indexes should enable comparability within the data set or in other words, indexes often use indicators which collect data that is convenient, not necessary what is needed. After analysing the literature available on QoL there is a poor understanding of which variables have an effect on quality of life, as well as how this affect is manifest. Also, there is lack of any agreement on how these indicators can best be congregated into an index. The indicators are chosen by the coverage, measurability representativeness and importance to the QoL. The nearby QoL Index, created by the Faculty of Social Science of The Chinese University of Hong Kong, covers a wide scope of life spaces and comprises of 23 indicators that are gathered into five sub-records: Social, Health, Economic and Environmental, Cultural and Leisure (Chan et al., 2005). For eliminating discrepancies, it is vital that the development and administration of the index be totally open to and understood by the public and not controlled by any particular group. Thus, it is quite clear that indicators can measure any number of types of data viz. social, physical, economic, environmental, health status, quality of life, liveability, etc. The only issue is the right selection of indicators for measuring concepts such as Quality of life due to failure to connect the overlapping.



**Khurram Ashraf et al.,****Quality Of Life and Live ability**

Quality of life is not a new term but has its root embedded in ancient times where the importance of QoL has been debated by philosophers including Aristotle, Socrates and Royce. With the industrialization paralleled with urbanization led to migration of rural population to urban areas in search of better living opportunities or for enjoying better QoL. But this migration impeded QoL in urban areas as the available infrastructure was shared by large populace for whom it was not designed thus giving researchers new domain of study which will act as an interface for different disciplines to come together and define QoL. As indicated by WHO's definition, QoL alludes to person's impression of their situation in life with regards to the way of life and the frameworks corresponding to objectives, assumptions, standards and concerns (Power & Kuyken, 1998). According to (Dillman & Beck, 1986), up until the early 1900, quality of life in urban environments was defined by neighbourhood ethnic makeup and industrial orientation. The last 30 years have seen a great many attempts to measure QoL in many parts of the world (Ferris, 2000). During the era of unprecedented economic growth in the 1960's and 1970's, researchers saw worsening social indicators in form of inflated suicide rates, drug usage etc. (Merelman, 1981). Different researcher proposed different definition of QoL making it a multi-faceted concept without measurement. In recent researches it has been established that people's relation to their surrounding environment is a vital issue in assessing QoL. Liu (Liu, 1999) identified spatial development inside the lodging, comfort of area, propriety of site, the board and upkeep of the domain and environmental factors as key factors showing positive relationship with private fulfillment in Hong Kong. Eventually, many researchers were involved in debates whether perceived quality of life could depend less on external factors such as housing and environmental aesthetics, and more on personal experiences such as sense of achievement, satisfaction etc. After going through the varied definitions of QoL, it could be simply defined as an individual construct which certainly have correlation with the social, physical environment and also have the capability to modulate them for one's well-being. QoL is also accompanied with term such as Liveability and is sometime used synonymously irrespective of the fact that they are separate entities but are interrelated. The word Liveability made its first appearance in 1950 which is defined as fit to live in by Oxford dictionaries online. According to Brundtland Commission's meaning of Sustainability, the possibility of liveability incorporates the capacity of a local area to address the issues of the present generation without bargaining the capacity of people in the future to meet their own need (Visser & Brundtland, 1987). Broadly, liveability can be related with the space quality and the spatial environment. It is all about living in a place with pleasant ambience. (O'Brien et al., 2006). Therefore, for achieving sustainability the planners must deal with these two separate but interrelated issues- QoL and Liveability. The first is liveability, which gives us a picture of how suitable the city is for living. The second is quality of life, which refers to how well-being is achieved by the individual and communities through holistic usage of resources available in an area. It involves an examination of how individual and localized communities behave and plan the way to use their resources in an optimum way so as to provide an improved quality of life.

**LITERATURE REVIEW**

From field observations and subsequent data analysis narrated in Table 1, it become evident that the architectural domain related to QoL studies in high rise buildings is not very well elaborated and is not included in the architectural research especially in context of spatial quality which strongly affects the complete well-being of the users. Further, after an overview of the research papers it is understood that QoL is a user-centric experience assessment focused on a particular context with the characteristics given in figure 3: In the research article "Quality of life and housing ", Stremikian ( Stremikian, 2015) discussed the main indicators related to the evaluation of the dimensions of housing in quality-of-life index. The author opined that the housing indicators that reflect the quality of life can be evaluated by the housing quality indicators, the quality of the housing environment and the burden of housing costs indicators. (Streimikiene, 2015). The observations penned by Fasoulaki (Fasoulaki, 2008) states that the intrinsic monumentality of tall buildings, due to their size, makes their architectural expression very important in urban sense. In spite of this, the high rise can still become a positive factor in the urban composition and therefore be linked to its surroundings and not be a foreign factor. Location and the ecosystem therefore play a significant role in the construction of high rise buildings at any given site (Fasoulaki, 2008). Research done by Haeseong Je. (Haeseong Je , 2007) has analysed various factors which aids in determining Quality index of Super high rise but still certain



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indexes which are directly related to QoL are left unexplored which creates research gap (Je et al., 2007). Further, up to some extent the study done by Fernanda Acre and Annemie Wyckmans (Fernanda Acre and Annemie Wyckmans, 2014) has analysed spatial quality determinants for residential building renovations which does have some relevance to architectural spatial quality but needs more addition of attributes and indexes for better QoL assessment (Acre & Wyckmans, 2014). Consequently, the study and analysis of research papers on QoL establishes the following research gap:

**Lack of Resident Centered Theoretical framework of QoL of Residential Environment**

Most of the current examinations zeroed in on the connections between respondents' segment highlights (like sexual orientation, age, level of instruction, and pay), certain skyscraper private climate features (such as building structure, stature and thickness) and explicit liveability issues (such as wellbeing, security and social connection) from the different disciplinary viewpoints (like natural brain research, conduct brain science, and social science). Particularly for skyscraper or high-rise lodging bequests, there is no bound together strategy or standard for the estimation of liveability. So, it becomes important to understand and identify the QoL attributes within the high-rise residential buildings by conducting more and more research in this gamut.

**Dearth of studies on QoL of high-rise housing in the Near Capital Region (NCR)**

Most of the high-rise housing QoL studies have referred to the data from developed countries like U.K., U.S.A, Japan etc. . As far as Indian studies are concerned, assessment of spatial quality in high rise for residents is still unmapped by the researchers which creates a vacuum in establishing QoL in built spaces especially high rise on account of absence of any available relevant architectural research on spatial quality. NCR region of India has witnessed significant rise in construction of high-rise housing in last few years, and thus this region can be well utilized for research purposes. Therefore, the research gap established should be covered by conducting extensive QoL studies in context of high-rise buildings owing to the popularity of high-rise construction in urban areas. Also, through various studies it has been established that developing metropolitan cities such as Lucknow is experiencing multiple UHI effect on account of rapid urbanization, unplanned/ informal growth, and increase in population density in the central core of the city accompanied with reduction in vegetation and open area [30] [33]. Accordingly, future research should be conducted in developing cities which will definitely contribute in confronting the issue of UHI in India. Thus, it can be concluded that developing country like India should focus on conducting research for analyzing the gravity of UHI phenomenon as the available research done in the country is not at par with the research conducted worldwide. All these efforts are worthy, as this will contribute in enhancing sustainable development in urban areas of a country.

**FINDING AND INTERPRETATIONS**

As per the analysis of research papers, it becomes evident that fewer researches have been conducted worldwide to appraise satisfaction level among residents of high-rise building. Furthermore, relatively barely any studies have utilized structure or neighbourhood-scale information to assess occupant's fulfilment in context of Quality of Life. For the purpose of studying and analysing the components for good QoL, it is important to understand High rise housing as a four layered physical environment. The four physical levels are defined below: Apartment Unit comprising of individual house unit which includes family and personal spaces. Apartment Building holds multiple apartment units within a single structure which includes semi-public spaces and physical infrastructure for the occupants such as staircase, elevators etc. Apartment Complex is defined as the gated complex holding multiple apartment buildings and with defined boundaries. It includes social spaces, landscape areas, parking etc. Urban Areas in Vicinity includes the immediate neighbourhood of the Apartment complex and adds value to the apartment if located at a good location. The attributes of these four levels should be identified to understand and assess QoL within the high-rise buildings which will aid in creating conducive livable environment eliminating all negative energies associated with high-rise housing. So, after analysing viewpoints of the cited researches the QoL evaluation attributes listed in Table 2 for analysing high-rise buildings is identified on which further research can be conducted for evaluating QoL of high-rise housing based on survey in the form of questionnaires, observations,



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interviews etc. The results of these survey will help in assessing QoL of the building surveyed and will help architects and urban planners in modulating and creating liveable environment in high-rise buildings. Most of the UHI studies are site specific and the extrapolation of the results to other climatic zones and geographical areas might be challenging. Leal Filho et al. (2017) stated that there is a need to better understand the UHI phenomenon and also how it affects individual regions and that there is a need to consider mitigation and adaptation strategies which take the particularities of each city into account so as to make them more UHI resilient [34]. Therefore, it is necessary to conduct research in each of the climatic zones of the country and also a uniform methodology for collecting data should be established for analyzing UHI formation and its intensity so that urban development norms and building regulations incorporate UHI mitigation measures to minimize its impact. Further simulation research should be used to establish relative contribution between the varied factors responsible for increased land temperature. The spatial structure of UHI is obtained through satellite data which should be paralleled with the value of ground-based measurements and involvement of numeric modelling for obtaining better results. Keeping in mind the above-mentioned literature findings, the author(s) further tried to include more spatial attributes for determining Quality of Life as per individual user perception and grouped them at different physical levels as stated in the paper given in Table 3. Broadly, above tabulated domains and attributes are categorized on the basis of individual perception in contrary to the available research done on community perception. The community perception is considered to be the larger gamut which corresponds to urban/city scale while individual perception which is of equal importance for achieving QoL in high rise buildings corresponds to generating comfort at micro/site level. Consequently, for achieving QoL at community scale, it is very vital to establish it at individual scale for which further research should be conducted. Additionally, the domains, indicators and attributes sorted and listed in Table 3 are formulated after subsequent data analysing available information on architecture which defines and describes space, enclosure, form, etc. shown in Figure 3.

Thus, architecturally, it is already well defined and established that the attributes and domain used in the Table 3 directly impact the physical and psychological well-being of the users which is directly related to the QoL of the residents. Therefore, it becomes evident that without considering the architectural components which has direct impact on psychology and physical health, the QoL could not be achieved in any built space.

## CONCLUSION

As per the field observations and subsequent data analysis, first it is important to understand the concept of QoL in high rise buildings and also its evaluation in the best possible way which will aid in establishing complete well-being of the users. It is because of the few available scholarly resources related to this field (especially in case of India), there is large scope for further interpretation and analysis of spatial quality of life which once established will help architects and planners to improvise the overall environment of the upcoming constructs thus providing overall comfort and well-being. Therefore, through this article, the author(s) after analysing the QoL determinants proposed by the other researchers has projected certain sets of domains, its indicators and attributes which are directly related to QoL but needs effort to analyse their impact in achieving spatial quality in high-rise buildings especially for Indian cities. As already cited in the article, rapid urbanization resulted in the cities herding with high rise residential construct required for accommodating the inflating populace followed by the cases of mental depressions, suicidal attempts, illness etc. springing up due to lack of community and social cohesion spaces. Moreover, the improper design in the case of low as well as the high rise buildings leads to dissatisfied residents. This dissatisfaction may increase because often the resident may feel alone and secluded from the society because of the vertical orientation of the buildings. Consequently, study on analysing the impact of above formulated spatial quality determinants shown in Table 2 hopes to contribute to the discussions among architects and planners to bridge the gap in establishing QoL in urban areas. Studying QoL for residents in high density urban areas will make it an eminent field of social and architectural research.





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**Table 1 Field Observations**

| Reference                       | Title   | Findings – Parameters / Indicators / Determinants/ Attributes  |
|---------------------------------|---|--|
| (Boyer, R. & D. Savageau, 1989) | (Place Rated Almanac: Your Guide to Finding the Best Places to Live in America) | Indicators Used: <ul style="list-style-type: none"> <li>● <i>Cost of Living</i>: household income; taxes; college tuition; food, housing, health care and transport costs.</li> <li>● <i>Jobs</i>: job growth forecast.</li> <li>● <i>Crime</i>: violent and property crime rates; crime trends; drunk driving and handgun regulations; personal safety.</li> <li>● <i>Health Care / Environment</i>: family practitioners; medical specialist and surgeons; general hospitals; air quality; toxic dumps; acid rain; nuclear power plants.</li> <li>● <i>Transportation</i>: commuting times; mass transit; interstate highways; airline flights; train departures.</li> <li>● <i>Education</i>: college enrolments.</li> <li>● <i>Recreation</i>: restaurants; public golf course; bowling lanes; zoos; aquariums; theme parks; auto racing; professional sports; coastlines and inland waterways; forests, parks and wildlife areas.</li> <li>● <i>Climate</i>: hot / cold months; temperature variations; heating / cooling degree days; freezing days; 0- and 90-degree days.</li> </ul> |
| (Globe and Mail, 1990)          | (Montreal Tops List of Most Livable Cities)                                     | Indicators Used: Murder rates, Food costs, Living space, Access to clean water and to electricity, Access to a telephone, Education levels, Infant mortality, Air quality, Noise pollution, Traffic congestion.  |
| (Toronto Star, 1990)            | (Toronto Most Livable City, Survey Finds)                                       | Indicators Used: Household income, Murder rates, Number of homeless people, Commuting times, Housing prices, Suicide rates, Transit use, Transit costs, Projected job creation, Education levels, Transit crime, People per hospital bed, Average ticket costs for rock concerts, Average ticket costs for baseball games.   |
| (WHOQoL-BREF, 1997)             | (Measuring Quality of Life)   | Domains: <p><i>Physical Health</i> – Energy and Fatigue; Pain and Discomfort; Sleep and Rest</p> <p><i>Psychological</i> – Bodily image and Appearance; Negative feelings; Positive feelings; Self-esteem; Thinking; Learning; Memory and Concentration</p> <p><i>Level of Independence</i> – Mobility; Activities of daily living; Dependence on medical substances and medical aids; Work capacity</p> <p><i>Social Relationship</i> – Personal relationship; Social support; Sexual activity</p> <p><i>Environment</i> – Financial resources; Freedom; Physical safety and security; Health and social care; accessibility and quality; Home environment; Opportunities for acquiring new information and skills; Participation in and opportunities for recreation / leisure; Physical environment (pollution / noise / traffic / climate); Transport</p> <p><i>Spiritual / Religion / Personal Beliefs</i> – Religion / Spirituality / Personal beliefs</p>   |





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| (Haeseong Je, 2008)                        | (A study on Residential Quality Index of Super High-Rise Apartment Housing through Survey with Expert)   | <table border="1"> <thead> <tr> <th>Factors</th> <th>Indicators</th> <th>Design elements</th> </tr> </thead> <tbody> <tr> <td>Facility Infrastructure</td> <td>Equipments; Life convenience; Health; Amenity; Security; Safe</td> <td>Power and Water supply; Parking; Adequacy of elevator, landscape, openings for daylight, ventilation, fire escape; convenience store;</td> </tr> <tr> <td>Visual factor</td> <td>View; Form/Design; Exterior/Detail; Visual stability</td> <td>Building form; height; skyline; façade; interiors</td> </tr> <tr> <td>Space utilization</td> <td>Circulation; Space function; Space efficiency</td> <td>Adequacy of circulation; proximity between units; sizes; ceiling height; flexibility of spaces; efficiency of furniture layout</td> </tr> <tr> <td>Social environment</td> <td>Environmental load; Social relationship; Facility service</td> <td>Energy efficiency; CO2 emission</td> </tr> <tr> <td>Management service</td> <td>Maintenance; Serviceability; Economic value</td> <td>Maintenance of common areas; maintenance of common facilities; IT services; maintenance cost; economic value</td> </tr> </tbody> </table> | Factors   | Indicators  | Design elements | Facility Infrastructure | Equipments; Life convenience; Health; Amenity; Security; Safe | Power and Water supply; Parking; Adequacy of elevator, landscape, openings for daylight, ventilation, fire escape; convenience store; | Visual factor | View; Form/Design; Exterior/Detail; Visual stability | Building form; height; skyline; façade; interiors | Space utilization | Circulation; Space function; Space efficiency | Adequacy of circulation; proximity between units; sizes; ceiling height; flexibility of spaces; efficiency of furniture layout | Social environment | Environmental load; Social relationship; Facility service | Energy efficiency; CO2 emission | Management service | Maintenance; Serviceability; Economic value | Maintenance of common areas; maintenance of common facilities; IT services; maintenance cost; economic value |
|--|--|---|---|---|-----------------|-------------------------|---|---|---------------|--|---|-------------------|---|--|--------------------|---|---------------------------------|--------------------|---|--|
|  |  | Factors   | Indicators  | Design elements   |                 |                         |   |   |               |  |   |                   |   |  |                    |   |                                 |                    |   |  |
|  |  | Facility Infrastructure   | Equipments; Life convenience; Health; Amenity; Security; Safe | Power and Water supply; Parking; Adequacy of elevator, landscape, openings for daylight, ventilation, fire escape; convenience store; |                 |                         |   |   |               |  |   |                   |   |  |                    |   |                                 |                    |   |  |
|  |  | Visual factor   | View; Form/Design; Exterior/Detail; Visual stability          | Building form; height; skyline; façade; interiors   |                 |                         |   |   |               |  |   |                   |   |  |                    |   |                                 |                    |   |  |
|  |  | Space utilization   | Circulation; Space function; Space efficiency                 | Adequacy of circulation; proximity between units; sizes; ceiling height; flexibility of spaces; efficiency of furniture layout        |                 |                         |   |   |               |  |   |                   |   |  |                    |   |                                 |                    |   |  |
| Social environment                         | Environmental load; Social relationship; Facility service  | Energy efficiency; CO2 emission   |   |   |                 |                         |   |   |               |  |   |                   |   |  |                    |   |                                 |                    |   |  |
| Management service                         | Maintenance; Serviceability; Economic value  | Maintenance of common areas; maintenance of common facilities; IT services; maintenance cost; economic value  |   |   |                 |                         |   |   |               |  |   |                   |   |  |                    |   |                                 |                    |   |  |
| (Fernanda Acre and Annemie Wyckmans, 2014) | (Spatial quality determinants for residential building renovation: A methodological approach to the development of spatial quality assessment) | <p>Determinants of Spatial Quality:</p> <p><i>View</i> – Façade transparency; Distance and degree of sight protection; Dept of vision; Lighting; Enclosure</p> <p><i>Internal spatiality and arrangements</i> – Centricity and concavity; Internal division of space and spatial density; Spatial complexity; Privacy with dwelling; Lighting</p> <p><i>Transition between public and private spaces</i>: Private and public entrance; Boundaries between private, semi-public and public domain; Outdoor private spaces; Uniformity and coherence of boundaries; Internal division of space and spatial density and façade composition</p> <p><i>Perceived density, built and human densities</i> – Principle of complexity; Enclosure and peripheral density; Built density; Human density; Function</p>  |   |   |                 |                         |   |   |               |  |   |                   |   |  |                    |   |                                 |                    |   |  |





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**Table: 2 Analyzing High-Rise Buildings is Identified**

| Space attributes for Quality of Life of Residents in High-rise Buildings |                         |                             |   |   |
|--|-------------------------|-----------------------------|---|---|
| Perception:  | Domain / Index          | Indicator                   | Attributes  |   |
| Individual   | Space Enclosure         | Daylight and Ventilation    | Penetration, orientation  |   |
|  |                         | Scale and Proportion        | Ceiling height, interior dimensions;                                    |   |
|  |                         | Aesthetic Ambiance          | Views, Orientation, Colour scheme                                       |   |
|  |                         | Circulation and function    | Hierarchy of spaces, Transition of Public, Semi-public and Private zone |   |
|  | Form Exterior           | Exterior Facade             |   | Building Form and Skyline                             |
|  |                         |                             |   | Scale and Proportion                                  |
|  | Value and Landmark      | Environment and Surrounding |   | Aesthetic and Ambiance                                |
|  |                         |                             |   |   |
|  | Amenity and Maintenance | Adequacy and Efficiency     |   | Services – Staircase, Lifts, Water supply, Electrical |
|  |                         |                             |   | Accessibility and Integration                         |
|  |                         |                             | Density and Resources   |   |
|  |                         |                             | Safety and Security   |   |

**Table 3. Different Physical Levels as Stated in the Paper**

| FOUR LEVELS             | QOL ATTRIBUTES FOR ANALYZING HIGH-RISE BUILDING   |
|-------------------------|---|
| Apartment Unit          | Size of Unit, Layout, Storage, Structure quality, Infrastructure, Natural lighting and ventilation, Passive Heating and Cooling, Indoor Air Quality, Noise prevention, Private open Space, View and Vista from the apartment unit, Security, physical and psychological comfort, Price          |
| Apartment Building      | Form, Height, Facade, Vertical Transportation-no. of lifts and staircase, quality of lifts, Community Space, Essential services such as Lighting of common spaces, Ventilation of common Space, Universal Design, Upkeep of Common Facilities, Waste management, Fire safety, Earthquake safety |
| Apartment complex       | Landscape and Green Area, play areas, Community spaces, Pedestrian paths, Roads for vehicular movement, Parking for residents and outsiders, Internal Public Service Facilities, Universal Design, Building Density and Spacing, Outdoor Environment  |
| Urban Areas in Vicinity | Surrounding Environment, Public Spaces, Service Facilities, Noise, Traffic, Public Transportation,  |





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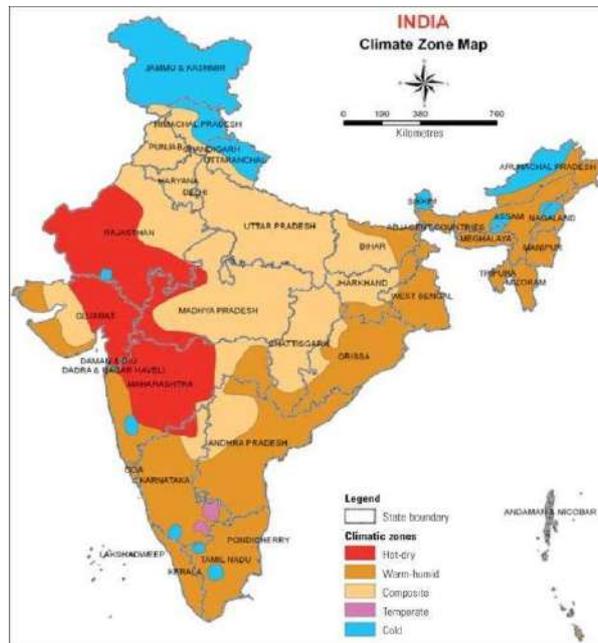


Fig. 1. Map showing climatic zones in India. Source: Nation Building Code of India (2005)



Fig. 2: Urban Development Scenario in India

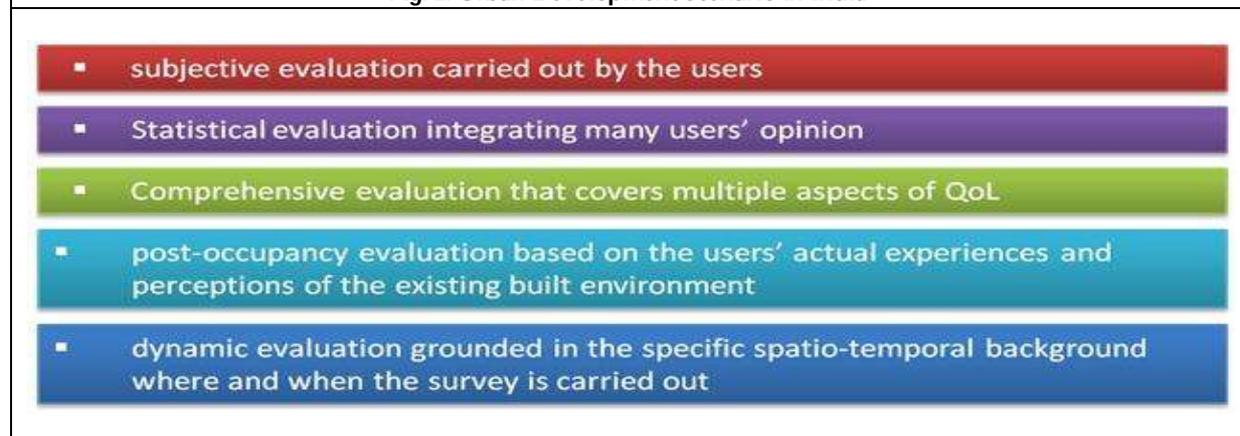


Fig. 3. Experience Assessment Focused On A Particular Context With The Characteristics





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### Architectural Systems

|                      |                    |   |
|----------------------|--------------------|---|
| The Architecture of  | <b>Space</b>       | <ul style="list-style-type: none"><li>• organizational pattern, relationships, clarity, hierarchy</li></ul>   |
|                      | <b>Structure</b>   | <ul style="list-style-type: none"><li>• formal image and spatial definition</li></ul>   |
|                      | <b>Enclosure</b>   | <ul style="list-style-type: none"><li>• qualities of shape, color, texture, scale, proportion</li><li>• qualities of surfaces, edges, and openings</li></ul>  |
| Experienced through  | <b>Movement in</b> | <ul style="list-style-type: none"><li>• approach and entry</li></ul>  |
|                      | <b>Space-Time</b>  | <ul style="list-style-type: none"><li>• path configuration and access</li><li>• sequence of spaces</li><li>• light, view, touch, hearing, and smell</li></ul>   |
| Achieved by means of | <b>Technolog</b>   | <ul style="list-style-type: none"><li>• structure and enclosure</li><li>• environmental protection and comfort</li><li>• health, safety, and welfare</li><li>• durability and sustainability</li></ul>  |
| Accommodating a      | <b>Program</b>     | <ul style="list-style-type: none"><li>• user requirements, needs, aspirations</li><li>• sociocultural factors</li><li>• economic factors</li><li>• legal constraints</li><li>• historical tradition and precedents</li></ul>                          |
| Compatible with its  | <b>Context</b>     | <ul style="list-style-type: none"><li>• site and environment</li><li>• climate: sun, wind, temperature, precipitation</li><li>• geography: soils, topography, vegetation, water</li><li>• sensory and cultural characteristics of the place</li></ul> |

**Fig. 4. Architectural system**





## Design, Synthesis, Characterization and Anti-Microbial Activity of Schiff and Mannich Bases of Novel Isatin Derivatives

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### ABSTRACT

The present work is designed to synthesize the novel Schiff and Mannich bases of isatin derivatives by using different compounds like 4-chloro aniline, 4-nitro aniline, para amino benzoic acid and 4-toluidine. The Isatin derivative of Schiff bases were prepared by taking Isatin and solution of amino compounds (4-chloro aniline, 4- nitro aniline, para amino benzoic acid, 4-toluidine) in ethanol and of glacial acetic acid. The obtained Isatin derivatives of Schiff bases were allowed to react with ethanol, glacial acetic acid, formalin and secondary amines (diethyl amine and dimethyl amine). Chemical structures of these synthesized compounds were confirmed using IR spectroscopy elemental analysis. The antibacterial activity was evaluated by measuring minimum inhibitory concentration (MIC) values. The novel Schiff and Mannich bases of Isatin derivatives showed significance difference from standard drug in zone of inhibition especially it was found more in the chlorine substituted compounds and next by PABA

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substituted compounds. It is observed that the antimicrobial activities are compared with the standard drug streptomycin and found that the synthesized Schiff and Mannich bases of Isatin derivatives showed more antimicrobial activity than the standard.

**Keywords:** Isatin derivatives, Schiff and Mannich bases, Antimicrobial, Streptomycin.

## INTRODUCTION

Isatin has been known for about 150 years and has been recently found, like oxindole and endogenous poly functional heterocyclic compounds, to exhibit biological activity in mammals.[1] It is also a synthetically versatile substrate that can be used to prepare a large variety of heterocyclic compounds, such as indoles and quinolines, and as a raw material for drug synthesis. Isatin derivatives show such diverse activity, including fibrinolytic, muscle relaxant, antiallergic, immunosuppressant antimicrobial, antibiotic, anti-inflammatory, analgesic, anticonvulsant, antimalarial, anticancer[2]. The isatin derivatives can give its pharmacological action after reacting with Schiff and Mannich bases. The Schiff bases of Isatin derivative were prepared from the condensation reaction between amino compounds (aniline & amino acids) and Isatin. Schiff bases are aldehyde- or ketone-like compounds in which the carbonyl group is replaced by an imine or azomethine group [3]. Mannich base were synthesized from Schiff base by reacting with secondary amine the structures of these compounds were established by means of IR, <sup>1</sup>H-NMR analysis. A mannich base is a beta-amino-ketone, which is formed in the reaction of an amine, formaldehyde (or an aldehyde) and a carbon acid. The Mannich base is an endproduct in the Mannich reaction [4]. In this present study, the starting material isatin is allowed to react with aromatic amines which contain different functional groups in the para position such as chloro, nitro, acid and methyl. The end product of this reaction is Schiff base of isatin. The Schiff bases of isatin were allowed to react with dimethyl amine and diethyl amine for getting the Mannich bases of isatin derivatives. In this study 8 different Schiff and Mannich bases of Isatin derivatives were obtained and their structures were identified by using IR (or) FTIR, which helps to know the functional group present in the synthesized compounds [5]. The synthesized compounds were evaluated to know the antimicrobial activity against both gram-ve (*Escherichia coli*, *Pseudomonas aeruginosa* and *Serratia marcescens*) and gram+ve (*Bacillus subtilis*, *Staphylococcus aureus* and *Bacillus cereus*) organisms [6-8]. The zone of inhibition was observed around the paper discs placed on the nutrient agar in petridish and compared with the standard drug like streptomycin [9,10]. The present study is performed to enhance the antimicrobial activity and minimize the dose and side effects that were caused due to the over dose of marketed standard drugs.

## MATERIALS AND METHODS

### General

All chemicals and solvent used were of analytical grade. Silica gel (Research lab fine chem. Industry), methanol (Jiangse Hauxi International Trade co Ltd.), chloroform (Rankem Ltd.), Isatin (Lobal chemi Ltd.), 4-chloro aniline (Lobal chemi Ltd.), 4-nitro aniline(Sd-fine-chem. Ltd.), para amino benzoic acid (Qualikem Ltd.), p-toluidine (Research-lab-fine chem. Industry), ethanol (Jiangse Hauxi International Trade co Ltd.), glacial acetic acid(Lobal chemi Ltd.), dimethyl amine (Sd-fine-chem Ltd.), diethyl amine (Merck lab), dimethyl formamide (Research- lab-fine chem. Industry), formalin (Finar chemicals Ltd.). The IR spectra were recorded using KBR disc in (FTIR) spectrophotometer/Shimadzu, Japan, Laminar air flow chamber (Kem), Autoclave (Kadavil electro mechanical industry), Incubator (Bio techniques India), Magnetic stirrer (Remi ZMCH), Hot Air Oven (Kemi) and Microscope. All these tested strains are reference strains and were collected from NCIM (National Collection of Industrial Microorganisms).



**Nandhini et al.,****General method for synthesis of Schiff and Mannich bases of Isatin derivatives****Step: 1 - Synthesis of Schiff bases of Isatin derivatives**

The Isatin derivative of Schiff bases were prepared by taking 0.003 moles of Isatin. Then 0.003 moles solution of amino compounds were added [4- chloro aniline (**a**), 4- nitro aniline (**b**), para amino benzoic acid (**c**), 4-toluidine (**d**)] in 20ml ethanol and 10ml of glacial acetic acid. The solution mixture was refluxed for three hours, and then stirred on a magnetic stirrer for about half an hour. The obtained precipitated Isatin derivatives of Schiff bases were allowed to refrigerate overnight. The precipitate was removed and evaporated on a hot plate until the residue remains which is the end product of step: 1. The product was washed with water to remove acidic nature.

**Step: 2 - Synthesis of Mannich bases of Isatin derivatives**

The previously synthesized Isatin derivative of Schiff bases (0.0025 moles) is taken. To this 10ml ethanol, 20ml of glacial acetic acid, 2ml of formalin and 0.0025 mole of secondary amines (diethyl amine and dimethyl amine) were added. The solution mixture was refluxed for eight hours, and then stirred on a magnetic stirrer for about half an hour. The obtained coloured solution of Mannich bases of Isatin derivative were allowed to refrigerate overnight. The solution was removed and evaporated on a hot plate until a concentrated product was obtained. This concentrated was then left to be dried under room temperature to get a crystallized residue. It is then washed with water to remove acidic nature.

**Thin Layer Chromatography**

TLC plates were prepared, the  $R_f$  values was used to determine the end point of each step involved in the synthesis of Mannich bases of isatin derivatives. Two consecutive constant  $R_f$  values represent that the reaction is complete[11].

$$R_f = \frac{\text{Distancetravelledbysample}}{\text{Distancetravelledbysolventfront}}$$

**Solvent system:** Mixture of two solvents is used here for determining  $R_f$  value. Chloroform and water are used in the ratio of 9:1.

**Anti-microbial activity****Preparation of nutrient agar medium [12]**

All the additives are weighed and added in the conical flask and it is heated on a water bath with stirring till agar completely dissolved. Adjust to pH 8.0-8.4 with 5M NaOH and Boil for 10min. If necessary, filter it and adjust to pH 7.2-7.4. Sterilization by autoclave, using 15lb pressure at 115°C for 30min.

**Preparation of agar plate**

Aseptically the sterile nutrient agar was transferred in to the Petri plates on the table top of laminar air flow bench. The neck of culture flask was flamed and half of the lid of sterile Petri-dish was lifted and nutrient agar was added into it, so that it is equally distributed throughout the plate. The closure was replaced and the plate was allowed to solidify[13].

**Screening for Anti-microbial activity**

This method is based on the diffusion of an antibiotic from a vertical cylinder or filter disc through the solidified agar layer of a Petri-dish. Growth of inoculated microorganism is inhibited in a circular area "zone", around the filter disc containing a solution of antibiotics. Microbial inoculum was prepared with the required quantity of test organisms. The prepared microbial suspension was mixed and added into the media. They were transfer into the Petri-dish. A known concentration of the standard solution was prepared with the respect to the concentrations of the antibiotics to be examined. The solutions are applied to the filter discs and placed them on the prepared agar plate. The plates were left for 1-4hrs at room temperature and incubated in inverted position at 20-30°C for 18hrs. The zone around the filter disc was observed by antibiotic zone reader or visually. Synthesized compounds were dissolved in DMF in the





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ratio of 1:1 and used as the sample solution. Streptomycin injection was used as a standard drug to compare the antimicrobial activity [14].

## RESULTS

Synthesis of Schiff and Mannich bases of Isatin derivatives, Scheme 1: Synthesis of Schiff bases of Isatin derivatives Scheme 2: Synthesis of Mannich bases of Isatin derivatives, Scheme 3: Synthesis of Mannich bases of Isatin derivatives, Characterization of Schiff and Mannich bases of isatin derivatives using IR Spectroscopy, Fig. 1: Compound 5<sub>a1</sub>, Fig. Compound 5<sub>b1</sub>, IR Interpretation 4-Cl + DMA , 4--NITRO + DMA.

### Antimicrobial activity

The antimicrobial activity for eight synthesized compounds was evaluated and the results were tabulated 3 & 4.

## DISCUSSION

The screening of literature of Schiff and Mannich bases of Isatin derivatives synthesis by using Schiff bases like aromatic amines (4-chloro aniline 4-nitro aniline para amino benzoic acid 4-toluidine) and Mannich bases like (dimethyl amine and di ethyl amine), revealed that no antimicrobial work has been done so far. The functional groups that were present in the synthesised compounds were identified by using FTIR spectroscopy. The Antimicrobial activity was performed by using synthesized Schiff and Mannich bases of isatin derivatives (5<sub>a1</sub>, 5<sub>b1</sub>, 5<sub>c1</sub>, 5<sub>d1</sub>, 5<sub>a2</sub>, 5<sub>b2</sub>, 5<sub>c2</sub>, 5<sub>d2</sub>) and Streptomycin (as standard) on both gram-ve (*Escherichia coli*, *Pseudomonas aeruginosa* and *Serratia marcescens*) and gram+ve (*Bacillus subtilis*, *Staphylococcus aureus* and *Bacillus cereus*) organisms. The zone of inhibition was observed around the paper discs placed on the nutrient agar in petridish. This zone was measured by Antibiotic zone reader. These can be easily interpreted using histograms. Two histograms were plotted that represent, the effect of synthesized compounds (5<sub>a1</sub>, 5<sub>b1</sub>, 5<sub>c1</sub>, 5<sub>d1</sub>, 5<sub>a2</sub>, 5<sub>b2</sub>, 5<sub>c2</sub>, 5<sub>d2</sub>) on different microorganisms. Effect on *Escherichia coli*: Among all the synthesized compounds 5<sub>a1</sub>, 5<sub>a2</sub> shows more antimicrobial activity when compared with the standard streptomycin, as the zone of inhibition of 5<sub>a1</sub>, 5<sub>a2</sub> was more than all the synthesized compounds and also the standard. Effect on *Pseudomonas aeruginosa*: Among all the synthesized compounds 5<sub>a1</sub>, 5<sub>a2</sub> shows more antimicrobial activity when compared with the standard streptomycin, as the zone of inhibition of 5<sub>a1</sub>, 5<sub>a2</sub> was more than all the synthesized compounds and also the standard. Effect on *Serratia marcescens*: Among all the synthesized compounds 5<sub>a1</sub>, 5<sub>a2</sub> shows more antimicrobial activity when compared with the standard streptomycin, as the zone of inhibition of 5<sub>a1</sub>, 5<sub>a2</sub> was more than all the synthesized compounds and also the standard. Effect on *Bacillus subtilis*: Among all the synthesized compounds 5<sub>a1</sub>, 5<sub>a2</sub> shows more antimicrobial activity when compared with the standard streptomycin, as the zone of inhibition of 5<sub>a1</sub>, 5<sub>a2</sub> was more than all the synthesized compounds and also the standard. Effect on *Staphylococcus aureus*: Among all the synthesized compounds 5<sub>a1</sub>, 5<sub>a2</sub> shows more antimicrobial activity when compared with the standard streptomycin, as the zone of inhibition of 5<sub>a1</sub>, 5<sub>a2</sub> was more than all the synthesized compounds and also the standard. Effect on *Bacillus cereus*: Among all the synthesized compounds 5<sub>a1</sub>, 5<sub>a2</sub> shows more antimicrobial activity when compared with the standard streptomycin, as the zone of inhibition of 5<sub>a1</sub>, 5<sub>a2</sub> was more than all the synthesized compounds and also the standard. The functional groups were analysed by IR spectroscopy elemental analysis.

## CONCLUSION

The antimicrobial activity test answered positively for gram-ve (*Escherichia coli*, *Pseudomonas aeruginosa*, *Serratia marcescens*) and gram+ve (*Bacillus subtilis*, *Staphylococcus aureus*, *Bacillus cereus*) microorganisms. The novel Schiff and Mannich bases of Isatin derivatives showed significance difference from standard drug in zone of inhibition especially it was found more in the chlorine substituted compounds and next by PABA substituted compounds. It





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was observed that the antimicrobial activities are compared with the standard drug streptomycin and found that the synthesized compounds had showed more significant activity than the standard.

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**Table 1: Formula for nutrient agar medium**

| Ingredients     | Quantity taken |
|-----------------|----------------|
| Beef extract    | 0.75gms        |
| Peptone         | 1.25gms        |
| Nacl            | 1.25gms        |
| Agar            | 3.75gms        |
| Distilled water | up to 250ml    |





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Table 2. IR Interpretation

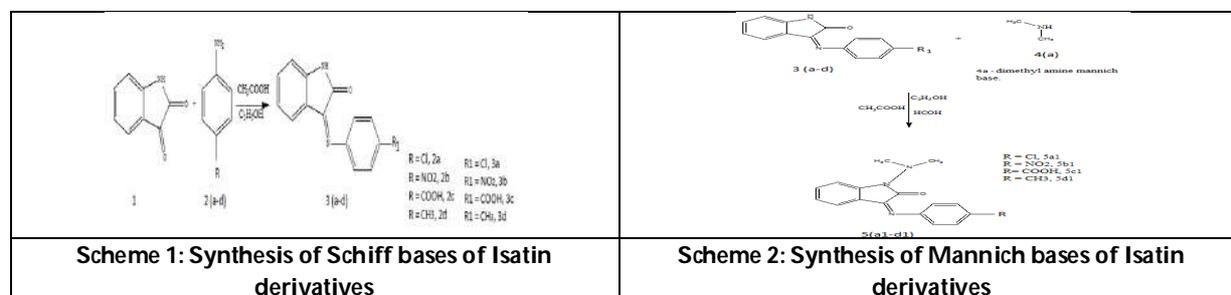
| 4-Cl + DMA           |         | 4-NITRO + DMA        |         |
|----------------------|---------|----------------------|---------|
| C-H(Stretching)      | 3064.19 | C-H(Stretching)      | 3058.42 |
| CH <sub>2</sub> Bend | 1468.76 | CH <sub>2</sub> Bend | 1469.06 |
| Cl                   | 752.45  | NO <sub>2</sub>      | 1492.13 |
| C-N                  | 1098.89 | C-N                  | 1095.63 |
| CH <sub>3</sub>      | 2873.5  | C=O                  | 1715.74 |

Table 3 : Zone of inhibition of gram-ve bacteria

| Compound     | <i>E.coli</i> (mm) | <i>Pseudomonas aeruginosa</i> (mm) | <i>Serratia marcescens</i> (mm) |
|--------------|--------------------|------------------------------------|---------------------------------|
| 5a1          | 8                  | 7                                  | 9                               |
| 5b1          | 6                  | 5                                  | 7                               |
| 5c1          | 6                  | 7                                  | 9                               |
| 5d1          | 5                  | 5                                  | 8                               |
| 5a2          | 9                  | 9                                  | 7                               |
| 5b2          | 5                  | 6                                  | 6                               |
| 5c2          | 7                  | 7                                  | 7                               |
| 5d2          | 5                  | 5                                  | 4                               |
| Streptomycin | 4                  | 6                                  | 10                              |

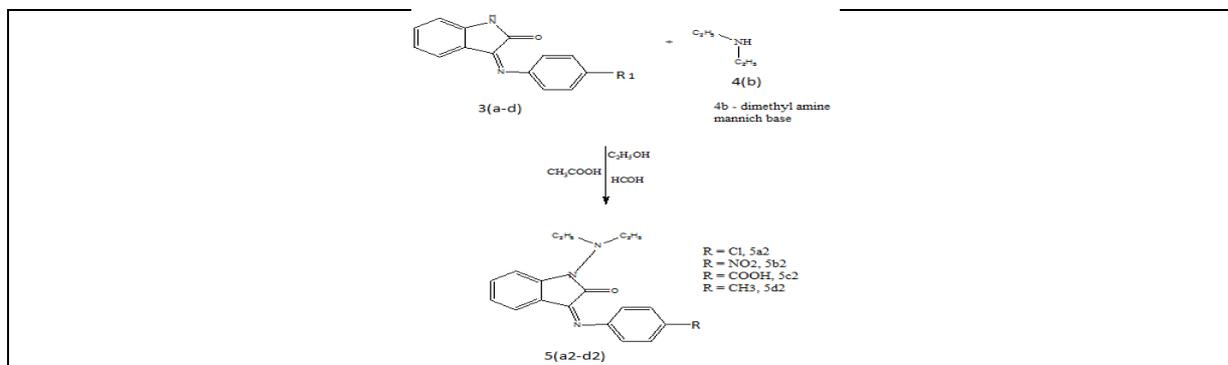
Table 4. Zone of inhibition of gram +ve bacteria

| Compound     | <i>Bacillus subtilis</i> (mm) | <i>Staphylococcus aureus</i> (mm) | <i>Bacillus cereus</i> (mm) |
|--------------|-------------------------------|-----------------------------------|-----------------------------|
| 5a1          | 9                             | 10                                | 8                           |
| 5b1          | 8                             | 7                                 | 5                           |
| 5c1          | 8                             | 7                                 | 6                           |
| 5d1          | 7                             | 6                                 | 4                           |
| 5a2          | 10                            | 8                                 | 8                           |
| 5b2          | 4                             | 6                                 | 7                           |
| 5c2          | 8                             | 7                                 | 7                           |
| 5d2          | 4                             | 4                                 | 6                           |
| Streptomycin | 9                             | 8                                 | 9                           |





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Scheme 3: Synthesis of Mannich bases of Isatin derivatives

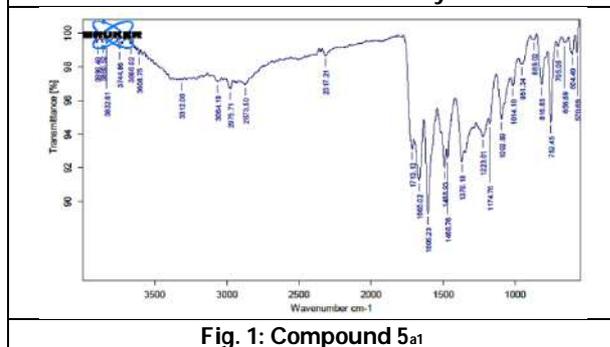


Fig. 1: Compound 5a<sub>1</sub>

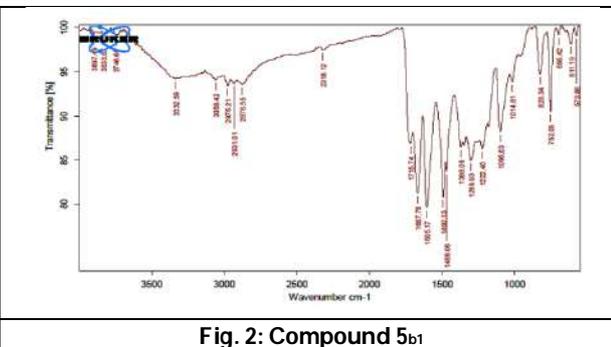


Fig. 2: Compound 5b<sub>1</sub>





## Effectiveness of Health Education on Reproductive Health Rights among Young People

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### ABSTRACT

Adolescence Reproductive health (ASRH) is influenced by multiple factors and comprised a major component of the global burden of reproductive & sexual ill health. Globally adolescents are facing many sexual and reproductive health challenges such as early pregnancy, unwanted pregnancy and parenthood, difficulties in accessing contraception and safe abortion services, high rates of HIV/AIDS and sexually transmitted infections, gender-based discrimination or abuse, etc. Young people including both boys and girls continue to face obstacles in achieving their fullest sexual and reproductive health. They are deprived of reproductive health rights in many aspects including access to gain information, open discussion, respect, decision making, required health care services, etc. The present study aimed to evaluate the effectiveness of health education on reproductive health rights among young people residing at selected rural area, Karaikal. Quantitative research approach was adopted for the present study. One group pre-test-post-test design was carried out at selected rural area, Karaikal. By using purposive sampling technique, 100 young people of 15-24 years were selected as study participants. After explaining the purpose of the study, informed consent was obtained from each study participants. Researcher Made -structured questionnaire cum interview schedule was used to collect the data from study participants. After pre-test, the health education on reproductive health rights was imparted to the young people. After one month, the post-test was performed by using the same tool. The data were analyzed by using both descriptive and inferential statistics. The results of the present study revealed that the highest 64% of young people had inadequate knowledge in pre-test whereas none had inadequate knowledge in post-test. The findings of the present study represented that the health

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education was effective (t value 22.295 with p value 0.0001 at 5% significant level) in increasing knowledge of young people on reproductive health rights from pre-test to post test. The findings of the present study also revealed that there was significant association between level of knowledge with selected demographic variables such as age, sex and monthly family income of the young people. The result of the present study revealed that the majority of the young people had inadequate knowledge on reproductive health rights in Pre-test. Health Education is the simple and effective means to enhance the knowledge of the young people. A well-informed young people can utilize the health care services better and have successful, illness free reproductive health in their life.

**Keywords:** Assess, Knowledge, Reproductive Health Rights, Young People.

## INTRODUCTION

The age group between 15-24 years are termed as youth or young people and further categorized into three stages: early adolescence under 14 years, middle adolescence 15-17 years and late adolescence and early adulthood between 18-24 years. Adolescence is a phase of human growth and development that transforms a child into a mature adult. It is a transitional stage that includes multidimensional changes including physical, physiological, psychological, emotional, social changes with development of behavior pattern. Adolescence period has an important concern in the area of reproductive health. Adolescence Reproductive health (ASRH) is influenced by multiple factors and comprised a major component of the global burden of reproductive & sexual ill health. Globally adolescents are involuntarily facing many sexual and reproductive health challenges such as early pregnancy, unwanted pregnancy and parenthood, difficulties in accessing contraception and safe abortion services, high rates of HIV/AIDS and sexually transmitted infections, gender-based discrimination or abuse, etc. Young people including both boys and girls continue to face obstacles in achieving their fullest sexual and reproductive health. They are deprived of reproductive health rights in many aspects including access to gain information, respect, decision making, required health care services, etc. In Indian social context, talking and open discussions regarding reproductive health issues are discouraged due to traditional habits, customs and taboos. This predisposes the young people to be remain a largely neglected, ignored group and unknowingly susceptible to enter reproductive duties. Adolescents are unaware of their unmet needs of reproductive health. Creating awareness alone can generate changes in their behavior and bring positive practices to protect themselves from reproductive illness.

## AIM

The present study aimed to evaluate the effectiveness of health education on reproductive health rights among young people residing at selected rural area, Karaikal

## METHODOLOGY

Quantitative research approach was adopted for the present study. One group pre-test-post-test design was carried out at selected rural area – Keezhakasakudi, Karaikal. A total of 100 young people between 15-24 years and both the sexes were included as study participants by Non Probability - purposive sampling technique. A predesigned and pretested Researcher Made -structured questionnaire cum interview schedule was used for data collection. It consisted of two sections. Section A consisted of demographic variables of young people such as sex, age, educational status, monthly family income, religion, accessibility to health care services and source of obtaining health information. Section B of the tool consisted of 25 items related to knowledge on reproductive health rights which included 5 items on rights to access information, 8 items on rights of reproductive health, 4 items on



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contraceptive rights and 9 items on rights of health care services. Young people of 25-30 members were gathered nearby common place for data collection. Initially the purpose of the study was explained to the young people and informed consent was obtained from each study participants. Pre-test was conducted by using the Researcher Made - structured questionnaire cum interview schedule. Systematically planned and pretested health education on reproductive health rights was imparted to the young people with help of health education module and pamphlets. The duration of teaching was 40-50 minutes. The post-test was carried out one month after health education by using the same tool from the participants. The collected data were analyzed by using both descriptive and inferential statistics such as frequency, percentage, mean, mean percentage, standard deviation and chi square test, etc.

**RESULTS**

The data analysis on demographic characteristics of young people portrayed that the maximum 77% of study participants were females and the rest 23% were males. The greatest 47% of the participants were between the age group of 19-21 years and the nearly half of the study participants 48% had educated up to diploma/degree. The greater 46% of study participants had belonged to monthly family income of Rs.5,001-Rs.10,000/- group and the least 7% had monthly income of above Rs. 15,000/-. Among participants, the highest 76% of young people were Hindus, 17% were Christians and only 7% were Muslims. The results of the present study revealed that more than half 79% had accessibility to health care services within 2kms. Friends and relatives (39%) were the reported major source of information by the young people. The findings of the present study represented that the overall mean knowledge was increased from  $10.2 \pm 3.93$  in pre-test to  $20.8 \pm 2.36$  in post-test. This showed that the health education Was significantly effective in increasing knowledge of young people on reproductive health rights from pre-test to post test. The results of the present study revealed that the health education was effective in increasing the knowledge of young people regarding reproductive health rights (t value 22.295 with p value 0.0001 at 5% significant level).The findings of the present study also revealed that there was significant association between level of knowledge with selected demographic variables such as age ( $X^2 = 27.603$ ), sex ( $X^2 = 9.343$ ) and monthly family income ( $X^2 = 14.920$ ) of the young people.

**DISCUSSION**

The results of the present study revealed that in pre-test the highest 64% of young people had inadequate knowledge whereas in post-test the greater 81% of young people had adequate knowledge on reproductive health rights. This was similar to the study findings of Tads' et al [13] (2020) which reported that more than half, 56.1% of participants were found to have poor knowledge on reproductive health. Further the results of the present study were similar to the findings of the study conducted by Parul Chaudhari, Sijo Koshy. Ravindra HN [10] (2015) which revealed that 80.0% had average level of knowledge in Pre-Test and in post-test 81.0% participants had good and 18.3 % had average knowledge on reproductive health. Incomplete knowledge regarding reproductive health related subject can lead to not only health problems but also psychosocial problems among young people [11]. Health awareness plays a pivotal role in motivating young people to have a favorable attitude towards reproductive health [12].The findings of the present study represented that the overall mean knowledge was increased from  $10.2 \pm 3.93$  in pre-test to  $20.8 \pm 2.36$  in post-test which showed that the health education was effective in increasing knowledge among young people on reproductive health rights. This was supported by the study conducted by Bajracharya S, Bam P, Bajracharya P.[9] (2020) which reported that the structured teaching programme was statistically effective in improving mean knowledge score on menstrual hygiene from  $19.84 \pm 3.29$  in pre-test to  $24.80 \pm 2.37$  in post-test. The above study findings proved that the health education intended for young people can be a good source of information for young people especially adolescent girls in Indian society to improve their knowledge on reproductive health rights. The findings of the present study also revealed that there was significant association between level of knowledge with selected demographic variables such as age ( $X^2 = 27.603$ ), sex ( $X^2 = 9.343$ ) and monthly family income ( $X^2 = 14.920$ ) of the young people. This was similar to the findings of the study conducted by Muhammed S. A. Masood et al<sup>6</sup>(2017) which showed high significant differences between the mean scores for all five





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indices such as sex, age groups, levels of education, marital status and area sites of participants in Sana City, Yemen ( $P < 0.001$ ).

## CONCLUSION

The result of the present study revealed that the majority of the young people had inadequate knowledge on reproductive health rights in pre-test. Inadequate knowledge predisposes the young people to faulty health practices and reduction in health seeking behavior. Health education with culturally acceptable method of teaching on reproductive health rights is the effective way to increase knowledge of the young people and make them to be fully aware of their reproductive health rights. It is recommended to incorporate the content of reproductive health rights in school curriculum for appropriate behavior development and healthy practices among young people.

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## Conflict of interest

No conflict of interest

## Funding

Self

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**Table: 1 Effectiveness of Health Education on Reproductive Health Rights among Young People**

| Aspects of Reproductive Health Rights | Maximum score | PRETEST      |             |            | POSTTEST    |             |            |
|---------------------------------------|---------------|--------------|-------------|------------|-------------|-------------|------------|
|                                       |               | Mean         | S.D         | Mean %     | Mean        | S.D         | Mean %     |
| Access to Information                 | 5             | 1.87         | 0.44        | 18.66      | 4.2         | 0.46        | 20.19      |
| Reproductive Health                   | 7             | 2.3          | 0.74        | 22.95      | 5.6         | 0.65        | 26.92      |
| Contraception                         | 5             | 2.2          | 0.93        | 21.97      | 3.8         | 0.42        | 18.27      |
| Health care services                  | 9             | 3.65         | 1.82        | 36.43      | 7.2         | 0.83        | 34.62      |
| <b>Total</b>                          | <b>25</b>     | <b>10.02</b> | <b>3.93</b> | <b>100</b> | <b>20.8</b> | <b>2.36</b> | <b>100</b> |

**Table: 2 Association between level of knowledge on reproductive health rights with selected demographic variables of young people**

| S. NO.             | DEMOGRAPHIC VARIABLES                           | IA | MA | AK | FREQUENCY | df | X <sup>2</sup> Value |
|--------------------|---|----|----|----|-----------|----|----------------------|
| 1.                 | <b>Sex</b>                                      |    |    |    |           |    |                      |
|                    | a. Male   | 11 | 9  | 3  | 23        | 1  | 9.343*               |
|                    | b. Female                                       | 53 | 18 | 6  | 77        |    |                      |
| 2.                 | <b>Age</b>                                      |    |    |    |           |    |                      |
|                    | a. 15-18 years                                  | 26 | 6  | 2  | 34        | 2  | 27.603*              |
|                    | b. 19-21 years                                  | 34 | 10 | 3  | 47        |    |                      |
| c. 22-24 years     | 4   | 11 | 4  | 19 |           |    |                      |
| 3.                 | <b>Educational status</b>                       |    |    |    |           |    |                      |
|                    | a. Upto 5 <sup>th</sup> standard                | 6  | 2  | 1  | 9         | 3  | 4.0397               |
|                    | b. 6 <sup>th</sup> -10 <sup>th</sup> standard   | 8  | 5  | 3  | 16        |    |                      |
|                    | c. 11 <sup>th</sup> & 12 <sup>th</sup> standard | 16 | 9  | 2  | 27        |    |                      |
| d. Diploma /degree | 34  | 11 | 3  | 48 |           |    |                      |
| 4.                 | <b>Monthly family income</b>                    |    |    |    |           |    |                      |
|                    | a. <Rs. 5,000/-                                 | 28 | 3  | 2  | 33        | 3  | 14.920*              |

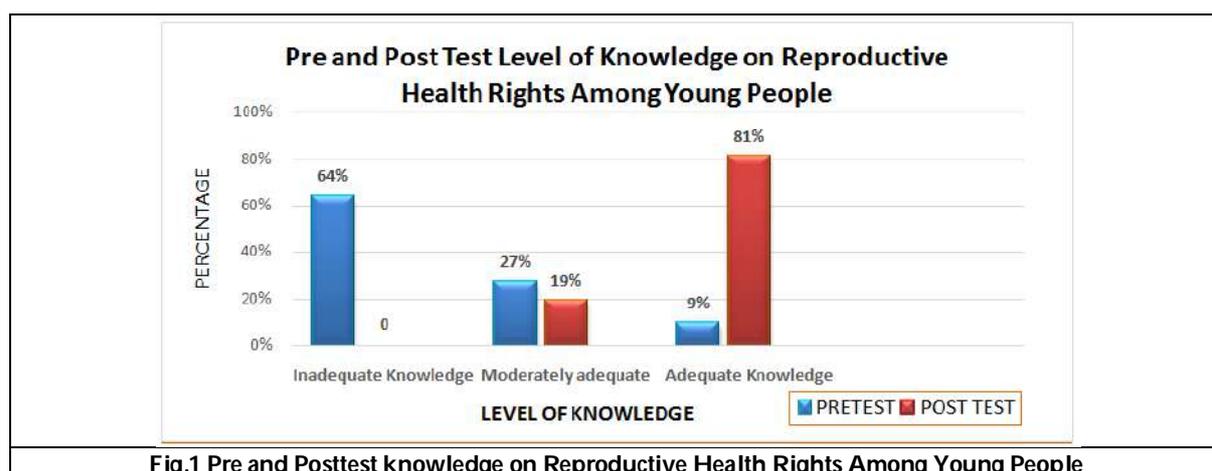




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|           |  |    |    |   |    |   |       |
|-----------|--|----|----|---|----|---|-------|
|           | b. Rs. 5001 -Rs.10,000/-                     | 28 | 14 | 4 | 46 |   |       |
|           | c. Rs. 10001 – Rs.15,000/                    | 4  | 8  | 2 | 14 |   |       |
|           | d. >Rs. 15,000/-                             | 4  | 2  | 1 | 7  |   |       |
| <b>5.</b> | <b>Religion</b>                              |    |    |   |    |   |       |
|           | a. Hindu                                     | 50 | 19 | 7 | 76 | 2 | 0.65  |
|           | b. Christian                                 | 10 | 5  | 2 | 17 |   |       |
|           | c. Muslim                                    | 4  | 3  | 0 | 7  |   |       |
| <b>6.</b> | <b>Accessibility to health care services</b> |    |    |   |    |   |       |
|           | a. Within 2Km                                | 54 | 18 | 7 | 79 | 1 | 3.59  |
|           | b. Above 2 km                                | 10 | 9  | 2 | 21 |   |       |
| <b>7.</b> | <b>Sources of information</b>                |    |    |   |    |   |       |
|           | a. Mother                                    | 17 | 9  | 4 | 30 | 3 | 5.160 |
|           | b. Friends & Relatives                       | 29 | 7  | 3 | 39 |   |       |
|           | c. Mass Media                                | 14 | 7  | 2 | 23 |   |       |
|           | d. Health care professionals                 | 4  | 4  | 0 | 8  |   |       |

\*Significant at < 0.05 level



**Fig.1 Pre and Posttest knowledge on Reproductive Health Rights Among Young People**





## Earthquake Natural Hazard over Major Dams of Chhattisgarh State

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### ABSTRACT

On 1<sup>st</sup> November 2000 another territory of India named as Chhattisgarh (21° 15' 0" N, 81° 36' 0" E) comes in power as a new state. Chhattisgarh is encircled by southern Jharkhand and Odisha in the east, Madhya Pradesh and Maharashtra in the west, Uttar Pradesh and western Jharkhand in the north and Andhra Pradesh in the south. Recently born state is rich in minerals, forest and watercourse. The Mahanadi River is the life saver of the state. In Civil Engineering, dam is an essential structure. The malfunction of dam causes a significant devastation around the dam site. The seismic movement in peninsular India has expanded gradually. It is therefore essential to examine major dam sites of Chhattisgarh seismically. The Deterministic Seismic Hazard Analysis (DSHA) has been carried out for four noteworthy dam sites at Chhattisgarh, India. The data of seismic tremors occur around the dam sites e.g., Dudhawa, Tandula, Balar and Hasdeo Bango for the time period from the year 1827 to 2015, 1846 to 2015, and 1837 to 2018 is collected and are used for the assessment. The total number of 16, 23, 33 and 41 linear faults are identified within 300 k M radius around the four major dam sites. The Peak Ground Acceleration (PGA) from various tremor sources around the study area are assessed by utilizing the attenuation models developed by Cornell et al. (1979) and Iyengar & Raghu Kanth (2004). It is observed that among these major dam sites of Chhattisgarh, maximum Peak Ground Acceleration (PGA) value 0.0501g is found for fault F17, having fault length 58kM with minimum distance of 56.863 k M for Tandula dam site. For Balar dam site the observed PGA value 0.00962g is minimum for fault F30, having fault length 58 k M with minimum map distance of 178.652 k M. In IS: 1893 (2016) Part 1 for zone II the zone factor value is recommended as 0.1g. Hence estimated maximum PGA (g) values for all the four major dams of Chhattisgarh are within the limit and so all the four dam sites are found to be seismically safe.



**Ashish Kumar Parashar and Sohanlal Atmapoojya**

**Keywords:** Dam Site, Deterministic Seismic Hazard Analysis (DSHA), Faults, Peak Ground Acceleration (PGA), Seismic Parameters.

## INTRODUCTION

Earthquakes are most causative usual hazards of the globe. These likely events can cause massive harm to structures and lead to total destruction of urban areas. Tremors, which manifest themselves in the form of shaking of the ground, are the origin of hasty release of strain that has accumulated over a long time. Tremor causes collapse of Civil Engineering Structures, compounded with the influence of landslides, flood, tsunamis and fire. The seismic risk in the country has been increasing rapidly in recent years as there were large magnitude earthquakes in recent times even in the stable continental region. Dams and large reservoirs constructed on the area with high seismicity, pose a high-risk potential for downstream life and property. It is clear that active seismic sources, which are found near dam destinations, can influence, damage of the embankment as dependent on unsteadiness of the dam and muscle loss of foundation materials. It is indispensable, strong ground shaking can result instability of the dam and quality loss of foundation materials.

In the most recent decade, huge tremors have killed large number of individuals and caused financial devastation, often because of failure of massive Civil Engineering structures in seismic incidents. Consequently, important seismic parameters are expected to play vital role in seismic assessment of dam structure (Tosun, 2002). Scientists have acknowledged and vast numbers of researches have explained the behavior of earth structures under seismic forces.

Seismic tremors can bring about harms to dam structures, while dams with huge reservoirs can induce to earthquakes. The earthquake peril can be trimmed downed by designing earthquake-resistant structures. Sometimes numerous precautionary measures need to be taken, to keep the structures safe from most possible types of failures. The principle objective of the tremor-resistant design is to make a structure such that, structure can withstand a specific degree of shaking without excessive damage. Site characterization is one of the measures of collection of data, information, evaluation and delineation through maps without which the hazard in the subterranean of the site can't be known. In irrigation project the fundamental Civil Engineering structure is dam, so it is essential to check the safety of the structure from tremors. A Deterministic Seismic Hazard Analysis (DSHA) has been utilized to assess Peak Ground Acceleration (PGA) for four significant dam sites of province of Chhattisgarh e.g. Dudhawa, Tandula, Balar and Hasdeo-Bango. These Dams in Chhattisgarh are constructed on different rivers which flow across the various parts of state. These dams are constructed to meet the drinking water requirements of nearby towns and fulfill the irrigation purpose.

### Seismology and Earthquakes

Geotechnical Earthquake Engineering research includes various mechanisms by which earthquakes occur and their effect on earth movement. The seismology field was born from a need to comprehend the earth's internal structure and behavior, particularly as they relate to phenomena of earthquake. Although earthquakes are complex phenomena, advances in seismology have produced a good understanding of the mechanisms and rates of occurrence of earthquakes in most seismically active areas of the India as well as the world. For precise seismic hazard analysis of a site, the knowledge of plate-tectonic and location of seismic sources and characteristics is required. To enhance the knowledge and acquire the innovative techniques in the research, the past literature and pioneer contribution of various seismologist and researchers have been taken into consideration. The following literature and key research techniques were adopted as the basis, to find out the seismic parameters for particular region or site. Gutenberg–Richter (1944), tried to revise the frequency of destructive shocks in California as was based on the imperfect historical records. They made a comparison of earthquake frequency of California with that of the whole world. They stated that, the difference between the larger and the smaller shocks should be based on the





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instrumental records and not based on the destructive effects. To compute this, Guttenberg Richter used instrumental magnitude scale which was originally set up for California and then extended to shocks in all parts of the world. In 1954 Guttenberg–Richter presented a Logarithmic relationship for seismic hazard analysis.

$$\text{Log } N = a - b \times M \text{-----(1)}$$

Where; N=number of earthquakes, M=magnitude and a & b are constants. Cornell (1968), devised a source-based approach where according to him, potential source of earthquakes in the form of a point, a fault or a region, where there is a possibility for the occurrence of earthquakes, plays a very important role in Seismic Hazard Analysis. For deciding this potential source, the size, boundary and activity rates of earthquakes of different magnitudes needs to be pre decided. Stepp (1972), had studied the earthquakes in Puget Sound area, among 1870 to 1969 and evaluated them for completeness and the question of becoming the frequency equation (1) to the samples which might be too short to achieve best estimates, of longtime earthquake incidence. The frequency formula acquired was then tried to fit over homogeneous samples.

Stepp (1972) had proposed a technique to discover seismic parameters for a site with insufficient historic data. The Deterministic Seismic Hazard Analysis (DSHA) is the earliest approach originated in nuclear power industry presently it is extensively used for seismic hazard assessment. It provides a base for Probabilistic Seismic Hazard Assessment of earthquake. Apart from the global researches, pinpointed seismic hazard studies for the Indian subcontinent has also been carried out by researches e.g. Parvez et al (2003), Sitharam and Panjamani (2006), Sitharam and Panjamani (2008), Ganpathy (2010), Rao et al (2012), Kolathayar et al (2012), Kumar et al (2013), Puri and Jain(2016), Tripathi and Zafar (2016) and Naval and Chandan (2017).

#### Deterministic Seismic Hazard Analysis

The Deterministic Seismic Hazard Analysis (DSHA) approach is used to identify the seismic sources which are adequately found in the vicinity of the site. Accessible chronological seismic and geological data are utilized to generate discrete, single-valued events or models of ground motion at the site. Typically, one or more earthquakes are specified by magnitude and location with respect to the site. The site ground movements are assessed deterministically, for given magnitude, minimum seismic source distance and site condition. The DSHA approach is originated from application over nuclear power plants. Recently the DSHA method is used for seismic hazard analysis for large dams and large bridges. In application of DSHA the first important step is to identify the faults for four major dams. The faults were taken from the Seismotectonic Atlas developed by Survey of India (SEISAT 2000). The Seismotectonic Maps were prepared for each Dam sites, keeping the dam sites at the center of the circle, with a radius of 300km, based on the Latitude and Longitude for them. Then all probable faults within the radius were identified and numbered with respect to their minimum map distances.

For Dudhawa dam site total 16 numbers, for Tandula dam site 23 numbers, for Balar dam site 33 numbers and for Hasdeo-Bango dam site 41 numbers seismic sources (Linear Faults) were considered for seismic hazard analysis, in which minimum fault length ( $L_{\min}$ ) is taken as 25 km and maximum fault length ( $L_{\max}$ ) is taken as 477 km. The minimum map distances of Linear Faults for all major dam sites were tabulated in Table II.

#### Computation of Seismic Hazard Parameters

In second step for DSHA, the seismic parameters (a and b values) were assessed for the study area. For these two procedures were utilized for estimation of b-values for dam sites as discussed below

- i. Linear Least-Square Fit
- ii. Maximum-Likelihood Estimation

In earthquake data analysis, noteworthy step is to investigate the available data set to assess its nature and degree of completeness. The Gutenberg-Richter recurrence law that accepts an exponential distribution of magnitude is usually utilized with alteration of minimum and maximum magnitudes. For a specific range and time interval,





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equation (1) will give the number of earthquakes, (N) with magnitude, (M) where ‘a’ and ‘b’ are positive, real constants ‘a’ describes the seismic activity (log number of events with M=0) and ‘b’ which is typically close to 1 is a tectonics parameter describing the relative abundance of large to smaller shocks.

To overcome data incompleteness problem Stepp (1972) has proposed a method. The method proposed by Stepp (1972) was adopted for the present investigation, in order to check the completeness of the earthquake data. Catalogue completeness analysis for seismic data collected from year 1946 to 2018 was carried out for major dams of Chhattisgarh State. Using data of Table III, the graphs for each dam site was prepared, which gave the regional recurrence relation for major dam sites of Chhattisgarh. The b values for each dam sites were adopted from their regional recurrence relation. Another method was Maximum-Likelihood Estimation, when applied over dam sites the b values were calculated using relation given as below

$$b = \log_{10}e / (M_{avg} - M_{min}) \text{-----}(2)$$

where  $M_{avg}$  is the mean of the observed magnitudes and  $M_{min}$  is the minimum or threshold magnitude 3.0. The maximum b values from among two methods were adopted for Disaggregation of Seismic Sources for the study areas. From Table IV the maximum b value has been accounted for Dudhawa dam site and minimum b value has been accounted for Tandula dam site.

**Estimation of Maximum Magnitude**

The Maximum Credible Earthquake (MCE) is defined as the maximum tremor that can be practically expected to be generated by a precise source on the origin of seismological and geological evidence. Since a site may be influenced by seismic tremors produced by different sources, each with its own fault mechanism, the highest earthquake magnitude and distance from the site, multiple MCE’s may be defined for the site, each with characteristic ground movement parameters.

The third step in DSHA is determining MCE. In seismic hazard analysis, the knowledge of estimating the maximum magnitude is important and used as one of the key input parameters in the seismic design. It indicates the noteworthy potential of accumulated strain energy to be released, in the region or a seismic source/fault. Alternatively, the  $M_{max}$  is an upper limit or the largest possible earthquake that may produce the highest seismic hazard scenarios of the region.  $M_{max}$  was estimated by two methods (1) Wells and Coppersmith (1994) and (2) Gupta (2002). Among the two methods the maximum magnitude has been considered for further estimation of peak ground acceleration. In Wells and Coppersmith (1994) method a relation between  $M_w$  and Surface Rupture Length (SRL) was developed, using reliable source parameters and this is further applicable for all types of faults, shallow earthquakes and intraplate or earthquakes.

$$\text{Log (SRL)} = 0.57M_w - 2.33 \text{-----}(3)$$

The above equation was used to estimate  $M_{max}$  for all sources of district headquarters of south Chhattisgarh region. In Gupta’s method (2002), the  $M_{max}$  was estimated after adding an incremental unit. In this method for estimation of  $M_{max}$  an increment of 0.5 is added to the observed maximum magnitude. This incremental technique has been used by various researchers to estimate the seismic hazard in India. The  $M_{max}$  was calculated by equation (4) as given below

$$M_{max} = M_{obs} + 0.5 \text{-----}(4)$$

$M_{max}$ = Maximum Magnitude,  
 $M_{obs}$ = Moment Magnitude ( $M_w$ )

After comparing the outcome of the two methods, maximum magnitude  $M_{max}$  values have been tabulated in Appendix B-I& II for calculating Peak Ground Acceleration.





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**Disaggregation of Seismic Sources**

The maximum possible earthquake magnitude for each major dam sites of all the seismic sources, within the area has been estimated. In the present investigation truncated exponential recurrence model developed by Mcguire and Arabasz (1990) is used which is given by the following expression;

$$\lambda_m = w_i * v * \frac{\exp[-\beta(M - M_0)] - \exp[-\beta(M_{max} - M_0)]}{1 - \exp[-\beta(M_{max} - M_0)]} \dots\dots\dots (5)$$

Where  $\lambda_m$ = Annual Rate of exceedence,  $v = \exp(\alpha - \beta * M_0)$ ,  $\alpha = 2.303 * a$ ,  $\beta = 2.303 * b$ , 'a' and 'b' are positive, real constants,  $w_i = L_i / \sum L_i$  is the weightage factor for a particular fault and  $L_i$  is the fault length.

Threshold value of magnitude 3.0 is adopted in the study. Taking the recurrence period of the earthquake as 100 years, the magnitude ( $M_{100}$ ) for all the sources were calculated for all four major dam sites of Chhattisgarh. The above stated method was adopted to estimate most likely source to site distance and most likely magnitude for estimation of peak ground acceleration for dam sites. For a recurrence period of 100 years, the magnitude ( $M_{100}$ ) was found from plotted Figure 3 for each source for all dam sites.

**Estimation of Peak Ground Acceleration**

The peak ground acceleration (PGA) at bedrock level is estimated using the attenuation equations of strong ground motion. In the present study, two attenuation relations were used for prediction of strong ground motion at the bed rock level. The first, Ground-Motion Predication Model which has been developed by Cornell et al. (1979) was used to find out Peak Ground Acceleration (PGA). The attenuation relationship developed by Cornell et al. (1979) has been universally accepted for all sites and is given as below

$$\ln Y = 6.74 + 0.859 * M - 1.80 * \ln(R + 25) \dots\dots\dots (6)$$

where Y, M, and R refer to PGA(g), Moment Magnitude, and Minimum Map Distance to the site in k M respectively. The second, Ground-Motion Predication Model which have been developed by Iyengar and Raghu Kanth (2004) which is site specific, was used to find out Peak Ground Acceleration (PGA). Chhattisgarh comes under Peninsular India, so the attenuation relationship proposed by Iyengar and Raghu Kanth (2004) has been used to calculate the Peak Ground Acceleration (PGA) and is given as below

$$\ln Y = C_1 + C_2 (M - 6) + C_3 (M - 6)^2 - \ln(R) - C_4 (R) + \ln(\epsilon) \dots\dots\dots (7)$$

where Y, M, and R refer to PGA(g), moment magnitude, and hypocentral distance in km and standard deviation factor respectively. Peninsular India Region:  $C_1 = 1.6858$ ,  $C_2 = 0.9241$ ,  $C_3 = -0.0760$ ,  $C_4 = 0.0057$ ,  $\ln(\epsilon) = 0$  for DSHA. The hypo central distance R, may be evaluated as  $R = \sqrt{(d^2 + f^2)}$ , where d is the shortest distance from the site (Minimum Map distance) to the fault considered and 'f' is the focal depth taken as 10 km. The above calculated magnitude ( $M_{100}$ ) values were used in equation (7) for estimation of PGA values and tabulated in Table VII Appendix C-I, II, III & IV. The Maximum PGA (g) at bed rock level for each site has been marked.

**CONCLUSIONS**

For estimating the Peak Ground Acceleration (PGA), an endeavor has been made, for the four major dams of Chhattisgarh and its adjoining areas. From all the tremors which have occurred in the past years(1846-2018) in the study region and after overlaying them on the tectonic map, in order to identify the seismic sources that are likely to generate significant ground motion in the study area. In the present research, the deterministic seismic hazard analysis carried out for the four dam sites of Chhattisgarh, the b values (maximum one) obtained in Table IV are as, 0.8500, 0.3583, 0.6486 & 0.8429 for Dudhawa, Tandula, Balar and Hasdeo-bango dam sites respectively. Using the method developed by Wells & Coppersmith (1994) and Gupta (2002), the maximum magnitude potential ( $M_{max}$ ) of





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each seismogenic source has been estimated. In present study for estimation of Peak Ground Acceleration (PGA), Cornell et al. (1979) and Iyengar & Raghu Kanth (2004) attenuation relations were used. The minimum map distance and maximum magnitude ( $M_{max}$ ) plays vital role in the estimation of seismic hazard for the site. The maximum value of Peak Ground Acceleration (PGA) for recurrence period of 100 years for Dudhawa dam site was found to be due to fault No. 6 (Fault length 58 km, Min. Map Distance 127.985 km), which was found as 0.02015g. On the other hand, the Maximum values of PGA(g) for the same recurrence period for Tandula, Balar and Hasdeo Bango Dam Sites were found to be due to fault No. 17 (Fault length 58 km, Min. Map Distance 56.863 km) which came out to be equal to 0.0501g, for fault No. 30 (Fault length 58 km, Min. Map Distance 178.652 km) which came out to be equal to 0.00962g & for fault No. 7 (Fault length 140 km, Min. Map Distance 84.356 km) came out to be equal to 0.02038g respectively. Thus, from the present research it is clearly reflected that obtained PGA (g) value is less for Balar dam site and maximum for Tandula Dam site. Fault having fault length 58 km (F6, F17 & F30) is key fault for major dam sites except for Hasdeo Bango site. The present study results hence can be directly implemented for designing of earthquake-resistant structures, in and around four major dam sites of Chhattisgarh.

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**Table I Location of Major Dams of Chhattisgarh [Latitude and Longitude]**

| S. No. | Name of Dam  | Location of Dam |            |
|--------|--------------|-----------------|------------|
|        |              | Latitude        | Longitude  |
| 1      | Dudhawa      | 20°18'28"N      | 81°46'18"E |
| 2      | Tandula      | 20°42'00"N      | 81°10'00"E |
| 3      | Balar        | 21°32'00"N      | 82°30'00"E |
| 4      | Hasdeo-Bango | 22°36'00"N      | 82°36'00"E |

**Table II Seismic Sources Consider for Major Dams of Chhattisgarh**

| S. No. | Name of Dam  | Total No of Faults | Fault Length                          |                                       |
|--------|--------------|--------------------|---------------------------------------|---------------------------------------|
|        |              |                    | Minimum Length of Fault ( $L_{min}$ ) | Maximum Length of Fault ( $L_{max}$ ) |
| 1      | Dudhawa      | 16                 | 26                                    | 180                                   |
| 2      | Tandula      | 23                 | 25                                    | 477                                   |
| 3      | Balar        | 33                 | 25                                    | 140                                   |
| 4      | Hasdeo-Bango | 41                 | 25                                    | 477                                   |

**Table III Completeness of the Earthquake Catalogue and Activity Rate for Major Dams of Chhattisgarh**

| Name of Dam | Magnitude $M_w$ | No of Events $\geq M_w$ | Complete in interval (year) | No. of Events per year $\geq M_w$ |
|-------------|-----------------|-------------------------|-----------------------------|-----------------------------------|
| Dudhawa     | 3               | 107                     | 40                          | 2.6750                            |
|             | 4               | 64                      | 80                          | 0.8000                            |
|             | 5               | 21                      | 120                         | 0.1750                            |
|             | 6               | 7                       | 140                         | 0.0500                            |
| Tandula     | 3               | 58                      | 50                          | 1.1600                            |
|             | 4               | 34                      | 100                         | 0.3400                            |
|             | 5               | 13                      | 120                         | 0.1084                            |
|             | 6               | 6                       | 140                         | 0.0429                            |





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|              |   |    |     |        |
|--------------|---|----|-----|--------|
| Balar        | 3 | 82 | 40  | 2.0500 |
|              | 4 | 55 | 80  | 0.6875 |
|              | 5 | 19 | 100 | 0.1900 |
|              | 6 | 7  | 140 | 0.0539 |
| Hasdeo Bango | 3 | 54 | 20  | 2.7000 |
|              | 4 | 42 | 70  | 0.6000 |
|              | 5 | 14 | 90  | 0.1556 |
|              | 6 | 5  | 130 | 0.0385 |

**Table IV “b” values for Major Dams of Chhattisgarh**

| Name of Dam  | b Value from Stepp (1972) | b Value from Maximum Likelihood Estimation, Utsu. (1965) | b Value Considered for the Present Study |
|--------------|---------------------------|--|--|
| Dudhawa      | 0.8500                    | 0.3323   | 0.8500                                   |
| Tandula      | 0.3583                    | 0.3190   | 0.3583                                   |
| Balar        | 0.6486                    | 0.2924   | 0.6486                                   |
| Hasdeo-Bango | 0.8429                    | 0.2710   | 0.8429                                   |

**Table V Appendix A Minimum Map Distance for Seismic Sources for Major Dams of Chhattisgarh**

| Fault No. | Name of Dam       |                      |                   |                      |                   |                      |                   |                      |
|-----------|-------------------|----------------------|-------------------|----------------------|-------------------|----------------------|-------------------|----------------------|
|           | Dudhawa           |                      | Tandula           |                      | Balar             |                      | Hasdeo Bango      |                      |
|           | Fault Length (kM) | Minimum Map Distance |
| F1        | 26                | 289.756              | 140               | 277.988              | 75                | 235.362              | 51                | 265.661              |
| F2        | 75                | 271.966              | 51                | 288.123              | 86                | 230.450              | 26                | 249.032              |
| F3        | 38                | 297.007              | 31                | 288.103              | 26                | 195.08               | 25                | 192.316              |
| F4        | 91                | 271.613              | 76                | 243.533              | 75                | 157.25               | 28                | 153.904              |
| F5        | 70                | 240.306              | 47                | 288.372              | 87                | 251.652              | 62                | 118.128              |
| F6        | 58                | 127.985              | 60                | 293.945              | 46                | 180.273              | 46                | 64.789               |
| F7        | 25                | 166.533              | 70                | 299.464              | 62                | 230.570              | 140               | 84.356               |
| F8        | 45                | 180.596              | 477               | 294.270              | 28                | 261.430              | 30                | 162.628              |
| F9        | 70                | 237.523              | 109               | 272.903              | 25                | 291.832              | 77                | 116.155              |
| F10       | 125               | 220.98               | 182               | 230.574              | 30                | 274.547              | 30                | 146.664              |
| F11       | 180               | 237.443              | 38                | 225.292              | 30                | 264.203              | 55                | 127.989              |
| F12       | 130               | 236.667              | 91                | 202.258              | 55                | 246.201              | 78                | 138.173              |
| F13       | 32                | 287.825              | 70                | 164.806              | 32                | 279.807              | 25                | 244.659              |
| F14       | 121               | 218.039              | 70                | 164.605              | 30                | 263.365              | 39                | 186.934              |
| F15       | 46                | 283.577              | 125               | 149.066              | 117               | 302.292              | 32                | 161.027              |
| F16       | 51                | 255.876              | 45                | 108.287              | 140               | 211.371              | 30                | 144.591              |
| F17       | -                 | -                    | 58                | 56.863               | 78                | 256.656              | 45                | 132.865              |
| F18       | -                 | -                    | 25                | 93.749               | 45                | 251.408              | 117               | 185.247              |
| F19       | -                 | -                    | 180               | 189.923              | 28                | 295.007              | 42                | 193.699              |
| F20       | -                 | -                    | 174               | 284.288              | 28                | 294.420              | 28                | 187.093              |
| F21       | -                 | -                    | 139               | 233.739              | 33                | 282.625              | 47                | 201.148              |
| F22       | -                 | -                    | 228               | 225.552              | 51                | 281.124              | 28                | 189.959              |





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|     |   |   |     |         |     |         |     |         |
|-----|---|---|-----|---------|-----|---------|-----|---------|
| F23 | - | - | 121 | 290.814 | 31  | 292.602 | 33  | 208.930 |
| F24 | - | - | -   | -       | 60  | 285.130 | 51  | 225.683 |
| F25 | - | - | -   | -       | 76  | 263.365 | 31  | 247.852 |
| F26 | - | - | -   | -       | 91  | 267.253 | 76  | 239.501 |
| F27 | - | - | -   | -       | 70  | 201.754 | 47  | 275.347 |
| F28 | - | - | -   | -       | 70  | 280.174 | 60  | 229.745 |
| F29 | - | - | -   | -       | 45  | 224.872 | 70  | 247.894 |
| F30 | - | - | -   | -       | 58  | 178.652 | 38  | 282.477 |
| F31 | - | - | -   | -       | 125 | 279.902 | 477 | 279.412 |
| F32 | - | - | -   | -       | 25  | 210.922 | 91  | 274.714 |
| F33 | - | - | -   | -       | 121 | 280.167 | 70  | 211.181 |
| F34 | - | - | -   | -       | -   | -       | 45  | 268.990 |
| F35 | - | - | -   | -       | -   | -       | 25  | 265.808 |
| F36 | - | - | -   | -       | -   | -       | 58  | 219.338 |
| F37 | - | - | -   | -       | -   | -       | 26  | 228.917 |
| F38 | - | - | -   | -       | -   | -       | 75  | 280.091 |
| F39 | - | - | -   | -       | -   | -       | 75  | 178.787 |
| F40 | - | - | -   | -       | -   | -       | 86  | 262.522 |
| F41 | - | - | -   | -       | -   | -       | 87  | 243.598 |

**Table VI Appendix B-I Maximum Magnitude for Seismic Sources for Major Dams of Chhattisgarh**

| Fault No. | Name of Dam       |                         |                                       |                   |                         |                                       |
|-----------|-------------------|-------------------------|---------------------------------------|-------------------|-------------------------|---------------------------------------|
|           | Dudhawa           |                         |                                       | Tandula           |                         |                                       |
|           | Fault Length (kM) | M <sub>w</sub> Observed | Maximum Magnitude (M <sub>max</sub> ) | Fault Length (kM) | M <sub>w</sub> Observed | Maximum Magnitude (M <sub>max</sub> ) |
| F1        | 26                | 4.6                     | 5.1                                   | 140               | 4.5                     | 5.4                                   |
| F2        | 75                | 4.6                     | 5.1                                   | 51                | 4.7                     | 5.2                                   |
| F3        | 38                | 4.9                     | 5.4                                   | 31                | 6.7                     | 7.2                                   |
| F4        | 91                | 5.8                     | 6.3                                   | 76                | 6.7                     | 7.2                                   |
| F5        | 70                | 5.8                     | 6.3                                   | 47                | 6.7                     | 7.2                                   |
| F6        | 58                | 5.8                     | 6.3                                   | 60                | 6.7                     | 7.2                                   |
| F7        | 25                | 3.9                     | 4.4                                   | 70                | 6.7                     | 7.2                                   |
| F8        | 45                | 3.9                     | 4.6                                   | 477               | 6.7                     | 7.2                                   |
| F9        | 70                | 3.9                     | 4.9                                   | 109               | 3.4                     | 5.2                                   |
| F10       | 125               | 3.9                     | 5.3                                   | 182               | 4.9                     | 5.6                                   |
| F11       | 180               | 5.0                     | 5.6                                   | 38                | 4.9                     | 5.4                                   |
| F12       | 130               | 6.0                     | 6.5                                   | 91                | 5.8                     | 6.3                                   |
| F13       | 32                | 4.8                     | 5.3                                   | 70                | 5.8                     | 6.3                                   |
| F14       | 121               | 4.8                     | 5.3                                   | 70                | 3.9                     | 4.9                                   |
| F15       | 46                | 3.7                     | 4.6                                   | 125               | 3.9                     | 5.3                                   |
| F16       | 51                | 4.3                     | 4.8                                   | 45                | 3.9                     | 4.6                                   |
| F17       | -                 | -                       | -                                     | 58                | 5.8                     | 6.3                                   |
| F18       | -                 | -                       | -                                     | 25                | 3.9                     | 4.4                                   |
| F19       | -                 | -                       | -                                     | 180               | 5.0                     | 5.6                                   |
| F20       | -                 | -                       | -                                     | 174               | 3.0                     | 5.6                                   |
| F21       | -                 | -                       | -                                     | 139               | 6.0                     | 6.5                                   |
| F22       | -                 | -                       | -                                     | 228               | 6.0                     | 6.5                                   |
| F23       | -                 | -                       | -                                     | 121               | 4.8                     | 5.3                                   |





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**Table VI Appendix B-II Maximum Magnitude for Seismic Sources for Major Dams of Chhattisgarh**

| Fault No. | Name of Dam       |             |                                 |                   |             |                                 |
|-----------|-------------------|-------------|---------------------------------|-------------------|-------------|---------------------------------|
|           | Balar             |             |                                 | Hasdeo-Bango      |             |                                 |
|           | Fault Length (kM) | Mw Observed | Maximum Magnitude ( $M_{max}$ ) | Fault Length (kM) | Mw Observed | Maximum Magnitude ( $M_{max}$ ) |
| F1        | 75                | 4.4         | 4.9                             | 51                | 3.3         | 4.7                             |
| F2        | 86                | 4.1         | 5.0                             | 26                | 3.3         | 4.1                             |
| F3        | 26                | 4.6         | 5.1                             | 25                | 4.0         | 4.5                             |
| F4        | 75                | 4.6         | 5.1                             | 28                | 4.0         | 4.5                             |
| F5        | 87                | 5.3         | 5.8                             | 62                | 4.0         | 4.8                             |
| F6        | 46                | 4.3         | 4.8                             | 46                | 4.3         | 4.8                             |
| F7        | 62                | 4.0         | 4.8                             | 140               | 4.5         | 5.4                             |
| F8        | 28                | 4.0         | 4.5                             | 30                | 4.5         | 5.0                             |
| F9        | 25                | 4.0         | 4.5                             | 77                | 4.5         | 5.0                             |
| F10       | 30                | 4.5         | 5.0                             | 30                | 4.5         | 5.0                             |
| F11       | 30                | 4.5         | 5.0                             | 55                | 4.5         | 5.0                             |
| F12       | 55                | 4.5         | 5.0                             | 78                | 4.5         | 5.0                             |
| F13       | 32                | 4.2         | 4.7                             | 25                | 4.0         | 4.5                             |
| F14       | 30                | 4.2         | 4.7                             | 39                | 4.0         | 4.5                             |
| F15       | 117               | 4.6         | 5.3                             | 32                | 4.2         | 4.7                             |
| F16       | 140               | 4.5         | 5.4                             | 30                | 4.2         | 4.7                             |
| F17       | 78                | 4.5         | 5.0                             | 45                | 6.5         | 7.0                             |
| F18       | 45                | 6.5         | 7.0                             | 117               | 4.6         | 5.3                             |
| F19       | 28                | 6.5         | 7.0                             | 42                | 6.5         | 7.0                             |
| F20       | 28                | 5.0         | 5.5                             | 28                | 6.5         | 7.0                             |
| F21       | 33                | 6.7         | 7.2                             | 47                | 5.0         | 5.5                             |
| F22       | 51                | 4.7         | 5.2                             | 28                | 5.0         | 5.5                             |
| F23       | 31                | 6.7         | 7.2                             | 33                | 6.7         | 7.2                             |
| F24       | 60                | 6.7         | 7.2                             | 51                | 4.7         | 5.2                             |
| F25       | 76                | 6.7         | 7.2                             | 31                | 6.7         | 7.2                             |
| F26       | 91                | 5.8         | 6.3                             | 76                | 6.7         | 7.2                             |
| F27       | 70                | 5.8         | 6.3                             | 47                | 6.7         | 7.2                             |
| F28       | 70                | 3.9         | 4.9                             | 60                | 6.7         | 7.2                             |
| F29       | 45                | 3.9         | 4.6                             | 70                | 6.7         | 7.2                             |
| F30       | 58                | 5.8         | 6.3                             | 38                | 6.7         | 7.2                             |
| F31       | 125               | 3.9         | 5.3                             | 477               | 6.7         | 7.2                             |
| F32       | 25                | 3.9         | 4.4                             | 91                | 5.8         | 6.3                             |
| F33       | 121               | 4.8         | 5.3                             | 70                | 5.8         | 6.3                             |
| F34       | -                 | -           | -                               | 45                | 3.9         | 4.6                             |
| F35       | -                 | -           | -                               | 25                | 3.9         | 4.4                             |
| F36       | -                 | -           | -                               | 58                | 5.8         | 6.3                             |
| F37       | -                 | -           | -                               | 26                | 4.6         | 5.1                             |
| F38       | -                 | -           | -                               | 75                | 4.4         | 4.9                             |
| F39       | -                 | -           | -                               | 75                | 4.6         | 5.1                             |
| F40       | -                 | -           | -                               | 86                | 4.1         | 5.0                             |
| F41       | -                 | -           | -                               | 87                | 5.3         | 5.8                             |





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**Table VII Appendix C-I Peak Ground Acceleration for Seismic Sources for Dudhawa Dam**

| Fault No. | Fault Length (kM) | Hypo-central Distance R in kM | Magnitude M <sub>100</sub> [Recurrence Period -100 Years] | Peak Ground Acceleration (g) |                                |
|-----------|-------------------|-------------------------------|---|------------------------------|--------------------------------|
|           |                   |                               |   | Cornell <i>et al.</i> (1979) | Iyengar and Raghu Kanth (2004) |
| F1        | 26                | 289.929                       | 5.018   | 0.00205                      | 0.00134                        |
| F2        | 75                | 272.15                        | 5.068   | 0.00238                      | 0.00167                        |
| F3        | 38                | 297.176                       | 5.302   | 0.00252                      | 0.00169                        |
| F4        | 91                | 271.798                       | 6.082   | 0.00569                      | 0.00455                        |
| F5        | 70                | 240.514                       | 6.036   | 0.00669                      | 0.00589                        |
| F6        | 58                | 128.376                       | 5.996   | 0.01740                      | 0.02015                        |
| F7        | 25                | 166.833                       | 4.379   | 0.00290                      | 0.00229                        |
| F8        | 45                | 180.873                       | 4.581   | 0.00304                      | 0.00247                        |
| F9        | 70                | 237.734                       | 4.879   | 0.00253                      | 0.00189                        |
| F10       | 125               | 221.207                       | 5.275   | 0.00399                      | 0.00340                        |
| F11       | 180               | 237.654                       | 5.566   | 0.00456                      | 0.00387                        |
| F12       | 130               | 236.879                       | 6.283   | 0.00848                      | 0.00763                        |
| F13       | 32                | 287.999                       | 5.206   | 0.00244                      | 0.00167                        |
| F14       | 121               | 218.269                       | 5.272   | 0.00406                      | 0.00350                        |
| F15       | 46                | 283.754                       | 4.582   | 0.00147                      | 0.00088                        |
| F16       | 51                | 256.071                       | 4.777   | 0.00205                      | 0.00142                        |

**Table VII Appendix C-II Peak Ground Acceleration for Seismic Sources for Tandula Dam**

| Fault No. | Fault Length (kM) | Hypo-central Distance R in kM | Magnitude M <sub>100</sub> [Recurrence Period -100 Years] | Peak Ground Acceleration (g) |                                |
|-----------|-------------------|-------------------------------|---|------------------------------|--------------------------------|
|           |                   |                               |   | Cornell <i>et al.</i> (1979) | Iyengar and Raghu Kanth (2004) |
| F1        | 140               | 278.168                       | 5.251   | 0.00269                      | 0.00191                        |
| F2        | 51                | 288.297                       | 4.894   | 0.00186                      | 0.00119                        |
| F3        | 31                | 288.277                       | 5.554   | 0.00328                      | 0.00237                        |
| F4        | 76                | 243.739                       | 6.263   | 0.00795                      | 0.00701                        |
| F5        | 47                | 288.546                       | 5.902   | 0.00442                      | 0.0033                         |
| F6        | 60                | 294.116                       | 6.095   | 0.00505                      | 0.00375                        |
| F7        | 70                | 299.631                       | 6.192   | 0.00532                      | 0.00389                        |
| F8        | 477               | 294.44                        | 6.994   | 0.01091                      | 0.00796                        |
| F9        | 109               | 273.087                       | 5.039   | 0.00231                      | 0.0016                         |
| F10       | 182               | 230.791                       | 5.460   | 0.00436                      | 0.00373                        |
| F11       | 38                | 225.514                       | 4.942   | 0.00290                      | 0.00229                        |
| F12       | 91                | 202.506                       | 5.851   | 0.00754                      | 0.00731                        |
| F13       | 70                | 165.110                       | 5.739   | 0.00947                      | 0.00997                        |
| F14       | 70                | 164.909                       | 4.721   | 0.00396                      | 0.00347                        |
| F15       | 125               | 149.402                       | 5.151   | 0.00668                      | 0.00666                        |
| F16       | 45                | 108.748                       | 4.402   | 0.00567                      | 0.00503                        |
| F17       | 58                | 57.736                        | 5.689   | 0.04119                      | 0.0501                         |
| F18       | 25                | 94.281                        | 4.300   | 0.00640                      | 0.00559                        |
| F19       | 180               | 190.187                       | 5.462   | 0.00597                      | 0.00572                        |
| F20       | 174               | 284.464                       | 5.457   | 0.00309                      | 0.00222                        |
| F21       | 139               | 233.953                       | 6.112   | 0.00747                      | 0.00674                        |
| F22       | 228               | 225.774                       | 6.266   | 0.00903                      | 0.0084                         |
| F23       | 121               | 290.986                       | 5.146   | 0.00228                      | 0.00152                        |





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**Table VII Appendix C-III Peak Ground Acceleration for Seismic Sources for Balar Dam**

| Fault No. | Fault Length (kM) | Hypo-central Distance R in kM | Magnitude $M_{100}$ [Recurrence Period -100 Years] | Peak Ground Acceleration (g) |                                |
|-----------|-------------------|-------------------------------|--|------------------------------|--------------------------------|
|           |                   |                               |  | Cornell et al. (1979)        | Iyengar and Raghu Kanth (2004) |
| F1        | 75                | 235.575                       | 4.847  | 0.00249                      | 0.00187                        |
| F2        | 86                | 230.667                       | 4.948  | 0.00281                      | 0.00219                        |
| F3        | 26                | 195.337                       | 4.915  | 0.00358                      | 0.00305                        |
| F4        | 75                | 157.568                       | 5.033  | 0.00556                      | 0.00532                        |
| F5        | 87                | 251.851                       | 5.640  | 0.00442                      | 0.00363                        |
| F6        | 46                | 180.551                       | 4.730  | 0.00346                      | 0.00293                        |
| F7        | 62                | 230.787                       | 4.748  | 0.00237                      | 0.00176                        |
| F8        | 28                | 261.622                       | 4.428  | 0.00147                      | 0.00091                        |
| F9        | 25                | 292.004                       | 4.419  | 0.00122                      | 0.00068                        |
| F10       | 30                | 274.730                       | 4.860  | 0.00196                      | 0.00130                        |
| F11       | 30                | 264.393                       | 4.858  | 0.00209                      | 0.00143                        |
| F12       | 55                | 246.405                       | 4.916  | 0.00246                      | 0.00181                        |
| F13       | 32                | 279.986                       | 4.615  | 0.00154                      | 0.00094                        |
| F14       | 30                | 263.555                       | 4.610  | 0.00169                      | 0.00109                        |
| F15       | 117               | 302.458                       | 5.238  | 0.00231                      | 0.00151                        |
| F16       | 140               | 211.608                       | 5.340  | 0.00453                      | 0.00402                        |
| F17       | 78                | 256.851                       | 4.940  | 0.00235                      | 0.00168                        |
| F18       | 45                | 251.607                       | 6.004  | 0.00604                      | 0.00514                        |
| F19       | 28                | 295.177                       | 5.768  | 0.00379                      | 0.00274                        |
| F20       | 28                | 294.590                       | 5.207  | 0.00235                      | 0.00157                        |
| F21       | 33                | 282.802                       | 5.898  | 0.00455                      | 0.00347                        |
| F22       | 51                | 281.302                       | 5.086  | 0.00229                      | 0.00156                        |
| F23       | 31                | 292.773                       | 5.869  | 0.00419                      | 0.00308                        |
| F24       | 60                | 285.306                       | 6.196  | 0.00579                      | 0.00445                        |
| F25       | 76                | 263.555                       | 6.331  | 0.00742                      | 0.00614                        |
| F26       | 91                | 267.441                       | 6.006  | 0.00548                      | 0.00442                        |
| F27       | 70                | 202.002                       | 5.942  | 0.00818                      | 0.00801                        |
| F28       | 70                | 280.353                       | 4.834  | 0.00185                      | 0.00120                        |
| F29       | 45                | 225.095                       | 4.546  | 0.00207                      | 0.00148                        |
| F30       | 58                | 178.932                       | 5.868  | 0.00932                      | 0.00962                        |
| F31       | 125               | 280.081                       | 5.242  | 0.00264                      | 0.00186                        |
| F32       | 25                | 211.159                       | 4.330  | 0.00191                      | 0.00133                        |
| F33       | 121               | 280.346                       | 5.240  | 0.00263                      | 0.00185                        |

**Table VII. Appendix C-IV Peak Ground Acceleration For Seismic Sources For Hasdeo Bango Dam**

| Fault No. | Fault Length (kM) | Hypo-central Distance R in kM | Magnitude $M_{100}$ [Recurrence Period -100 Years] | Peak Ground Acceleration (g) |                                |
|-----------|-------------------|-------------------------------|--|------------------------------|--------------------------------|
|           |                   |                               |  | Cornell et al. (1979)        | Iyengar and Raghu Kanth (2004) |
| F1        | 51                | 265.85                        | 4.652  | 0.00173                      | 0.00112                        |
| F2        | 26                | 249.233                       | 4.072  | 0.00117                      | 0.00067                        |
| F3        | 25                | 192.576                       | 4.437  | 0.00243                      | 0.00184                        |
| F4        | 28                | 154.229                       | 4.444  | 0.00347                      | 0.00287                        |
| F5        | 62                | 118.551                       | 4.751  | 0.00674                      | 0.00649                        |





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|     |     |         |       |         |         |
|-----|-----|---------|-------|---------|---------|
| F6  | 46  | 65.557  | 4.735 | 0.01537 | 0.01559 |
| F7  | 140 | 84.947  | 5.330 | 0.01797 | 0.02038 |
| F8  | 30  | 162.936 | 4.868 | 0.00458 | 0.00418 |
| F9  | 77  | 116.585 | 4.944 | 0.00815 | 0.00825 |
| F10 | 30  | 147.005 | 4.868 | 0.00537 | 0.00507 |
| F11 | 55  | 128.380 | 4.922 | 0.00692 | 0.00684 |
| F12 | 78  | 138.535 | 4.944 | 0.00628 | 0.00613 |
| F13 | 25  | 244.864 | 4.437 | 0.00165 | 0.00107 |
| F14 | 39  | 187.202 | 4.458 | 0.00259 | 0.00200 |
| F15 | 32  | 161.338 | 4.627 | 0.00378 | 0.00325 |
| F16 | 30  | 144.937 | 4.625 | 0.00446 | 0.00397 |
| F17 | 45  | 133.241 | 5.784 | 0.01371 | 0.01547 |
| F18 | 117 | 185.517 | 5.233 | 0.00510 | 0.00476 |
| F19 | 42  | 193.957 | 5.748 | 0.00739 | 0.00727 |
| F20 | 28  | 187.361 | 5.548 | 0.00658 | 0.00642 |
| F21 | 47  | 201.397 | 5.285 | 0.00468 | 0.00423 |
| F22 | 28  | 190.223 | 5.178 | 0.00468 | 0.00427 |
| F23 | 33  | 209.170 | 5.633 | 0.00593 | 0.00553 |
| F24 | 51  | 225.905 | 5.083 | 0.00327 | 0.00265 |
| F25 | 31  | 248.054 | 5.621 | 0.00445 | 0.00369 |
| F26 | 76  | 239.710 | 6.049 | 0.00680 | 0.00601 |
| F27 | 47  | 275.529 | 5.796 | 0.00435 | 0.00337 |
| F28 | 60  | 229.963 | 5.932 | 0.00658 | 0.00594 |
| F29 | 70  | 248.096 | 6.016 | 0.00625 | 0.00537 |
| F30 | 38  | 282.654 | 5.73  | 0.00394 | 0.00296 |
| F31 | 477 | 279.591 | 6.772 | 0.00982 | 0.00765 |
| F32 | 91  | 274.896 | 5.878 | 0.00469 | 0.00366 |
| F33 | 70  | 211.418 | 5.802 | 0.00674 | 0.00636 |
| F34 | 45  | 269.176 | 4.557 | 0.00156 | 0.00098 |
| F35 | 25  | 265.997 | 4.348 | 0.00133 | 0.00079 |
| F36 | 58  | 219.566 | 5.739 | 0.00601 | 0.00550 |
| F37 | 26  | 229.136 | 4.915 | 0.00277 | 0.00215 |
| F38 | 75  | 280.270 | 4.853 | 0.00189 | 0.00123 |
| F39 | 75  | 179.067 | 5.033 | 0.00454 | 0.00414 |
| F40 | 86  | 262.713 | 4.950 | 0.00228 | 0.00161 |
| F41 | 87  | 243.804 | 5.596 | 0.00448 | 0.00376 |





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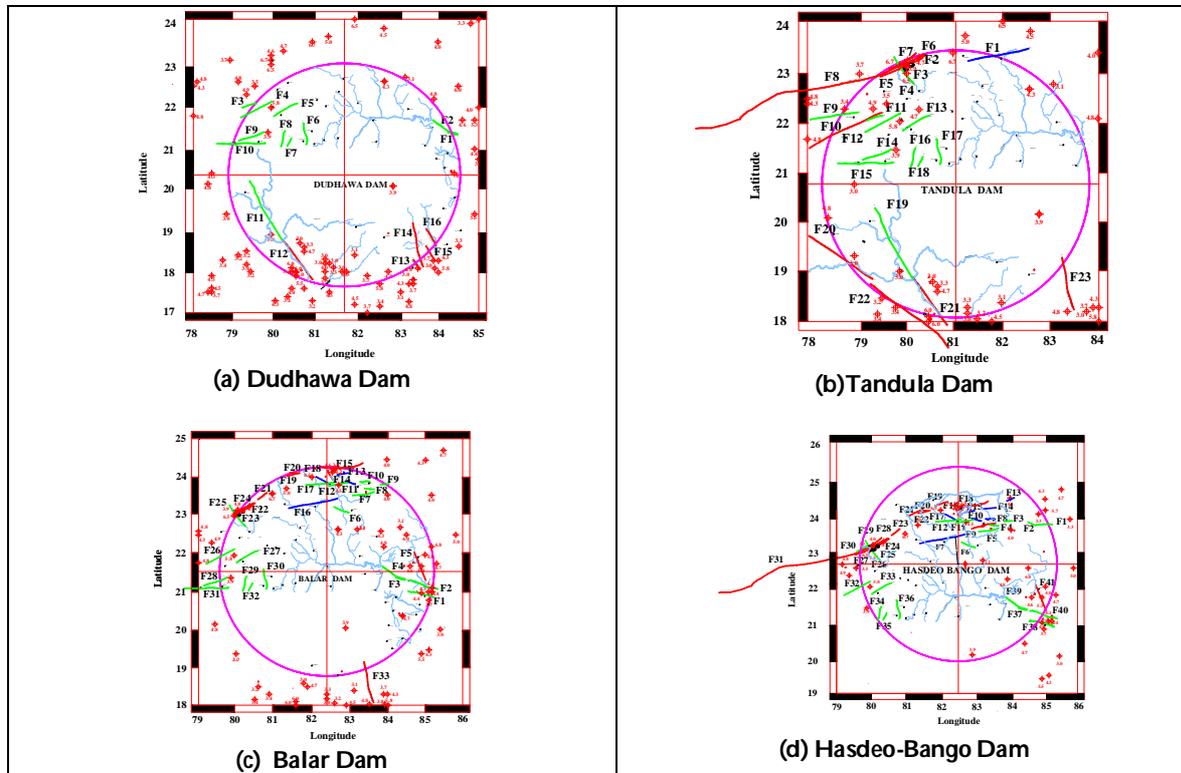


Fig.1 Seismotectonic Map of Dam Sites of Chhattisgarh

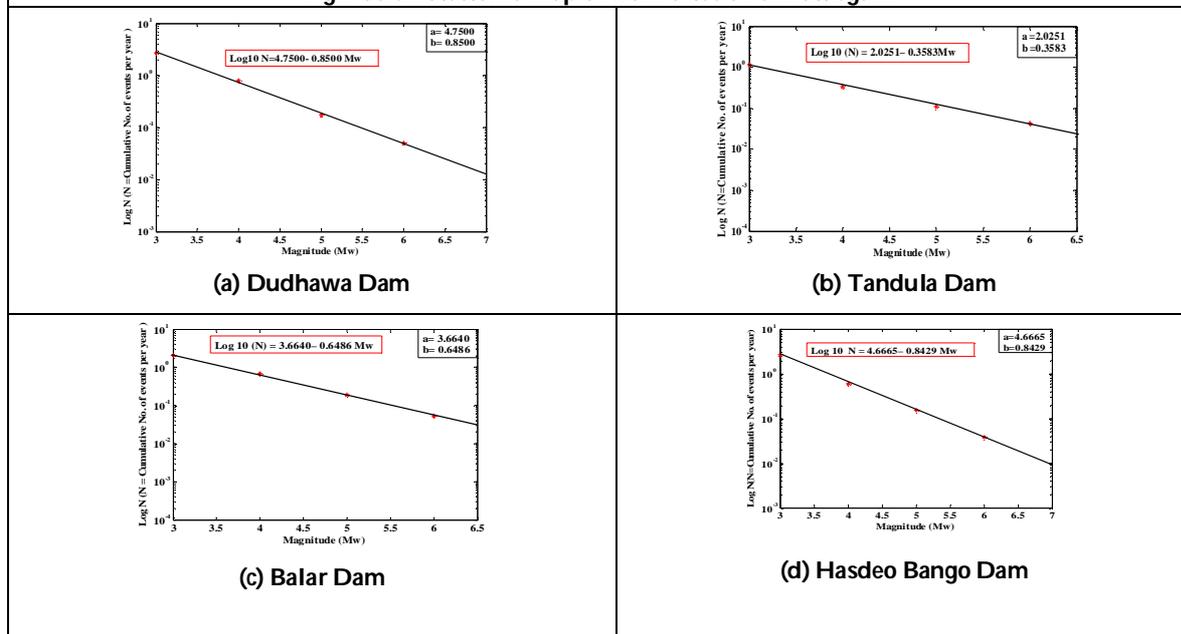


Fig. 2 Frequency-Magnitude Relationship for Major Dams of Chhattisgarh





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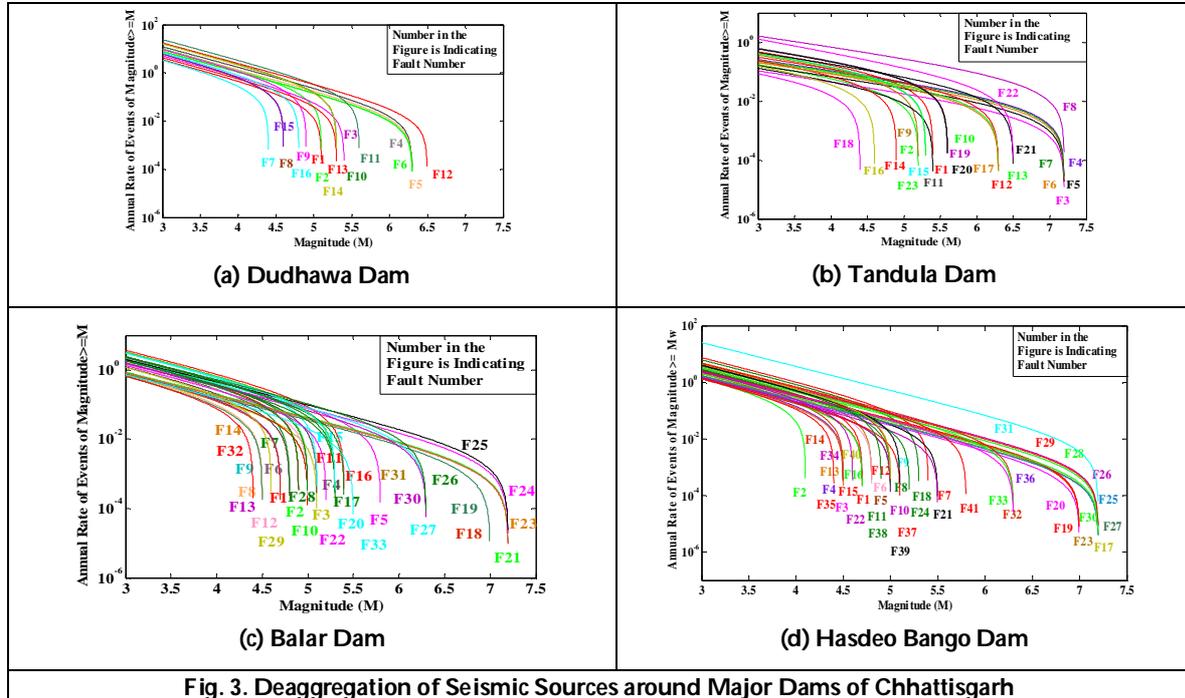


Fig. 3. Deaggregation of Seismic Sources around Major Dams of Chhattisgarh





## Ghat Road Construction

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### ABSTRACT

A hill road is one that passes through terrain with a cross slope of 25% or more and is distinguished by widely varying elevations, deep gorges, numerous watercourses, and steep slopes. These are also known as ghat roads in some places. It entails things like parapets to demarcate the roadway boundary, rock cuttings in difficult areas, erosion control measures, a greater number of drainage crossings, and so on. The planning of roads in hilly areas differs significantly from that in plain areas. Landslides, soil erosion, land degradation, and steep terrain are some of the key ecological issues that control the development of roadways in mountainous terrains, necessitating greater design. The analysis of a feasibility assessment for a PWD ghat road construction project is presented in this paper. The ghat route will improve connectivity between two villages by reducing the distance between them by 8 kilometres (Design length 7.355 kilometres), which will benefit inter-district transit between Keonjhar and Dhenkanal districts. The planned route aims to cut travel time by shortening the distance between two settlements. This will facilitate community trade and commerce while also alleviating traffic congestion. The project's objective is to research and document the alignment, prepare a detailed project report using applicable IRC codes, and estimate and design the Ghat Alignment with respect to traffic demand forecast. Data collection, alignment design, design drawings, and detail estimate preparation will be the methodology for this project.

**Keywords:** Ghat, Road safety, Accident, Pavement Design





**Akanksha Parida et al.,**

## INTRODUCTION

In hill roads, landslides are a frequent subject. There is a lot of rock cutting involved in road construction, which disrupts environmental condition and the equilibrium of forces. As a result, highway engineers, geotechnical engineers, and planners in connectivity schemes of hill road find it difficult to assess the risk of slope failure and risk mitigation measures. Landslides caused by an increase in shear stress and a decrease in shear strength, according to geotechnical engineering. Increased pore-water pressure, weights of structures, and external traffic loads are some of the possible sources of increased shear stress and reduced shear strength caused by faults, discontinuities, joints, and cleavage planes, as well as seepage pressure from percolating water. Afforestation, adequate drainage systems such as catch-water drains, provision of check walls, breast walls, and toe walls, grouting and rock bolting, and other measures can be implemented to reduce the effects of landslides. Keonjhar, which has a mountainous terrain, is one of Odisha's most important mineral-producing districts. Iron ore, manganese ore, chromate, quartzite, bauxite, gold, pyrophyllite, and limestone housed in this district. Dhenkanal is also rich in important minerals such as chrome ore and granite stone, which support a variety of businesses. As a result, the finest transit connection (safe, accessible, rapid, and cost-effective) between these key industrial districts have urgent need, which can benefit the listed district's in its commercial, and industrial development.

### Area

The ghat route described is part of a 40-kilometer project road from Nudurupada to Kaliahata that requires restoration and remodeling to accommodate current and future traffic growth. If we consider the 0.000km chainage at Nudurupada village, we can see that an all-weather road exists till 32.000km, which may necessitate some widening and restoration. However, between 32.000km chain age and 40.000km chainage (Kaliahata village), there is only an earthen road that is unfit for heavy vehicles. An 8-kilometer (32- to 40-kilometer) length of ghat connects these two villages, however it eventually becomes a barrier to joining Kamakhyanagar in Dhenkanal District in the long run. Construction of this proposed ODR will serve a huge volume of traffic in terms of transportation. Existing pedestrian and mule roads, as well as well-trodden animal tracks, present the best opportunities for modifications and expansion; as a result, one of the most essential ideas in hill road planning is to utilise existing routes to satisfy rising traffic demand to the greatest extent possible.

## LITERATURE REVIEW

Hilly ghat roads are more prone to landslides, soil erosion, slope failure and earthquakes. Slope deformations are caused by a combination of climatic conditions, erosion activity, water courses, and groundwater. Slopes with moist earth have become prone to landslides [14]. Hence, in mountainous terrain, additional land is necessary for slope protection works and approach roads, as well as the acquisition of neighboring properties such as dwellings for safety reasons, in addition to the carriageway, junctions, service road, toll plaza, rest area, bus stops, drains, and so on [9]. Siba Prasad Mishra et al. [6] examined data on earthquakes, landslides, rainfall, and road progress, and discovered that connectivity growth is difficult and challenging within forests, broken relief, frequent ghats roads, and deep gorges, in topography, which impedes pavement growth. They recommended that poor planning, engineering design, the executants's attitude, procurement policies and the contractor's skill, contract administration and construction management, road safety difficulties, contract documentation, and the inability of deploying bidders be addressed. Construction of road pavement in hilly terrains by cutting or filling creates instability in the naturally standing hillock system for some sections of every hilly road, which requires engineering attention to endure [10]. Harshada Targeet al. [2] have highlighted the relevance of road furniture, pavement design recommendations, expertise in intelligent traffic control systems in reducing the impact of road accidents, particularly in hairpin bends in hilly regions/ghat sections. They came up with the revolutionary idea of using CCTV and LCD screens instead of convex mirrors so that the driver may get a heads-up on a vehicle approaching from the other side of the hill at a hairpin bend and avoid colliding with it.



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Another innovative idea has been introduced by Greeshma, Krithi K J et al. [3] which is a high-level system to notify personnel in charge about casualties as soon as an accident occurs. They have emphasized on creating cost-effective IR sensors, buzzers, plus LED/LCD screens that can warn the driver about the vehicle approaching from the contrary direction of the curve/hairpin bend. The existing GPS and GSM models are only useful after an accident has occurred and it is pointed out by Mrs. Y. Lavanya, M. Monika Rani et al. [4]. They have proposed a novel new technique to improve the situation of accidents occurring in hilly areas, notably in hairpin bends where the driver is unaware of a vehicle entering from the opposite direction. They presented proximity sensors, signaling (RGB LED), and a counter in their report. The vehicles are detected by the proximity sensor, and the counter maintains track of how many vehicles are present in that turn, coming from a given direction. The signal will change colour based on the counter's data. Suresh Nama et al. [7] found out that a driver must constantly make decisions and act on them while operating a vehicle. According to studies, situational awareness has a significant impact on decision-making and driving performance. At majority of the sections studied, the acquired data suggest that the vehicle operating speed is higher than the design speed. The 85th percentile speed limit is used to correlate with highway design speed as part of the design consistent evaluation criteria. According to the comparisons, around 45 percent of cars are driving faster than the design speed. Furthermore, the average at 50% of the sites, automobile speeds are higher than the design speed. In the case of trucks, around 10% of truck drivers exceed the design speed. N. Naveen and S SanMithra [1], in their analysis considered all road users, from cyclists to heavy-laden truck drivers. They've identified potential road safety hazards, cast light on the root causes of concern, and prioritized solution ideas. They also have mentioned about the behavior of the road user especially the driver as the major contributing factor for road safety.

In developing countries like India, the emergency services and trauma care is underdeveloped. In India, the rate of traffic accidents is increasing day by day, but the development of emergency services is lagging far behind. As expected, the accident scene is chaotic since there are no quick response teams. To help victims rescue efforts are made usually by the passers-by and bystanders [12]. Joshi et al. proposed the following ways to reduce RTA in mountainous roads based on their research and similar studies. Unstable ground slopes, and cracked regions prone to landslides and washing away should be avoided while constructing new road alignments in the hillsides. Parapet/guide walls, safe barriers, good drainage, appropriate sign-ages, markings, and other safety measures should be erected. The blasting operations should be as little as feasible and well-designed, with adequate warning systems in place to ensure that stones do not fall and cause loss of life or property. Sahil S. Shinde et al. [5] have addressed the three potential alignments for tunnel construction that they evaluated after conducting field surveys, but owing to budgetary constraints, they chose to build a ghat road instead because tunnel building is not economically viable. They have provided a financial comparison between the tunnel and the ghat road, as well as a plan and profile of the suggested route, which will be quite useful in our investigations. For a 90 percent reliable design verification of performance criteria, Mohd Mujahid et al. recommend utilizing the IIT-PAVE software.

## METHODOLOGY

The following methodology is used for the analysis of the proposed ghat road:

- In order to determine the optimal construction alternative, a preliminary survey and reconnaissance survey were done. After carefully weighing the advantages and disadvantages of each alternative, the existing kutch road was chosen.
- Detailed Survey and Investigations were carried out for the following:
  - Topographical Survey
  - Geotechnical and Material Investigations
  - Road Safety Assessment
- A total station was used to complete the topographic survey. The data was gathered along a 30-meter stretch. Every 10 metres along the carriageway's centre line, longitudinal section levels were taken.
- The geotechnical investigation was carried out to estimate the subgrade's soaked CBR and density.



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- A survey and inquiry were conducted in order to discover potential sources of construction materials, as well as their availability and suitability. As required, relevant laboratory tests were performed on representative samples taken from sources.
- The proposed road has been designed in accordance with IRC: Geometric Design Standards. The design and drafting were done using MX Road, AutoCAD, and Autodesk Land Development Desktop software.
- Separate plan and profile drawings were created at scales of 1:1500 horizontally and 1:150 vertically. It depicts all existing plan characteristics, such as the toe line of the road embankment, planned right-of-way restrictions, drainage structure locations, existing ground profile, proposed finished profile, intersection layouts, and representative cross sections of the main alignment, among other things.
- New pavement designs have been developed in compliance with Indian standards. The CBR was recorded at various points along the route.

**RESULTS AND ANALYSIS**

- Stretch is divided into 3 TCS numbers depending on the conditions.
- At TCS-II, a 0.5m Hard Shoulder with Breast Wall is provided on both sides (Both Side Hilly).
- One side Breast Wall and one side Retaining Wall are provided in TCS-III.
- For new construction, 29 CDs are proposed, with 2 CDs being Box Culverts and 27 CDs being HP Culverts. Due to their bad condition, 6 HP Culverts are also planned for reconstruction.
- TCS has proposed a breast wall of 2950m and a retaining wall of 1980m.
- Crust: GSB 150mm, WMM - 250mm, BM - 50mm, and SDBC - 25mm were used for the Main Carriageway and Junction.

**CONCLUSIONS**

Rainwater infiltration, incorrect water drainage, and a steep slope are some of the key factors that affect road building in the ghats, resulting in vehicle crashes. Because effective raises and falls are unavoidable on hill roads, the particular alignment with the shortest resistive length is the most desired. This criterion must be used in conjunction with other criteria. A detailed survey, avoiding routes through woods, appropriately planned drainage systems, and geomechanical stabilisation can all help to ensure a stable all-weather road. Cutting and filling on a large scale should be avoided as much as feasible. For the most part, the route should be able to achieve a ruling gradient. Hill features that are unstable, water-logged places, and seepage-prone areas should be avoided as much as possible. Hill roads are built by following the contours of the hill. The road's safety depends on the stability of the hill face or slope.

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**Table 2 : TCS Schedule**

| SI No | Description  | Type of TCS | From   | To     | Length |
|-------|--|-------------|--------|--------|--------|
|       |  |             | (Km)   | (Km)   | (Km)   |
| 1     | Single Lane Carriageway (Filling)  | TCS-I       | 31.811 | 33.480 | 1.669  |
| 2     | Single Lane Carriageway (Hairpin Bend with Both side Hilly)                  | TCS-II      | 33.480 | 33.560 | 0.080  |
| 3     | Single Lane Carriageway (Filling)  | TCS-I       | 33.560 | 33.950 | 0.390  |
| 4     | Single Lane Carriageway (Hairpin Bend with Both side Hilly)                  | TCS-II      | 33.950 | 34.010 | 0.060  |
| 5     | Single Lane Carriageway (Filling)  | TCS-I       | 34.010 | 34.230 | 0.220  |
| 6     | Single Lane Carriageway (Hairpin Bend with Both side Hilly)                  | TCS-II      | 34.230 | 34.330 | 0.100  |
| 7     | Single Lane Carriageway (Filling)  | TCS-I       | 34.330 | 34.720 | 0.390  |
| 8     | Single Lane Carriageway (Hairpin Bend with Both side Hilly)                  | TCS-II      | 34.720 | 34.790 | 0.070  |
| 9     | Single Lane Carriageway (Filling)  | TCS-I       | 34.790 | 34.925 | 0.135  |
| 10    | Single Lane Carriageway (Hairpin Bend with Both side Hilly)                  | TCS-II      | 34.925 | 35.030 | 0.105  |
| 11    | Single Lane Carriageway (Filling)  | TCS-I       | 35.030 | 35.070 | 0.040  |
| 12    | Single Lane Carriageway (Hairpin Bend with One side Hilly & one side valley) | TCS-III     | 35.070 | 35.110 | 0.040  |
| 13    | Single Lane Carriageway (Hairpin Bend with Both side Hilly)                  | TCS-II      | 35.110 | 35.180 | 0.070  |





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|    |   |         |        |                          |              |
|----|---|---------|--------|--------------------------|--------------|
| 14 | Single Lane Carriageway (Filling)   | TCS-I   | 35.180 | 36.030                   | 0.850        |
| 15 | Single Lane Carriageway<br>(Hairpin Bend with One side Hilly & one side valley) | TCS-III | 36.030 | 36.470                   | 0.440        |
| 16 | Single Lane Carriageway (Filling)   | TCS-I   | 36.470 | 37.060                   | 0.590        |
| 17 | Single Lane Carriageway<br>(Hairpin Bend with One side Hilly & one side valley) | TCS-III | 37.060 | 37.320                   | 0.260        |
| 18 | Single Lane Carriageway (Filling)   | TCS-I   | 37.320 | 37.650                   | 0.330        |
| 19 | Single Lane Carriageway<br>(Hairpin Bend with One side Hilly & one side valley) | TCS-III | 37.650 | 38.890                   | 1.240        |
| 20 | Single Lane Carriageway (Filling)   | TCS-I   | 38.890 | 39.166                   | 0.276        |
|    |   |         |        | TCS-I                    | 4.890        |
|    |   |         |        | TCS-II                   | 0.485        |
|    |   |         |        | TCS-III                  | 1.980        |
|    |   |         |        | <b>Total Length (Km)</b> | <b>7.355</b> |

Pavement Design As per IRC-37-2018

Table 3: Pavement Design as per IRC-37-2018

| Symbol       | Description  | Values Considered for Design | Unit              | Remarks   |
|--------------|--|------------------------------|-------------------|---|
| A            | Initial Traffic in the year of completion of construction in terms of the number of commercial vehicles per day. | 147                          | CVPD              | After completion of construction and opening to traffic |
| D            | Lane Distribution Factor   | 1.00                         | Percent           | As per Clause No-4.5, Page No-17 of IRC-37-2018         |
| F            | Vehicle damage factor  | 3.90                         | Plain/<br>Rolling | As per Table-4.2 Page No-16 of IRC-37-2018              |
| n            | Design life in years   | 15                           | Years             | As per Clause No-4.3.1, Page No-14 of IRC-37-2018       |
| r            | Annual growth rate of commercial vehicles  | 0.05                         | Percent           | As per Clause No-4.2.2, Page No-14 of IRC-37-2018       |
| P            | Number of commercial vehicles as per last count  | 140                          | Nos               | As per seven days traffic survey at Km33+000            |
| x            | No of years between the last count and the year of completion of construction                                    | 1                            | Years             | 1Year Construction                                      |
| $A=P(1+r)^x$ |  |                              |                   |   |
|              | Traffic in the year of completion of construction in terms of the number of Commercial vehicles per day.         | 147                          |                   | CVPD  |





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| $365 * [(1+r)^n - 1] * r * A * D * F$   |     |                              |           |                              |           |                              |     |               |     |
|---|-----|------------------------------|-----------|------------------------------|-----------|------------------------------|-----|---------------|-----|
| Cumulative number of standard axles in terms of msa as per Calculation                                |     |                              |           | 4.52                         | MSA       | Say                          | 5   |               |     |
| <b>Design Life Considered<br/>for Sub base &amp; Base Layer 15 Years and Bituminous Layer 7 Years</b> |     |                              |           |                              |           |                              |     |               |     |
| <b>Flexible Pavement Thickness Design As per IRC-37-2018 Using IIT PAVE Software</b>                  |     |                              |           |                              |           |                              |     |               |     |
| CBR   | MSA | Existing Crust Thickness(mm) |           | Required Crust Thickness(mm) |           | Proposed Crust Thickness(mm) |     |               |     |
|   |     | Items                        | Thickness | Items                        | Thickness | Widening                     |     | Over Existing |     |
| 8   | 5   | Earthen Road                 |           | SDBC                         | 25        | SDBC                         | 25  | SDBC          | 25  |
|   |     |                              |           | BM                           | 50        | BM                           | 50  | BM            | 50  |
|   |     |                              |           | WMM                          | 250       | WMM                          | 250 | WMM           | 250 |
|   |     |                              |           | GSB                          | 150       | GSB                          | 150 | GSB           | 150 |
| Total Thickness(mm)   |     |                              | 0         |                              | 475       |                              | 475 |               | 475 |

Table 4: Pavement Design as per IRC-37-2018

| Symbol                                | Description  | Values Considered for Design | Unit          | Remarks   |
|---------------------------------------|--|------------------------------|---------------|---|
| A                                     | Initial Traffic in the year of completion of construction in terms of the number of commercial vehicles per day. | 147                          | CVPD          | After completion of construction and opening to traffic |
| D                                     | Lane Distribution Factor   | 1.00                         | Percent       | As per Clause No-4.5, Page No-17 of IRC-37-2018         |
| F                                     | Vehicle damage factor  | 3.90                         | Plain/Rolling | As per Table-4.2 Page No-16 of IRC-37-2018              |
| n                                     | Design life in years   | 7                            | Years         |   |
| r                                     | Annual growth rate of commercial vehicles  | 0.05                         | Percent       | As per Clause No-4.2.2, Page No-14 of IRC-37-2018       |
| P                                     | Number of commercial vehicles as per last count  | 140                          | Nos           | As per seven days traffic survey at Km33+000            |
| x                                     | No of years between the last count and the year of completion of construction                                    | 1                            | Years         | 1Year Construction                                      |
| $A = P(1+r)^x$                        |  |                              |               |   |
|                                       | Traffic in the year of completion of construction in terms of the number of Commercial vehicles per day.         | 147                          |               | CVPD  |
| $365 * [(1+r)^n - 1] * r * A * D * F$ |  |                              |               |   |





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| Cumulative number of standard axles in terms of msa as per Calculation               |     | 1.70                         | MSA       | Say                          | 2          |                              |            |               |            |
|--|-----|------------------------------|-----------|------------------------------|------------|------------------------------|------------|---------------|------------|
| <b>Design Life Considered</b>  |     |                              |           |                              |            |                              |            |               |            |
| <b>for Sub base &amp; Base Layer 15 Years and Bituminous Layer 7 Years</b>           |     |                              |           |                              |            |                              |            |               |            |
| <b>Flexible Pavement Thickness Design As per IRC-37-2018 Using IIT PAVE Software</b> |     |                              |           |                              |            |                              |            |               |            |
| CBR  | MSA | Existing Crust Thickness(mm) |           | Required Crust Thickness(mm) |            | Proposed Crust Thickness(mm) |            |               |            |
|  |     | Items                        | Thickness | Items                        | Thickness  | Widening                     |            | Over Existing |            |
| 8  | 2   | Earthen Road                 |           | SDBC                         | 25         | SDBC                         | 25         | SDBC          | 25         |
|  |     |                              |           | BM                           | 50         | BM                           | 50         | BM            | 50         |
|  |     |                              |           | WMM                          | 250        | WMM                          | 250        | WMM           | 250        |
|  |     |                              |           | GSB                          | 150        | GSB                          | 150        | GSB           | 150        |
| <b>Total Thickness(mm)</b>   |     |                              | <b>0</b>  |                              | <b>475</b> |                              | <b>475</b> |               | <b>475</b> |

**Table 4: Traffic Census from Nudurupada to Kaliahata and From Kaliahata to Nudurupada**

| Date        | 1.00               | 1.00      | 0.50         | 1.50                | 3.00     | 3.00      | 4.50         | 1.50                 | 1.50            | 3.00         | 6.00       |              |              |  |
|-------------|--------------------|-----------|--------------|---------------------|----------|-----------|--------------|----------------------|-----------------|--------------|------------|--------------|--------------|--|
|             | Passenger Vehicles |           |              | Commercial Vehicles |          |           |              | Slow Moving Vehicles |                 |              |            |              |              |  |
|             | Car                | 3-Wheeler | 2-Wheeler    | Mini Bus            | Pvt. Bus | LCV       | 2-Axle Truck | 3-Axle Truck         | Without Trailer | With Trailer | Cycle      | Vehicles     | PCUs         |  |
| 20/12/2021  | 188                | 15        | 2,203        | 6                   | 1        | 88        | 25           | 17                   | 35              | 14           | 180        | 2,772        | 1,780        |  |
| 21/12/2021  | 190                | 19        | 2,257        | 5                   | 1        | 77        | 22           | 19                   | 38              | 16           | 195        | 2,839        | 1,813        |  |
| 22/12/2021  | 182                | 22        | 2,662        | 6                   | 1        | 82        | 28           | 14                   | 32              | 12           | 191        | 3,232        | 1,994        |  |
| 23/12/2021  | 175                | 17        | 2,755        | 6                   | 1        | 85        | 31           | 15                   | 39              | 10           | 198        | 3,332        | 2,050        |  |
| 24/12/2021  | 195                | 18        | 2,694        | 5                   | 1        | 75        | 27           | 18                   | 35              | 13           | 182        | 3,263        | 2,020        |  |
| 25/12/2021  | 257                | 35        | 3,532        | 19                  | 5        | 117       | 30           | 17                   | 33              | 11           | 225        | 4,281        | 2,630        |  |
| 26/12/2021  | 172                | 22        | 2,492        | 5                   | 1        | 90        | 26           | 12                   | 36              | 10           | 183        | 3,049        | 1,890        |  |
| <b>ADT</b>  | <b>194</b>         | <b>21</b> | <b>2,656</b> | <b>7</b>            | <b>2</b> | <b>88</b> | <b>27</b>    | <b>16</b>            | <b>35</b>       | <b>12</b>    | <b>193</b> | <b>3,253</b> | <b>2,025</b> |  |
| <b>CVPD</b> | <b>140</b>         |           |              |                     |          |           |              |                      |                 |              |            |              |              |  |

**Table 5: Estimate**

| GENERAL ABSTRACT |   |                               |
|------------------|---|-------------------------------|
| SL. NO           | DESCRIPTION OF ITEM                           | AMOUNT                        |
| 1                | Road Proper                                   | 7.355 Km<br>Rs.5,06,71,991.53 |
| 2                | T/Y Junction                                  | 5 Nos<br>Rs.3,39,377.96       |
| 3                | Culvert -36 Nos                               |                               |
| i                | Reconstruction of HP Culvert (1 X 1200mm dia) | 6 Nos<br>Rs.21,47,268.97      |
| ii               | New of HP Culvert (1 X 1200mm dia)            | 2 Nos<br>Rs.5,79,701.36       |
| iii              | New of HP Culvert (1 X 1000mm dia)            | 25 Nos<br>Rs.62,77,410.45     |
| iii              | New construction of Box Culvert (1x5.0mx5.0m) | 1 No<br>Rs.58,46,700.72       |
| iv               | New construction of Box Culvert (1x6.0mx6.0m) | 1 No<br>Rs.77,44,710.58       |
| 4                | Breast Wall                                   | 2950 mtr<br>Rs.3,82,38,851.82 |
| 5                | Retaining Wall 2mtr Height                    | 1980 mtr<br>Rs.8,08,29,787.60 |





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|   |                                  |                              |                     |
|---|----------------------------------|------------------------------|---------------------|
| 6 | Road safety & Furniture          |                              | Rs.1,84,77,077.14   |
|   | Sub Total                        |                              | Rs. 21,11,52,878.13 |
|   |                                  | Add 9% SGST                  | Rs.1,90,03,759.03   |
|   |                                  | Add 9% CGST                  | Rs.1,90,03,759.03   |
|   |                                  | Add QUALITY CONTROL<br>1.00% | Rs.21,11,528.78     |
|   |                                  | Add CONTINGENCY 1.00%        | Rs.21,11,528.78     |
|   | Add SURVEY & INVESTIGATION 1.00% | Rs. 21,11,528.78             |                     |
|   | Total Cost                       |                              | Rs.25,54,94,982.54  |
|   |                                  | SAY Rs.                      | 25.550 CR           |

**Table 6: Details of Structure List**

| SL. NO | Chainage (Km) | Type of Structure | Existing Width | Existing Span | Condition | Proposed Chainage | Type   | Proposed Span | Proposal       | Proposed Width   |      |
|--------|---------------|-------------------|----------------|---------------|-----------|-------------------|--------|---------------|----------------|------------------|------|
| 1      | 31.858        | HP                | 7.50           | 1x0.900       | Poor      | 31+858            | HP     | 1x1.200       | Reconstruction | 7.50             |      |
| 2      | 32.065        | HP                | 10.00          | 5x0.900       | Good      | 32+068            | HP     | 5x0.900       | Retain         | -                |      |
| 3      | 32.250        | HP                | 7.50           | 1x0.900       | Poor      | 32+250            | HP     | 1x1.200       | Reconstruction | 7.50             |      |
| 4      | 32.400        | HP                | 10.00          | 1x0.600       | Good      | 32+412            | HP     | 1x1.200       | Reconstruction | 7.50             |      |
| 5      | 32.500        | HP                | 7.50           | 1x0.600       | Good      | 32+500            | HP     | 1x1.200       | Reconstruction | 7.50             |      |
| 6      | 32.690        | HP                | 7.50           | 1x0.600       | Poor      | 32+688            | HP     | 1x1.200       | Reconstruction | 7.50             |      |
| 7      | 32.915        | HP                | 7.50           | 1x0.900       | Poor      | 32+920            | HP     | 1x1.200       | Reconstruction | 7.50             |      |
| 8      | 32.990        | HP                | 7.500          | 1x0.900       | Good      | 32+995            | HP     | 1x0.900       | Retain         | -                |      |
| 9      | 33.200        | Causeway          |                |               |           |                   | 33+210 | Box           | 1x6.0x6.0      | Reconstruction   | 6.00 |
| 10     | Additional    |                   |                |               |           |                   | 33+610 | HP            | 1x1.200        | New construction | 7.50 |
| 11     |               |                   |                |               |           |                   | 33+880 | Box           | 1x5.0x5.0      | New construction | 6.00 |
| 12     | 34.070        | HP                | 7.500          | 1x0.900       | Good      | 34+073            | HP     | 1x0.900       | Retain         | -                |      |
| 13     | 34.450        | HP                | 7.500          | 1x0.900       | Good      | 34+457            | HP     | 1x0.900       | Retain         | -                |      |
| 14     | 34.900        | HP                | 7.500          | 1x1.200       | Good      | 34+912            | HP     | 1x1.200       | Retain         | -                |      |
| 15     | Additional    |                   |                |               |           |                   | 35+280 | HP            | 1x1.200        | New construction | 7.50 |
| 16     |               |                   |                |               |           |                   | 35+630 | HP            | 1x1.0          | New construction | 7.50 |
| 17     |               |                   |                |               |           |                   | 35+670 | HP            | 1x1.0          | New construction | 7.50 |
| 18     |               |                   |                |               |           |                   | 35+790 | HP            | 1x1.0          | New construction | 7.50 |
| 19     |               |                   |                |               |           |                   | 35+825 | HP            | 1x1.0          | New construction | 7.50 |
| 20     |               |                   |                |               |           |                   | 35+950 | HP            | 1x1.0          | New construction | 7.50 |
| 21     |               |                   |                |               |           |                   | 36+050 | HP            | 1x1.0          | New construction | 7.50 |
| 22     |               |                   |                |               |           |                   | 36+140 | HP            | 1x1.0          | New construction | 7.50 |
| 23     |               |                   |                |               |           |                   | 36+210 | HP            | 1x1.0          | New construction | 7.50 |
| 24     |               |                   |                |               |           |                   | 36+245 | HP            | 1x1.0          | New construction | 7.50 |
| 25     |               |                   |                |               |           |                   | 36+330 | HP            | 1x1.0          | New construction | 7.50 |
| 26     |               |                   |                |               |           |                   | 36+375 | HP            | 1x1.0          | New construction | 7.50 |
| 27     |               |                   |                |               |           |                   | 36+740 | HP            | 1x1.0          | New construction | 7.50 |





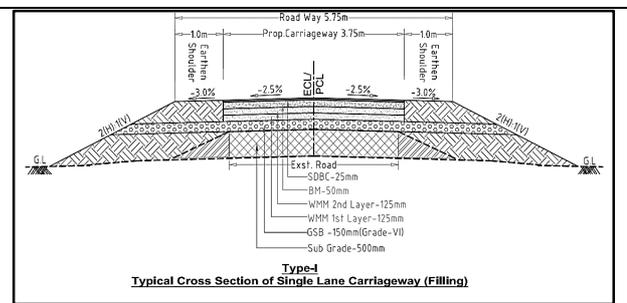
Akanksha Parida et al.,

|    |  |        |    |       |                  |      |
|----|--|--------|----|-------|------------------|------|
| 28 |  | 36+765 | HP | 1x1.0 | New construction | 7.50 |
| 29 |  | 37+260 | HP | 1x1.0 | New construction | 7.50 |
| 30 |  | 37+290 | HP | 1x1.0 | New construction | 7.50 |
| 31 |  | 37+750 | HP | 1x1.0 | New construction | 7.50 |
| 32 |  | 37+80  | HP | 1x1.0 | New construction | 7.50 |
| 33 |  | 38+035 | HP | 1x1.0 | New construction | 7.50 |
| 34 |  | 38+090 | HP | 1x1.0 | New construction | 7.50 |
| 35 |  | 38+395 | HP | 1x1.0 | New construction | 7.50 |
| 36 |  | 38+460 | HP | 1x1.0 | New construction | 7.50 |
| 37 |  | 38+590 | HP | 1x1.0 | New construction | 7.50 |
| 38 |  | 38+660 | HP | 1x1.0 | New construction | 7.50 |
| 39 |  | 38+810 | HP | 1x1.0 | New construction | 7.50 |
| 40 |  | 38+865 | HP | 1x1.0 | New construction | 7.50 |

| SI No. | Structure Type & Proposal       | Nos.      | Span      | Width |   |
|--------|---------------------------------|-----------|-----------|-------|---|
| 1      | Reconstruction of HP Culvert    | 6         | 1x1.200   | 7.50  | m |
| 2      | New construction of HP Culvert  | 2         | 1x1.200   | 7.50  | m |
| 3      | New construction of HP Culvert  | 25        | 1x1.0     | 7.50  | m |
| 4      | Reconstruction of Box Culvert   | 1         | 1x6.0x6.0 | 6.00  | m |
| 5      | New construction of Box Culvert | 1         | 1x5.0x5.0 | 6.00  | m |
|        |                                 | <b>35</b> | Nos       |       |   |



Fig 1: Red Line shows the proposed alignment



Typical Cross Section of Single Lane Carriageway (Filling)

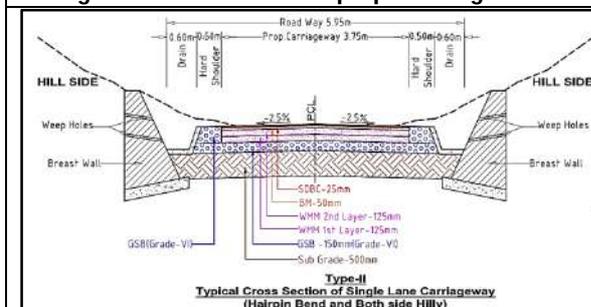


Fig 3: TCS II

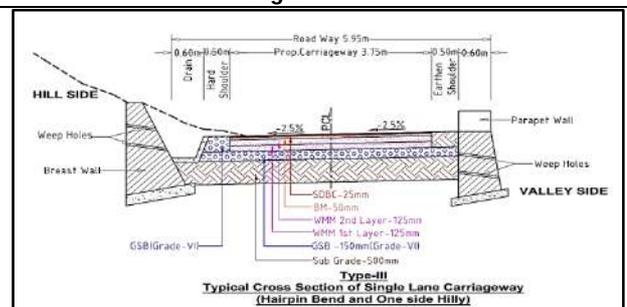


Fig 4: TCS III





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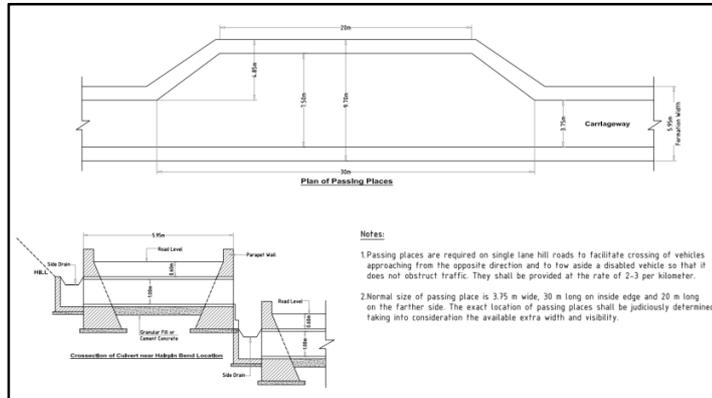


Fig 5: Plan of Passing Places





## Effectiveness of Autogenic Training in Reducing Insomnia among Older Adults in Selected Old Age Homes, Erode

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### ABSTRACT

Autogenic Training aims to get people relax and that can help reducing insomnia and make people sleep better. This study is aimed to assess the effectiveness of Autogenic Training in reducing insomnia among older adults in selected old age homes, Erode. The evaluative approach and non-randomized control group design was used. Non-probability sampling technique was used to select the study samples. Samples comprised of 60(30 in experimental group & 30 in control group). Pre-test score was assessed by modified Pittsburgh Sleep Quality Index scale. The level of insomnia among older adults were analyzed by paired „t“ test and unpaired „t“ test. In experimental group, pre-test mean and standard deviation are 10.6 and 2.44 respectively and in post-test, after Autogenic Training, the mean and standard deviation are 8 and 2.5 respectively. The calculated value of „t“ (12.4) is greater than the tabulated value of „t“ at 0.05 level. In control group, pre-test mean and standard deviation are 11.2 and 2.26 respectively and In post-test, with no intervention, the mean and standard deviation are 11.3 and 2 respectively. The calculated value of „t“ (0.83) is lesser than the tabulated value of „t“ at 0.05 level. Chi-square was used to find the association of insomnia scores with their selected demographic variables. The significant association were found in age ( $\chi^2=10.67$ ), education ( $\chi^2=7.9$ ), and participation of daily activity in old age home ( $\chi^2 = 8.43$ ).it shows, Autogenic Training was effective to reduce the level of insomnia among older adults.

**Keywords:** Autogenic Training, insomnia, old age, Pittsburgh sleep quality index scale, relaxation technique



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## INTRODUCTION

**“Sleep, that sometimes shuts sorrow’s eye”**

-William Shakespeare

Sleep is a part of the rhythm of life. Without a “good sleep”, the body loses the ability to revitalize, the mind is less adapted and one’s mood is altered. Normal aging changes conspire to interfere with the quality of sleep. Insomnia is defined as difficulty initiating or maintaining sleep at least three nights / week, in addition to complaints of sleep related daytime impairment. Good sleep is essential for one’s physical health and emotional well-being. Insomnia remains one of the most common sleep disorders encountered in the geriatric clinic population ,frequently characterized by the subjective complain to difficulty falling or maintaining sleep, or non restorative sleep, producing significant day time symptoms including difficulty concentrating and mood disturbances. Insomnia is associated with significant morbidity if left untreated .Older individuals with insomnia have a 23%increase in risk of development of depression symptoms. Several studies have documented an increased risk of depression in older patients with persistent insomnia . (Bushey & Cirelli, 2011).The aim of relaxation techniques is to achieve physical and mental relaxation. They are meant to reduce physical tension and interrupt the thought processes that are affecting sleep. Studies show that people who have learned relaxation techniques sleep a bit longer at night. The main benefit of the relaxation techniques was being able to fall asleep somewhat more quickly. There are different types of relaxation techniques: Progressive muscle relaxation, Autogenic Training, Biofeedback, Imagery (visualizations). [2017, Institute for quality & Efficiency in health care]. Autogenic Training may improve sleep patterns for patients with various health conditions and reduce anxiety & depression both of which may result from & cause insomnia. [2019, Bowden, Lorenc, Robinson].[2012,Pigeon,Conner.K].

## OBJECTIVES OF THE STUDY

- To assess the pre-test level of insomnia in experimental and control group among older adults in selected old age homes using the modified Pittsburgh Sleep Quality Index scale.
- To evaluate the effectiveness of Autogenic Training on insomnia in experimental group among older adults of selected old age home.
- To compare the post-test insomnia scores of experimental and control group among older adults in selected old age homes.
- To find the association between post-test insomnia scores of older adults with their selected demographic variables in experimental group.

## HYPOTHESIS

- **H<sub>1</sub>**: There will be a significant difference between the pre-test and post-test insomnia scores in terms of effect of Autogenic Training on reducing insomnia for thee experimental group.
- **H<sub>2</sub>**: There will be a significant difference between post-test insomnia scores of experimental and control groups among older adults in selected old age homes.
- **H<sub>3</sub>**: There will be a significant association between post-test insomnia score and their selected demographic variables in experimental group.

## MATERIALS AND METHODS

An evaluative approach was used in this study. Quasi experimental non-randomized control group design was selected. The study was conducted in selected old age homes in Erode. The target population for this study was older adults and the accessible population was older adults aged 55 years and above. The sample of the study was selected by non probability purposive sampling technical and comprised of 60 older adults (30 in experimental and 30 in control group) aged 55 Years and above having insomnia who fulfilled the inclusion criteria.



**Krishnaveni et al.,****INSTRUMENTS**

Section - A: Demographic Variables:

Section - B : The modified Pittsburgh Sleep Quality Index Scale

The modified PSQI scale, is a self-administered questionnaire, includes four open-ended questions and 14 questions to be answered using event-frequency and semantic scales. (The latter use paired words of opposite meaning, such as good-bad.)The tool looks at seven areas: subjective sleep quality, sleep latency (the time it takes to fall asleep), sleep duration, habitual sleep efficiency (the ratio of total sleep time to time in bed), sleep disturbances, the use of sleep-promoting medication (prescribed or over-the-counter), and daytime dysfunction.

**RELIABILITY**

The reliability was computed using the test-retest method, using Karl Pearson's coefficient of correlation formula. The obtained value of coefficient of correlation  $r$  was 0.87. Hence the tool was highly reliable.

**ETHICAL CONSIDERATION**

The written permission was obtained from the responsible authorities of old age homes. The consent was obtained from the samples before initiating the data collection. Thus, the ethical practices was ensured in the study.

**DATA COLLECTION PROCEDURE**

The investigator explained the purpose of this study and obtained consent from the participants. 30 samples were selected at each old age home by using non-probability purposive sampling technique. The pre-test was done by using the modified Pittsburgh Sleep Quality Index scale to each sample about 20 minutes to assess the level of insomnia among older adults living in both old age homes, Erode. After pre-test Autogenic Training given to the experimental group in the form of group teaching in the common place for 30 minutes. After a month, the quality of sleep and effectiveness of autogenic training were assessed with the modified Pittsburgh Sleep Quality Index scale for the experimental group of older adults and on the same day post-test was done for the control group of older adults with no intervention.

**DATA ANALYSIS**

Data was collected, tabulated, and analyzed on the basis of objectives and hypotheses by using statistical methods. Here descriptive and inferential statistics were used to analyze the data. Descriptive statistics used in this study were mean, standard deviation, frequency and percentage distribution to describe the demographic variables of the older adults with insomnia. Inferential statistics used in this study were paired,  $t$  test to evaluate the effectiveness of Autogenic Training on insomnia for the experimental group and for the control group the same test used to measure the insomnia with no intervention, unpaired  $t$  test to compare the post-test insomnia scores of experimental and control groups among older adults in selected old age homes and Chi-square test to find out the association between post-test score and their selected demographic variables.

**RESULTS AND DISCUSSION**

The findings of the study were discussed in the following sections:

**SECTION A**

Description of demographic variables of older adults in experimental and control group (Table 1).

**SECTION B**

Assessment of pre-test and post-test level of insomnia among older adults in experimental and control group (Table 2, Table 3). In pre-test, out of 30 older adults in experimental group, 13 (43%) of them had mild insomnia and 17 (57%) of them had moderate insomnia. In post-test, 20 (67%) of them had mild insomnia and 10 (33%) of them had

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moderate insomnia Inpre-test and post-test, out of 30 older adults in control group, 11 (37%) of them had mild insomnia and 19 (63%) of them had moderate insomnia.

### SECTION C

Effectiveness of Autogenic Training to reduce the level of insomnia among older adults in experimental group. In post-test out of 30 older adults in experimental group, 20 (67%) of them had mild insomnia, 10 (33%) of them had moderate insomnia and out of 30 older adults in control group, 11 (37%) of them had mild insomnia, 19 (63%) of them had moderate insomnia. Table 4 shows that in pretest, the mean and standard deviation are 10.6 and 2.44 respectively. In the Post test out of, after Autogenic Training, the mean and standard deviation are 8 and 2.5 respectively. The calculated value of „t“ (12.4) is greater than the tabulated value of „t“ at 0.05 level of significance. This implies that Autogenic Training is statistically highly effective to reduce the level of insomnia. Table 5 shows that in experimental group, the pretest mean and standard deviation are 11.2 and 2.26 respectively. In the post-test, with no intervention, the mean and standard deviation are 11.3 and 2 respectively. The calculated value of „t“ (0.83) is lesser than the tabulated value of „t“ at 0.05 level of significance. Table 6 shows that the post-test of experimental group, the mean and standard deviation are 8 and 2.5 respectively. In the post-test of control group, the mean and standard deviation are 11.3 and 2 respectively. The calculated value of „t“ (5.6) is greater than the tabulated value of „t“ at 0.05 level of significance. This implies that Autogenic Training is statistically highly effective to reduce the level of insomnia among older adults.

### SECTION D

Association between post-test insomnia scores of older adults and their selected demographic variables in experimental group. The results shows that there is significant association between post- test score and age ( $\chi^2 = 10.67$ ) education ( $\chi^2 = 7.9$ ) and the participation of daily activity in old age home ( $\chi^2 = 8.43$ ).

## DISCUSSION

The level of insomnia for experimental and control group among older adults were assessed by using the modified Pitts burgh Sleep Quality Indexscale. Table 2 and table 3 shows the description of pre-test and post-test scores on level of insomnia among experimental and control group respectively. Out of 30 older adults in experimental group, 13 (43%) of them had mild insomnia and 17 (57%) of them had moderate insomnia in pre-test, 20 (67%) of them had mild insomnia, 10 (33%) of them had moderate insomnia in post-test. Out of 30 older adults in control group, 11 (37%) of them had mild insomnia and 19 (63%) of them had moderate insomnia in pre-test, 11 (37%) of them had mild insomnia and 19 (63%) of them had moderate insomnia in post-test. Figure:1 represents the percentage distribution of post-test insomnia scores of experimental and control groups among older adults in selected old age homes. In post-test of 30 older adults in experimental group, 20 (67%) of them had mild insomnia, 10 (33%) of them had moderate insomnia and out of 30 older adults in control group, 11 (37%) of them had mild insomnia, 19 (63%) of them had moderate insomnia. Table 4 shows in experimental group the mean and standard deviation are 10.6 and 2.44 respectively in pre-test. In the post -test, the mean and standard deviation are 8 and 2.5 respectively. The calculated value of „t“ (12.4) is greater than the tabulated value of „t“ at 0.05 level of significance. Table 5 shows in control group the mean and standard deviation are 11.2 and 2.26 respectively in pre-test. In post -test, with no intervention, the mean and standard deviation are 11.3 and 2 respectively. The calculated value of „t“ (0.83) is lesser than the tabulated value of „t“ at 0.05 level of significance. Table 6 denotes that In experimental group mean and SD are 8 & 2.5 respectively. In control group mean & SD are 11.3 & 2 respectively in post-test. The calculated value of „t“ (5.6) is greater than the tabulated value of „t“ at 0.05 level of significance. This implies that Autogenic Training is highly effective to reduce the level of insomnia among older adults. So the researcher found that the level of insomnia has reduced in experimental group than in control group. Chi-square was used to find the association between post-test insomnia scores of older adults and their selected demographic variables. The results shows that there is significant association between post-test score and age ( $\chi^2 = 10.67$ ), education ( $\chi^2 = 7.9$ ), and participation of daily activity in old age home ( $\chi^2 = 8.43$ ).





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## CONCLUSION

There are serious health risks associated with insomnia. According to National Institute for Health, insomnia can increase people risk for mental health problems as well as overall health concerns. Sleep is essential for a person's health and well being. Improving the knowledge among older adults about relaxation techniques such as Autogenic Training could help them to reduce insomnia for better sleep. The present study was supported by series of other studies, which confirmed that Autogenic Training helped to reduce the level insomnia among older adults.

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**Table 1: Frequency and percentage distribution of demographic variables of older adults in experimental and control group**

| S.No | DEMOGRAPHICVARIABLES | EXPERIMENTAL GROUP |            | CONTROLGROUP |            |
|------|----------------------|--------------------|------------|--------------|------------|
|      |                      | Frequency          | Percentage | Frequency    | Percentage |
| 1.   | Age                  |                    |            |              |            |
|      | a) 55-60years        | 11                 | 37 %       | 8            | 27 %       |
|      | b) 61-65 years       | 8                  | 26 %       | 6            | 19 %       |
|      | c) 66-70 years       | 3                  | 10 %       | 8            | 27 %       |
|      | d) 71yearsand above  | 8                  | 27 %       | 8            | 27 %       |





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|     |   |    |      |    |      |
|-----|---|----|------|----|------|
| 2.  | Sex   |    |      |    |      |
|     | a) Male   | 18 | 60 % | 13 | 43 % |
|     | b) Female                                       | 12 | 40 % | 17 | 57 % |
|     | c) Others                                       | 0  | 0%   | 0  | 0%   |
| 3.  | Education                                       |    |      |    |      |
|     | a) Illiterate                                   | 11 | 37 % | 4  | 13 % |
|     | b) Schooling                                    | 14 | 46 % | 21 | 70 % |
|     | c) Graduate                                     | 5  | 17 % | 5  | 17 % |
|     | d) Postgraduate                                 | 0  | 0 %  | 0  | 0 %  |
| 4.  | Marital status                                  |    |      |    |      |
|     | a) Married                                      | 10 | 33 % | 17 | 57 % |
|     | b) Unmarried                                    | 0  | 0 %  | 1  | 3 %  |
|     | c) Widow/ Widower                               | 20 | 67 % | 12 | 40 % |
|     | d) Divorced                                     | 0  | 0 %  | 0  | 0 %  |
| 5.  | Previous occupation                             |    |      |    |      |
|     | a) Government job                               | 2  | 7 %  | 3  | 10 % |
|     | b) Private job                                  | 3  | 10 % | 4  | 13 % |
|     | c) Business                                     | 9  | 30 % | 8  | 27 % |
|     | d) Others                                       | 16 | 53 % | 15 | 50 % |
| 6.  | Family income per month                         |    |      |    |      |
|     | a) Less than ₹10,000                            | 4  | 13 % | 8  | 27 % |
|     | b) ₹10,001 - ₹20,000                            | 12 | 40 % | 7  | 23 % |
|     | c) ₹20,001 - ₹25,000                            | 10 | 33 % | 9  | 30 % |
|     | d) ₹25,001 and above                            | 4  | 14 % | 6  | 20 % |
| 7.  | History of medical illness                      |    |      |    |      |
|     | a) No illness                                   | 9  | 30 % | 9  | 30 % |
|     | b) Acute illness                                | 0  | 0 %  | 0  | 0 %  |
|     | c) Chronic illness                              | 9  | 30 % | 8  | 27 % |
|     | d) Acute and chronic illness                    | 12 | 40 % | 13 | 43 % |
| 8.  | Type of admission in old age home               |    |      |    |      |
|     | a) Voluntary                                    | 24 | 80 % | 25 | 83 % |
|     | b) Involuntary                                  | 3  | 10 % | 2  | 7 %  |
|     | c) Admission by relatives                       | 3  | 10 % | 3  | 10 % |
|     | d) Others                                       | 0  | 0 %  | 0  | 0 %  |
| 9.  | Duration of stay in old age home                |    |      |    |      |
|     | a) Less than a year                             | 10 | 33 % | 8  | 27 % |
|     | b) 1-2years                                     | 9  | 30 % | 6  | 20 % |
|     | c) 2-3years                                     | 4  | 13 % | 5  | 17 % |
|     | d) More than 3 years                            | 7  | 24 % | 11 | 36 % |
| 10. | Participation of daily activity in old age home |    |      |    |      |
|     | a) Independent                                  | 21 | 70 % | 21 | 70 % |
|     | b) Partially dependent                          | 8  | 26 % | 6  | 20 % |
|     | c) Dependent                                    | 1  | 4 %  | 1  | 3 %  |
|     | d) No participation                             | 0  | 0 %  | 2  | 7 %  |





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**Table 2: Frequency and percentage distribution of pre-test and post-test level of insomnia among older adults for experimental group.**

| S. No | LEVEL OF INSOMNIA | PRE-TEST  |            | POST-TEST |            |
|-------|-------------------|-----------|------------|-----------|------------|
|       |                   | Frequency | Percentage | Frequency | Percentage |
| 1.    | Mild              | 13        | 43%        | 20        | 67%        |
| 2.    | Moderate          | 17        | 57%        | 10        | 33%        |
| 3.    | Severe            | 0         | 0%         | 0         | 0%         |

**Table 3: Frequency and percentage distribution of pre-test and post-test level of insomnia among older adults for control group.**

**N=30**

| S. No | LEVEL OF INSOMNIA | PRE-TEST  |            | POST-TEST |            |
|-------|-------------------|-----------|------------|-----------|------------|
|       |                   | Frequency | Percentage | Frequency | Percentage |
| 1.    | Mild              | 11        | 37%        | 11        | 37%        |
| 2.    | Moderate          | 19        | 63%        | 19        | 63%        |
| 3.    | Severe            | 0         | 0%         | 0         | 0%         |

**Table 4 : Comparison of pre-test and post-test scores of the level of insomnia among older adults in experimental group.**

**N=30**

| LEVEL OF INSOMNIA | MEAN | STANDARD DEVIATION | t-VALUE | STATISTICAL RESULT                 |
|-------------------|------|--------------------|---------|------------------------------------|
| Pre-test          | 10.6 | 2.44               | 12.4    | <b>Significant</b><br>[0.05 level] |
| Post-test         | 8    | 2.5                |         |                                    |

**Table 5 : Comparison of pre-test and post-test scores of the level of insomnia among older adults in control group.**

| Level of Insomnia | Mean | Standard Deviation | t-Value | Statistical Result             |
|-------------------|------|--------------------|---------|--------------------------------|
| Pre-test          | 11.2 | 2.26               | 0.83    | No significant<br>[0.05 level] |
| Post test         | 11.3 | 2                  |         |                                |

**Table 6: Comparison of post-test scores of the level of insomnia among older adults in experimental and control group.**

**N=60**

| LEVEL OF INSOMNIA            | MEAN | STANDARD DEVIATION | t-VALUE | STATISTICAL RESULT                 |
|------------------------------|------|--------------------|---------|------------------------------------|
| Experimental Group post-test | 8    | 2.5                | 5.6     | <b>Significant</b><br>[0.05 level] |
| Control group post-test      | 11.3 | 2                  |         |                                    |





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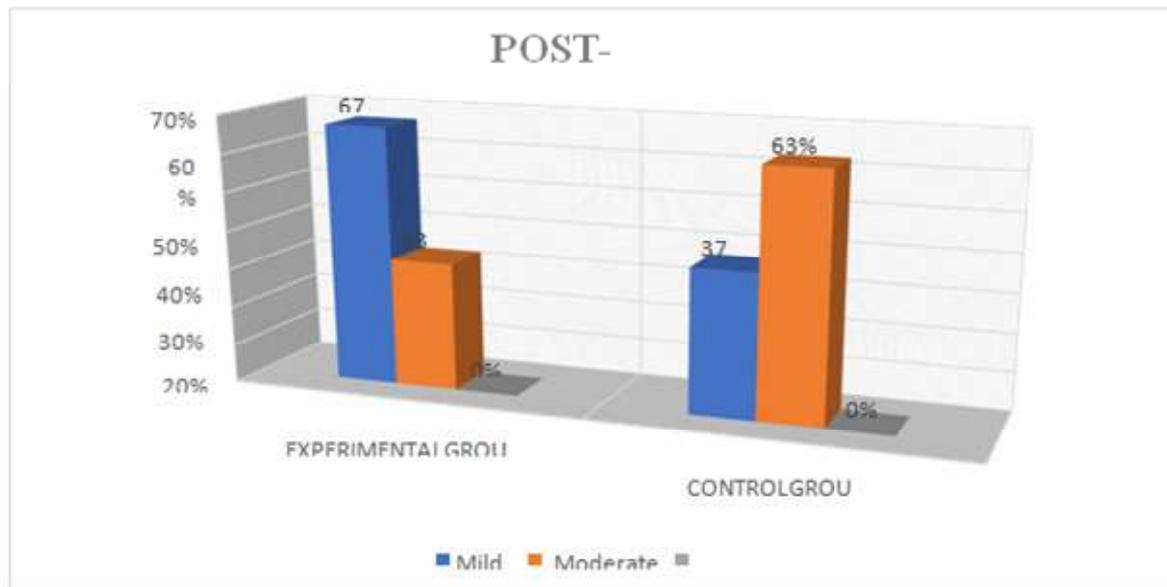


Figure 1. Represents the percentage distribution of post-test insomnia scores of experimental and control groups among older adults in selected old age homes





## Synthesis, Characterization, Antioxidant and Antimicrobial Studies of Lanthanide Complexes with Tri Dentate Schiff base Ligand

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### ABSTRACT

Using one pot methods, the tridentate N<sub>3</sub>-type Schiff base 2,6-di(pyridin-2-yl)-4-p-tolylpyridine was produced by condensation of 2-acetyl pyridine and 4-methyl benzaldehyde with ammonia. This hybrid ligand was utilised to make lanthanide complexes (La, Sm, and Eu) that could be exploited as new biological agents. Elements, FT-IR, UV-Visible, Mass spectrometry, and molar conductivity were used to characterise the lanthanide complexes. Antibacterial and antifungal activities against multidrug resistant organisms such as *Escherichia coli*, *Staphylococcus aureus*, and *Aspergillus niger* were tested in vitro. In comparison to other complexes, the antibacterial results demonstrated that the Sm<sup>+3</sup> complex had a high potency against gram positive and gram negative microorganisms. With IC<sub>50</sub>, all lanthanide compounds showed modest antioxidant activity. The effects of the Schiff base ligand and its Ln (III) complexes on DPPH radical scavenging were investigated. The Ln (III) complexes were substantially more effective than the free Schiff base ligand for quenching DPPH.

**Keywords:** Terpyridine, one pot method, lanthanides, antioxidant studies, anti-bacterial and anti-fungal activity

### INTRODUCTION

Terpyridine, or tpy, has attracted people's interest since its discovery in the early 1930s by Morgan and Burstall [1, 2]. Since then, a plethora of derivatives have been produced by grafting various substituents onto the terpyridine core using diverse synthetic techniques [3- 6]. Terpyridine molecules have three nitrogen atoms and can chelate a wide range of ions, including those from the main group, transition metals, and even lanthanides. These complexes feature



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unique redox and photophysical properties that can be fine-tuned due to the nature of the substitution pattern onto the tpy ligand. Photovoltaic materials [7], Nano materials [8], biomarkers [9], medicinal chemistry [10–12], and catalysts [13] are only a few of the applications for these compounds. In supramolecular chemistry, terpyridines and their derivative complexes are frequently employed. In the recent decade, lanthanide coordination chemistry has been one of the most researched areas of chemistry [14–16]. The intriguing structures [17–18] and potential applications in a variety of sciences, including diagnostic tools in biology [19], catalysis [20], luminescence [21], and magnetism [22], excite chemists' interest in these fields of research. The flexibility of the acyclic ligand and the many coordination sites allow for a wide range of configurations with lanthanide ions [23–24]. A variety of coordination molecules can be made with this type of ligand. Antibacterial [25], antifungal [26], anticancer [27], and depressing [28] characteristics have been reported in the literature. The study's purpose is to prepare, characterise, and assess the biological activity of lanthanide complexes as a result of the above. We can produce tridentate Schiff base 2,6-di(pyridin-2-yl)-4-p-tolylpyridine by condensation of 2-acetyl pyridine and 4-methyl benzaldehyde with ammonia. Elemental analysis, molar conductivity, UV–visible, NMR, and infrared (IR) spectroscopies were employed to determine the structure of the ligand and its lanthanide complexes (La, Sm, and Eu). The antibacterial activity of the free ligand and its lanthanide complexes was further investigated using agar well diffusion and minimum inhibitory concentration (MIC) methods against a variety of dangerous bacterial species. The antioxidant capabilities of the free ligand and its complexes were also examined using the 2,2 diphenylpicrylhydrazyl (DPPH) test technique in terms of their radical scavenging power.

**EXPERIMENTAL****Materials and reagents**

[Ln (NO<sub>3</sub>)<sub>3</sub>(H<sub>2</sub>O)<sub>6</sub>] (Ln = La, Sm), [Eu(NO<sub>3</sub>)<sub>3</sub>(H<sub>2</sub>O)<sub>5</sub>], 4-methyl benzaldehyde, 2-acetyl pyridine and ammonia were purchased from Sigma Aldrich Chemical Company. All other solvents and reagents were of analytical grade and used without further purification.

**Synthesis of Schiff base ligand L1**

Using one-pot methods, 4-methyl benzaldehyde (2.5 ml; 20 mmol), potassium hydroxide pellets (0.5 g; 67 mmol), and 25% aqueous ammonia (60 mL) are added to a solution of 2-acetylpyridine (5 ml; 41 mmol) in ethanol (100 mL). The reaction mixture was stirred for 24 hours at room temperature. After that, the solid was filtered through a glass-sintered funnel and washed in ice-cold 50 percent ethanol until the washings were colourless. Under vacuum, the product was dried. As a bright yellow solid, the ligand was obtained. Recrystallization in ethanol yielded an analytical sample. Molecular formulae of ligand C<sub>22</sub>H<sub>17</sub>N<sub>3</sub>. <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ: 2.36(s,3H), 7.37-7.35(d,2H,J=7.5),7.50-7.47(q,2H,J=8.5),7.80-7.78(d,2H,J=8.5),8.01-7.97(m,2H,J=8.1),8.65-8.62(t,4H,J=1.8),8.73-8.71(d,2H,J=4.7).

<sup>13</sup>CNMR(100MHz,CDCl<sub>3</sub>)δ:21.37,118.17,121.47,125.07,127.28,130.56,135.08,138.02,139.78,149.90,155.53,156.19. The synthesis of ligand L1 shown in scheme 1

**Synthesis of lanthanide complexes**

Refluxing and stirring a 1:2 ratio of metal [La (NO<sub>3</sub>)<sub>3</sub>(H<sub>2</sub>O)<sub>6</sub>], (0.5 g, 0.1 mmol) and ligand (1 g, 0.3 mmol) over a water bath for 8 hours yielded lanthanide complexes. The precipitate was collected after cooling to room temperature, washed with methanol multiple times, and dried in vacuum at room temperature. All of the other Sm and Eu complexes were made in the same way.

**RESULTS AND DISCUSSION****Characterization of Schiff base ligand L1**

Elemental analysis, IR, <sup>1</sup>H NMR, and <sup>13</sup>C NMR spectral investigations reveal the structure of the ligand L1. Scheme 1 depicts the synthesis method for the ligand L1. Table 1 shows the results of elemental analysis with molecular



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formula and percentage yield of the ligand L1. Figure 1 shows the mass spectrum of the ligand L1. Figures 2.1 and 2.2 show the whole and extended  $^1\text{H}$ NMR spectra of the ligand. Figure 3 shows the ligand's  $^{13}\text{C}$ NMR spectrum.

**Characterization of lanthanide complexes:**

Elemental analysis, MASS, IR, molar conductance, and UV-visible spectroscopy were used to characterise the isolated solid complexes. All of these complexes are non-hygroscopic, stable in air at room temperature, insoluble in water and most organic solvents, but soluble in DMF and DMSO solvents. So far, several attempts to obtain single crystals of the complexes have failed. Table 1 summarises the yields, molar conductivity values, and elemental analyses of Ln(III) complexes and ligand L. The general formula  $[\text{Ln}(\text{L}1)_2(\text{H}_2\text{O})_x]$  corresponds to the stoichiometry of the complexes derived from elemental analysis. These claims are also supported by the molar conductivity, infrared, and UV-Visible measurements provided in the next sections. Figure 4 shows the mass spectrum of the  $[\text{Sm}(\text{L}1)_2(\text{H}_2\text{O})_2]$  complex.

**Molar conductivity measurements**

The molar conductivities of the Ln (III) complexes in DMF solutions at 25 °C were measured and tabulated in Table 1. The molar conductivity values are in the range reported for 1:1 electrolytes reveals that the all complexes are non-electrolytes ( $\Delta\text{m} = 28.4\text{--}42.57 \Omega^{-1} \text{cm}^2 \text{mol}^{-1}$ ) [29].

**Infrared spectroscopy**

Table 2 shows the significant infrared frequencies, as well as a tentative attribution of the ligand L and its associated Ln(III) complexes. The IR spectra of the La complexes showed the ligand characteristic bands with suitable shifts due to complex formation, and the infrared spectra of the other Ln(III) complexes showed the same. The C=N of the azomethine group was discovered at 1640  $\text{cm}^{-1}$  in the free Schiff base. These bands move to lower wave numbers by 15 to 39  $\text{cm}^{-1}$  after complexation, indicating that the imine bonds have a double bond character and that the azomethine nitrogen atoms are coordinated to the Ln(III) ion [30-31]. The presence of a medium intensity band at 454 to 440  $\text{cm}^{-1}$  assigned to (Ln-N) vibration further reinforced this coordination. The presence of a medium intensity band about 471 to 464  $\text{cm}^{-1}$  assigned to (Ln-O) vibration further reinforced this coordination. In addition, the complex's IR spectrum shows a broad band between 3443 and 3425  $\text{cm}^{-1}$  in the spectra of the Ln(III) complexes, which is attributed to the stretching frequency of (O-H), with an increase in intensity indicating that the hydroxyl oxygen is coordinated to the Ln(III) ion without proton displacement.

**UV-visible spectroscopy of complexes**

UV-Vis absorption spectra of the lanthanide complexes were carried out in DMF solvent at room temperature. The UV-Vis spectra values of the maximum absorption wavelength ( $\lambda_{\text{max}}$ ), frequency of Ln (III) complexes {Ln = La, Sm, and Eu } and their assignment are listed in Table 3. [32-33]. The Electronic spectrum of  $[\text{La}(\text{L}1)_2(\text{H}_2\text{O})_2]$  complex as shown in the Fig.5.

**Antimicrobial activity**

The MIC of the ligand L1 and its Ln(III) complexes against different types of Gram-negative, Gram-positive bacteria and Fungal activities were determined and tabulated in Table 4. DMSO was used as a negative control and CEFADROXIL used as positive standards for antibacterial. FLUCONAZOLE was used as a reference for antifungal studies. These compounds exhibit moderate to strong antimicrobial activity. Comparatively a better activity is found for the bacteria rather than the fungi. The Sm(III) complex exhibits a higher activity than the other metal complexes towards fungal species. The Sm(III) complex shows a good activity, especially against the Gram-negative and Gram positive bacteria such as E. coli and S.aureus. The Eu(III) complex shows equal activity compared to Sm(III) complex in Gram-negative bacteria. The La(III) and Eu(III) complexes display moderate activity against the gram positive and fungal activity. The antimicrobial activity of the complexes is greater than those of the free ligand, this indicates that the complexation to metal enhances the activity of the ligand. This is explained on the basis of Overtone's concept and chelation theory. Chelation tends to make the ligand a more powerful and potent bacterial agent. A possible explanation for this increase in the activity upon chelation is that, in a chelated complex, the positive charge



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of the metal is partially shared with donor atoms present in the ligands and there is an electron delocalization over the whole chelated ring. This, in turn, increases the lipid layers of the bacterial membranes. Generally, it is suggested that the chelated complexes deactivate various cellular enzymes, which play a vital role in various metabolic pathways of these microorganisms. Other factors such as solubility, conductivity, and dipole moment that are affected by the presence of metal ions may also be the possible reasons for increasing the biological activity of the metal complexes as compared to the ligand from which they are derived [34-35].

**Antioxidant activity**

The antioxidant activity of the ligand L1 and its Ln(III) complexes have attracted increasing interests and been substantially investigated [36]. Fig.7. shows the plots of DPPH• free radical scavenging activity % for the ligand L1 and its Ln(III) complexes. It is obvious that the scavenging activity increases with increasing sample concentration in the range tested. As shown in Table 5, The free radical scavenging activity of ligand L and its lanthanide complexes was determined by their ability to bleach DPPH radical, which has been previously reported. This assay provides information on the reactivity of a compound with a stable free radical. Ln (III) complexes are significantly more efficient in quenching DPPH radical than free ligand L. The antioxidant activity of the Schiff base is due to hydrogen- or electron-donating tendency to DPPH• so as to produce a stable diamagnetic molecule. Molecules with greater ability to donate electrons or hydrogen to DPPH• have a higher antioxidant activity. The interaction of ligand L with the positively charged Ln (III) increases the electron density drawn from the nitrogen and oxygen atoms, which makes the N—H or O—H bonds more polarized. Among the examined lanthanide complexes, the Sm (III) complex has the highest activity. It can quench the DPPH radical more efficiently than the other lanthanide ions. In them, complex Sm (III) exhibited excellent antioxidant activity compare with Eu (III) and La (III) complexes found to have IC50 value and (%) inhibition. Addition of Ln complex to DPPH• Radical as shown in the Fig.8.

**CONCLUSION**

The tridentate Schiff base ligand L, as well as its Ln(III) complexes, are synthesised and described in this study. The ligand L coordinates to the central Ln(III) ion [La(III), Sm(III), and Eu(III)] with coordination number 8 according to analytical and spectroscopic data. The antibacterial activity of the produced Ln(III) complexes was higher than that of the comparable ligand L, according to the results. The Ln(III) complexes' antioxidant activity on DPPH• is concentration dependant and higher than the free ligand L. When compared to [La(L1)<sub>2</sub>(H<sub>2</sub>O)<sub>2</sub>] and [Eu(L1)<sub>2</sub>(H<sub>2</sub>O)<sub>2</sub>], the [Sm(L1)<sub>2</sub>(H<sub>2</sub>O)<sub>2</sub>] complex had superior antimicrobial and antioxidant properties.

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Table 1: Analytical and Physical Characterization Data for Ligand and Its Metal Complexes

| S. No | Compound   | Molecular Weight Found (Calculated) | Melting point (°C) | Colour Yield (%)     | Elemental analysis Found (calculated) |             |               |               | Molar conductivity $\Omega^{-1} \text{ cm}^2 \text{ mol}^{-1}$ |
|-------|--|-------------------------------------|--------------------|----------------------|---------------------------------------|-------------|---------------|---------------|--|
|       |  |                                     |                    |                      | C(%)                                  | H(%)        | N(%)          | Ln(%)         |  |
| 1     | Ligand   | 323.39 (323)                        | 165-167            | Yellow (63.68)       | 81.69 (81.79)                         | 5.29 (5.19) | 12.99 (13.00) | -             | -  |
| 2     | [La(L1) <sub>2</sub> (H <sub>2</sub> O) <sub>2</sub> ] | 822 (823)                           | 234-237            | Light yellow (84.29) | 64.28 (64.20)                         | 4.65 (4.65) | 10.22 (10.21) | 16.9 (16.88)  | 34.87  |
| 3     | [Sm(L1) <sub>2</sub> (H <sub>2</sub> O) <sub>2</sub> ] | 834.5 (834)                         | 267-269            | Orange (77.84)       | 63.31 (63.35)                         | 4.58 (4.59) | 10.07 (10.07) | 18.01 (18.02) | 42.57  |
| 4     | [Eu(L1) <sub>2</sub> (H <sub>2</sub> O) <sub>2</sub> ] | 836 (836.5)                         | 282-284            | Light orange (82.88) | 63.20 (63.16)                         | 4.33 (4.57) | 10.05 (10.04) | 18.18 (18.17) | 28.40  |





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**Table 2: Infra-Red Spectral Data for Ligand and Their Lanthanide Complexes**

| S.no | Compound   | $\nu(\text{OH})$ | $\nu(\text{C=N})$ | $\nu(\text{M-O})$ | $\nu(\text{M-N})$ |
|------|--|------------------|-------------------|-------------------|-------------------|
| 1    | L1   | -                | 1640              | -                 | -                 |
| 2    | [La(L1) <sub>2</sub> (H <sub>2</sub> O) <sub>2</sub> ] | 3425             | 1601              | 471               | 440               |
| 3    | [Sm(L1) <sub>2</sub> (H <sub>2</sub> O) <sub>2</sub> ] | 3435             | 1619              | 468               | 449               |
| 4    | [Eu(L1) <sub>2</sub> (H <sub>2</sub> O) <sub>2</sub> ] | 3443             | 1625              | 464               | 454               |

**Table 3: Electronic Spectral Data for Lanthanide Complexes**

| S.No | Compound   | Wavelength<br>$\lambda$ max (nm) | Frequency<br>(cm <sup>-1</sup> ) | Band<br>assignments                |
|------|--|----------------------------------|----------------------------------|------------------------------------|
| 1    | [La(L1) <sub>2</sub> (H <sub>2</sub> O) <sub>2</sub> ] | 284                              | 35,211                           | $\pi \rightarrow \pi^*$ transition |
|      |  | 346                              | 28,901                           | $\pi \rightarrow \pi^*$ transition |
|      |  | 365                              | 27,397                           | $\pi \rightarrow \pi^*$ transition |
|      |  | 377                              | 26,525                           | $\pi \rightarrow \pi^*$ transition |
|      |  | 404                              | 24,752                           | $n \rightarrow \pi^*$ transition   |
|      |  | 419                              | 23,866                           | $n \rightarrow \pi^*$ transition   |
| 2    | [Sm(L1) <sub>2</sub> (H <sub>2</sub> O) <sub>2</sub> ] | 290                              | 34,482                           | $\pi \rightarrow \pi^*$ transition |
|      |  | 353                              | 28,328                           | $\pi \rightarrow \pi^*$ transition |
|      |  | 375                              | 26,666                           | $\pi \rightarrow \pi^*$ transition |
|      |  | 393                              | 25,445                           | $\pi \rightarrow \pi^*$ transition |
|      |  | 408                              | 24,509                           | $n \rightarrow \pi^*$ transition   |
| 3    | [Eu(L1) <sub>2</sub> (H <sub>2</sub> O) <sub>2</sub> ] | 281                              | 35,587                           | $\pi \rightarrow \pi^*$ transition |
|      |  | 332                              | 30,120                           | $\pi \rightarrow \pi^*$ transition |
|      |  | 354                              | 28,248                           | $\pi \rightarrow \pi^*$ transition |
|      |  | 367                              | 27,247                           | $\pi \rightarrow \pi^*$ transition |
|      |  | 426                              | 23,474                           | $n \rightarrow \pi^*$ transition   |

**Table 4: Antimicrobial Activity of Schiff Base Ligand (L) and Its Lanthanide Complexes at Various Pathogens**

|  | Gram(-) bacteria | Gram(+) bacteria | Fungal species |
|--|------------------|------------------|----------------|
|  | <i>E.coli</i>    | <i>S.aureus</i>  | <i>A.niger</i> |
| Ligand L1  | -                | -                |                |
| [La(L1) <sub>2</sub> (H <sub>2</sub> O) <sub>2</sub> ] | +                | +                | +              |
| [Sm(L1) <sub>2</sub> (H <sub>2</sub> O) <sub>2</sub> ] | ++               | ++               | ++             |
| [Eu(L1) <sub>2</sub> (H <sub>2</sub> O) <sub>2</sub> ] | ++               | +                | +              |
| DMSO<br>(- ve control)                                 | -                | -                | -              |
| FLUCONAZOLE<br>(+ ve control)                          |                  |                  | +++            |
| CEFADROXIL<br>(+ ve control)                           | +++              | +++              |                |

NOTE: Inhibition zone :0 mm(-)inactive; 1-5 mm(+)= less active; 6-10 mm(++) moderately active; 10-15 mm(+++) highly active;

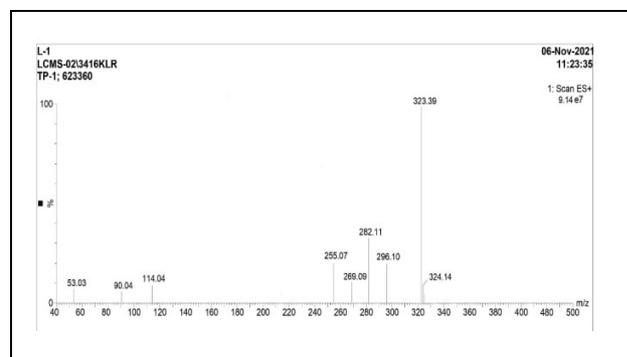




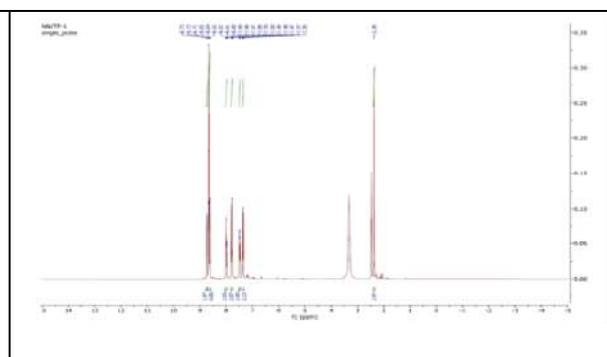
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**Table 5: Scavenging Effect of Schiff Base Ligand (L) and Its Lanthanide Complexes on DPPH Free Radical At Various Concentrations**

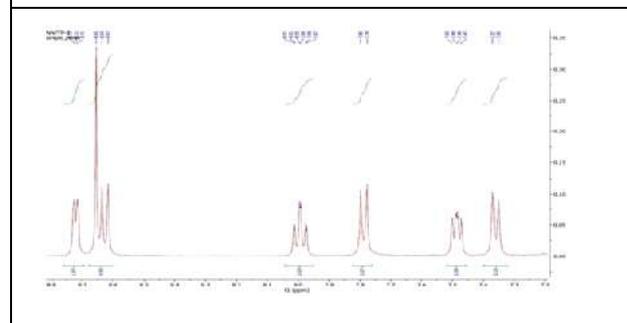
| Compound   | DPPH scavenging activity (%) |       |       |       | IC <sub>50</sub> |
|--|------------------------------|-------|-------|-------|------------------|
|  | 25µM                         | 50µM  | 75µM  | 100µM |                  |
| ligand   | 26.19                        | 32.45 | 39.63 | 44.32 | -                |
| [La(L1) <sub>2</sub> (H <sub>2</sub> O) <sub>2</sub> ] | 27.42                        | 36.52 | 44.92 | 54.81 | 85.50            |
| [Sm(L1) <sub>2</sub> (H <sub>2</sub> O) <sub>2</sub> ] | 31.63                        | 42.13 | 53.48 | 66.72 | 65.46            |
| [Eu(L1) <sub>2</sub> (H <sub>2</sub> O) <sub>2</sub> ] | 28.72                        | 39.19 | 49.67 | 58.32 | 74.91            |
| Ascorbic acid  | 36.42                        | 56.13 | 67.42 | 85.63 | 41.12            |



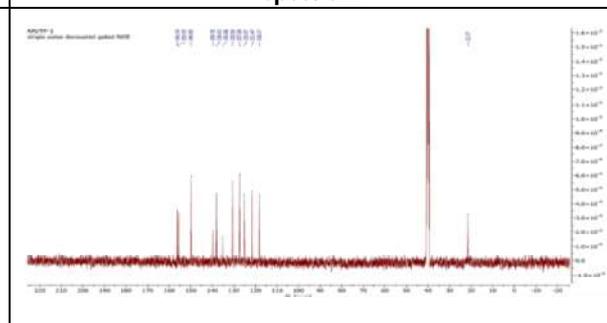
**Figure1: Mass spectrum of ligand L1**



**Figure 2.1: <sup>1</sup>H NMR spectrum of ligand L1(Complete spectrum)**



**Figure 2.2: <sup>1</sup>H NMR spectrum of ligand L1 (Expanded spectrum)**



**Figure 3: <sup>13</sup>C NMR spectrum of ligand L1**





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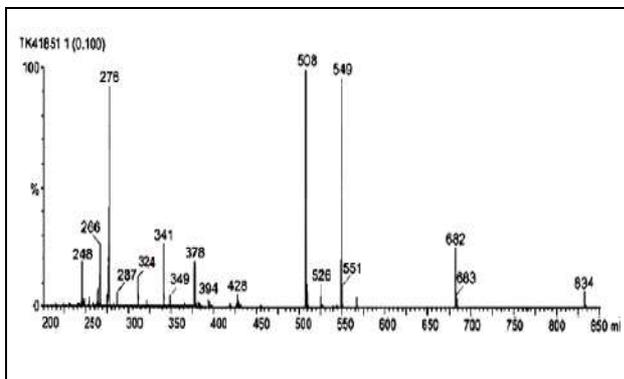


Figure 4: Mass spectrum of  $[Sm(L1)_2(H_2O)_2]$  complex.

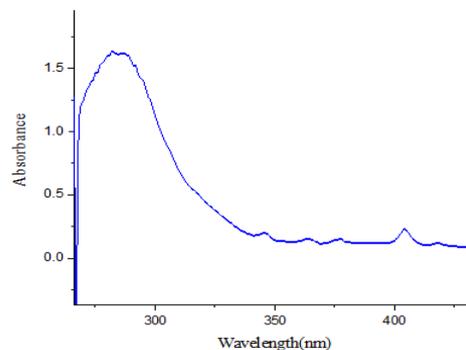


Figure 5: Electronic spectrum of  $[La(L1)_2(H_2O)_2]$  complex

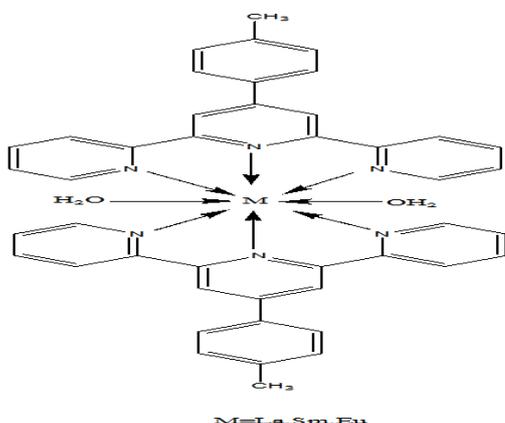


Figure 6: Schematic representation of lanthanide metal  $[M(L1)_2(H_2O)_2]$  complex

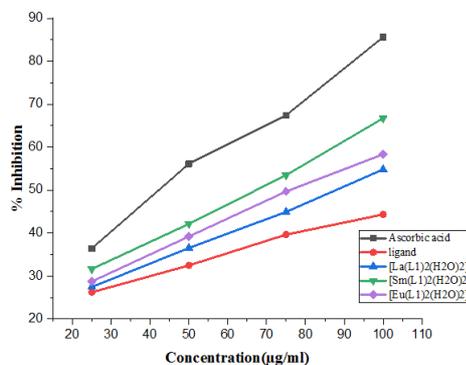


Figure 7: Antioxidant activity of the ligand and the lanthanide complexes

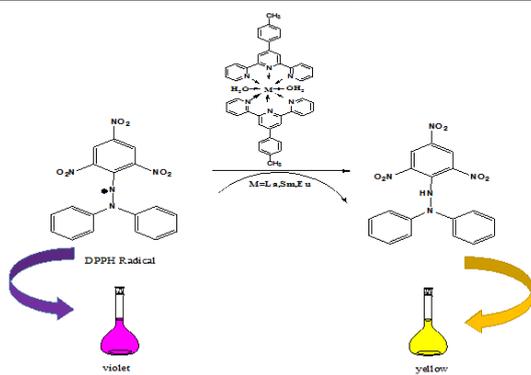
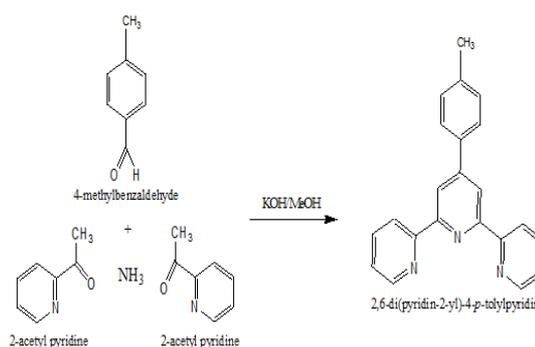


Figure 8: Addition of Ln complex to DPPH. Radical



Scheme 1: synthesis of ligand L1





## Cultural Ecology of Sacred Groves in Karbi Anglong District of Assam, India

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### ABSTRACT

One of the essential objectives of this paper is to explore the cultural ecology of the sacred groves of the Karbi tribe in the Karbi Anglong district of Assam. Generally, the sacred groves represent the remnants of the climax vegetation of the area. They are the natural treasure house of bio-diversity of the locality. The Karbi tribe often practices several traditional methods and belief systems. Such traditional methods are involved in the protection of sacred groves. They also practice cultural taboos on certain occasions, which certify that flora and fauna must be protected. Similarly, specific flora and fauna are considered sacred. However, recently, the sacred groves have started dilapidated due to changes in the belief system. In this context, the documentation of the diversity of sacred groves is reasonably necessary. Therefore, this study suggested essential measures for the immediate protection of sacred groves. Since this paper elucidated myths and beliefs of sacred groves, the data was collected in the form of oral interviews in the selected study area by applying qualitative research techniques.

**Keywords:** Animistic practice, conservation, Indigenous species, Taboos, Totemic objects

## INTRODUCTION

India is one of the binding regions to preserve various types of sacred groves. Indeed, the maintenance of sacred groves dates back several hundred years. Perhaps this could be said of the natural conservationist attitude of the local people who are closely associated with forests and sacred sites (Gadgil and Vartak 1975, Burman 1992, Mitra



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and Pal 1994, Hughes and Chandran 1998, Tripathi 2001, Mishra et al. 2004). Various sacred groves have appeared in India, primarily in the parts of the western ghats, northeast india, and Central India (Gadgil and Vartak 1976, Burman 1992, Rodgers 1994, Balasubramanyam and Induchoodan 1996, Tripathi 2001, Khumbongmayum et al. 2005, Khan 2008). In recent times some scholars have established a database for documentation of sacred groves with the help of technology which has become a helpful resource hub for understanding the biodiversity of sacred groves (Gaikwad et al. 2004). In the case of northeast India, various writings have been documented on sacred groves. However, these writings failed to address the cultural significance of sacred groves. The cultural construction of sacred groves plays a significant role in the region's cultural ecology. However, some recent writings have reported from northeast India paid diminutive attention to the ecological importance of sacred groves (Medhi and Borthakur 2003, Tripathi 2005, Saikia 2006, Teron 2008a, Bhattacharjee 2015, Teron 2017b, Shilpa et al. 2020a, Shilpa et al. 2020b, Timung 2020). The need to preserve the unique practice of maintaining sacred groves is now one of the essential management practices required for cultural and biological importance. However, there is a trend of declining sacred groves in India. However, a few sacred groves are still prevalent in northeast India's hill areas, which have been passed down the generations (Saikia 2006). Karbi Anglong is the largest hill district of Assam with extensive forest coverage. The landscape of this district is hilly terrain in nature and a source of rich flora and fauna where the people mainly depend on forest resources. Therefore, forests play an essential role in the socio-economic life of the Karbi tribe in this district. The forest type in this district is different from the diverse configuration pattern of the ground and the rainfall pattern. Karbi Anglong of fauna and flora is quite rich. This district is considered one of the hot spots of mega bio-diversity in the northeastern region (Dhanaraju 2019). An ecological imbalance between humans and the environment has become a serious concern. Therefore, this paper explores the various sacred groves and their cultural representation in the Karbi Anglong district of Assam. The people of Karbi Anglong have evolved a way of life for centuries woven around cultural ecology. Particularly the Karbi tribe always tries to ensure that their natural resources are protected against the degradation by man and nature by evolving their traditional method of the conservative system.

**MATERIALS AND METHODS**

Karbi tribe is one of the major ethnic groups in northeast India, mainly situated in the Karbi Anglong district of Assam. This paper is developed based on the primary data collected for Sponsored Research Project of the Indian Council of Social Science (ICSSR), New Delhi. The field study was conducted in the Karbi Anglong district of Assam from 2016 to 2018. The secondary sources were collected from the relevant Government publications, including Annual Souvenirs of Karbi Anglong Autonomous Council (KAAC), Reports, Websites of Assam State, etc. The field observations and oral narratives or myths of the community are extensively used in this paper by applying qualitative research techniques. Narrative inquiry is one of the essential data collection methods in qualitative research. It is the process of gathering information for research through storytelling. Besides this data collection method, other documentation methods like video and audio recording have been used during oral interviews. Since this study focuses on the oral narratives of the sacred groves of the Karbi tribe, the samples were collected purposefully from this community only.

**RESULT AND DISCUSSION****Karbi Myths and Cultural Ecology**

Myths are local traditions based on the communities' oral stories or cultural practices. There are various myths about the Karbi tribe, which is the source of information about the cultural ecology. According to Karbi mythology, the world of the Karbi ancestors invokes a harmonious world of co-existence with animals and plants, demons and deities, where 'the realm of the wild' and the 'human world' at times intersect. It is understood that the universe is shared by all beings, both animate and inanimate. The Karbi ancestors invoke a harmonious co-existence of humans with animals and plants, protective deities, and spirits. Before the creation of the universe, there existed a vast turbulent sea. Teron (2008) reiterated the myth of the Karbis that the 'Great Mother or Great Father' whom Karbis call





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'Pithe/Pothe' created the universe according to a version of the creation myth. Subsequently, grasses and trees, hills and mountains, lakes and rivers, varieties of animals, birds and avian species, ants and bees, maggots and flies came into being. The Karbi myth explores that the first Karbi parents, 'Sum' and Hemphu-Mukrang, created 'Sang'. The five principal clans of the Karbi tribe, viz., Kronjang, Ejang, Tungjang, Lijang, and Dingjang were emerged from Hemphu-Mukrang. The god also created a pair of divine dogs, Sibong and Sibe, to guard and protect the Karbi humans from being devoured to extinction by demons. In Karbi tradition, dogs are therefore respected. There is still another version of the myth called 'Mosera' which refers to a mythical bird, *Voplakpi*. The bird laid hundreds of 'eggs' from which the Karbi progenitors and contemporary human groups emerged. This illustrates the spiritual connection of the Karbi ancestors with their surroundings or nature (Teron, 2008). In several versions of creation narratives, the ecological vision of the Karbi ancestors is pronounced. In the innumerable origin narratives, the environmental idea of the Karbi ancestors is illustrated eloquently. In the early spring, according to tradition, a ritual invocation of monsoon known as 'Botor Kikur' is performed by Katharpo, the highest priest in the office of the Karbi chief, by the oral version of the legend of 'Ha'imu', which in a way is the propitiation of the deified spirit of the peasant woman who preferred death than to submit herself to a cruel chief. The nature of 'Ha'i' roamed the sky after her death, and her tears of agony poured down like rain. During the ritual, a grass-hopper (*chanrik*), a cicada (*bengcheret*), a golden beetle (*arni aharling*), a *vo-krokchur* (a kind of bird), and a frog (*chongho*) are propitiated. For Karbi's ancestors, the hills, mountains, rivers, lakes, etc., are entities that are alive and are owned by unseen spirits. A Karbi enters into spiritual communion with the unseen energies and worships them as protective deities in various annual rituals. Certain places in Karbi society are identified as *arnam-keso*, meaning under the spell of an 'angry god'; therefore, the places are considered sacred, and many strict taboos are associated with such places. The taboos are generally warnings and demand complete avoidance of foul speeches and actions so as not to defile the place and irritate the god living there. It is believed that such violation invites divine punishment, including immediate sickness leading even to death. According to researchers, taboos protecting sacred groves constitute indigenous conservation systems. In society, *arnam-keso* is almost a common occurrence. The sacred groves can be considered the 'specimens of cultural and ecological co-evolution'. Household deities, village deities, and territorial deities are characteristically similar. All of them are equally important in the community's belief system. There are angry counterparts of these deities, identified as *hi-i*, and both are worshiped together with *arnam* as *hi-i-arnam*. Therefore, *arnam-keso* is treated the same way. The Karbis believe that since the sacred groves have miraculous powers, they protect specific flora and fauna. For instance, the plant *Garugapinnata* is often thought of in the local community as having incredible healing powers (Sarma & Indrani, 2011). A female dirge singer (*charhepi*) plays a vital role during the death ritual. She sings *Arve Arniketoialun* (rain-cloud removal song) when imminent rain threatens to interrupt death rituals. The mourners also invoke rains with their songs when drought visits the earth. The man-animal relationship in Karbi tradition is varied and deep-rooted. The lycanthropic phenomenon of tiger-man still evokes a mysterious romance. For anthropologists, this fascinating phenomenon, a problem of 'human behavior' (Fodor, 1945:318), is rather widespread among cultures in the northeast, known as 'Killing-Nongkret' or 'Killing-Chongkret' among the Karbis, where a man physically transforms into a tiger. A particular category of priests, known as 'Ucha', communicates with tigers; he calls them at will and feeds them in an annual ritual.

#### Sacred Groves

Generally, the sacred groves represent the remnants of the climax vegetation of the area. They are a natural treasure house of bio-diversity. Many of the endangered species are generally continued to the forests. The foliage of the quiet groves can be distinguished into four major types: top canopy, sub-canopy layer, shrub layer, and ground flora. As mentioned, the Karbi people worship the hills and forest. The terrain and the rivers are considered saviors and friends. The Karbi King divided his territory into four zones: Ronghang, Chingthong, Socheng Dhenta, and Amri. The sites of the old kingdom were kept as sacred groves. No felling whatever is allowed inside such groves. Generally, the sacred groves are situated in the catchment areas of rivers. The detailed histories associated with every sacred grove are pretty different and vary from one another. The same varieties of mythology usually are associated with each sacred grove. At present, the groves are not appropriately maintained. The original system of keeping the sacred groves is also not practiced. Unlike Meghalaya, there is no legal framework formulated to protect sacred groves in Karbi Anglong. Totemic belief is one of the unique and peculiar characteristic features of the Karbi society.



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They are totemic because, like any other indigenous tribes of the world, they also have mysterious and mischievous physical objects, like plants, animals, birds, and even aquatic life. Some of which the Karbi considered as their totemic objects or taboo or curse otherwise, in Karbi dialect 'Kertang'(taboo). The belief of 'Kertang' continues from generation to generation. It is maintained in every household of each Karbi clan, and they prevent from killing or consuming those totemic objects. The non-adherence to such restrictions would bring them misfortune if not in the present generation but in the future generation to come. The Karbis believe that since the sacred groves have miraculous powers, they protect specific flora and fauna. For instance, the plant *Garuga pinnata* is often accepted among the local community that this plant has incredible powers (Sarma and Barpujari 2011). Franzer (2010) stated, "A totem is a class of objects which a savage is regarded with superstitious respect, believing that there exists between him and every member of the clans an intimate and altogether special relation". The connection between a person and his totem is mutually beneficial, and therefore, the totem protects the man. The man shows his respect for the totem in various ways by not killing it or cutting it. As distinguished from fetish, a totem is never an isolated individual. However, invariably a class of objects, generally a species or of plants, more rarely a class of inanimate natural objects, very rarely a class of artificial objects". Levi- Strauss (1963) argued that "totemism is not necessarily a religious phenomenon, but rather a classificatory one. Consequently, totemism is a label for a certain kind of logic. People employ the distinctions found in nature to impose distinctions between categories of people. The totemic designation does more than merely label people and groups; they also establish a particular structure of their relationship". There are both community and clan-based totemic objects. It is fascinating to state that different clans of the Karbi tribe admire different species as sacred (totemic belief). These are interconnected with their belief system, where the people are compelled to believe in certain animals and plant species. For instance, the Terang clan of Karbi believes that the killing of hornbills is completely prohibited because which a grave sin to the community (Sarma and Barpujari 2011). Besides, there are several totemic beliefs of the Karbi, such as killing tigers and elephants. Killing cats is also prohibited. Family is taboo for those Karbi who worshiped those animal spirits. Such worship is known as 'Sonpi-Sonbon'. The worshippers of 'Arnam' (God) never kill the cats. Likewise, those families who perform the rituals of 'Dor' never kill any of the snake's kind. In their paper, Sarma and Barpujari (2011) mentioned that "the Tokbi clan avoids killing or consuming eagles. Despite being good firewood, the Lo Teron tree is sacred for the Teron clan, and therefore, it is taboo for them to use it. Even it is not allowed to touch the tree. The Ingsung leaves, which are sour and taken as a vegetable by the Karbis, are sacred to the Ingti clan and are thus taboo for consumption". Apart from these restrictions, the killings of some important animals are strictly prohibited and often used to eat in society. The slaughter of any pregnant animal for eating purposes is prohibited. There are numerous animal and plant totems exclusive to clans and sub-clans. For example, the Langne sub-clan members of the Teron clan regard the python as their totem. According to myth, the animal helped Langnes cross a river on its back to safety. Therefore, it is taboo to harm the animal for the members of the sub-clan. For the Teron clan, it is taboo to touch a plant called Lo-Teron. Likewise, the Inghi clan members are not supposed to touch or contact the plant 'arhi' (*Eupatorium connabinum linn*) because the clan members reached the safety of a river shore with the help of the plant. The Bodrum, one of the thirty sub-clans of the Inghi clan of the Karbis, has an exciting tale about a widowed mother. She was a leper and was therefore ostracized in the wilderness and died. However, a tiger took pity and licked her into wellness and health. The sub-clan derives its name from the tiger. The Pancho sub-clan of the Tungjang has a similar totem tale. According to a myth, one of the brothers was left to die in the wilderness but survived by consuming the roots of the 'Phang' (*Gmelina Arborea Roxb*) tree. The man-animal relationship in Karbi tradition is varied and deep-rooted. The lycanthropic phenomenon of tiger-man still evokes romantic nostalgia. This interesting phenomenon, a problem of human behavior' for anthropologists, which is rather widespread among cultures in northeast India, is known among Karbis as 'Killing-Nongkret' or 'Killing-Chongkret', where a man physically transforms into a tiger. Again, a particular category of priests, known as 'ucha', communicates with the tiger, calls him at will, and feeds him in an annual ritual. Likewise, widespread throughout the world, serpent worship is practiced among Karbis as 'Dor Karkli' worship. Territorial deities are predominant Karbi animistic worships. Karbi's ancestors attribute extraordinary power and authority to a particular deity of a place and accordingly perform propitiatory sacrifices to receive protection from it. For example, the annual festival of 'Rongker' is a ritual for the propitiation of the genius loci or territorial deities performed for a village community's protection, well-being, and welfare. In such 'Rongker', territorial deities are called 'than-arnam', where goats, pigs, fowls, etc., are sacrificed. The



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number of the 'than-arnam' may vary from village to village according to the location. In a 'Rongker' performed in a locality called 'Donghap', such 'than-arnam' numbered sixteen, always including the compulsory worship of the three prominent deities of the Karbi pantheon: Hemphu, Mukrang, and Rasinja, as the following list demonstrates.

1. Hemphu Chingthong (territorial deity)
2. Rong Anglong (the protective deity)
3. Bulikang (river deity)
4. Langcherui (river deity)
5. Longri a-than (territorial deity)
6. Longle a-hi-i (negative/evil spirit of the soil)
7. Longri a-chekama (protective spirit of the territory)
8. Longri a-murti (minor spirit)

The 'Rongker' ritual remains a living example of the traditional belief of the Karbis. Each locality has its unseen guardian or protector. It is necessary to propitiate it to continue receiving its protection and blessings. This animistic practice has continued unabated despite modernity invading aspects of Karbi's life. As mentioned, certain places are identified as *arnam keso* or under the spell of an 'angry god,' and therefore sacred or sanctified, and many strict taboos are associated with such places. The taboos generally warn of complete avoidance of foul speeches and actions so as not to defile the place and irritate the god. It is believed that such violation invites divine punishment, including immediate sickness leading even to death. Recent environmental scholars say that taboos protecting sacred groves constitute indigenous conservation systems. Folklore and myth surround such *arnam keso*, which play an 'important role in conservation. The sacred groves can be considered the 'specimens of cultural and ecological co-evolution'. In traditional Karbi society, *arnam keso* is almost a common occurrence. Household deities, village deities, and territorial deities are characteristically similar. All of them are equally important in the community's belief system. There are angry counterparts of these deities, which are identified as 'hi-i', and worship together with *arnam* as *hi-i-arnam*. Therefore, the phenomenon of *arnam-keso* is treated the same way.

**The Present Condition of Sacred Groves**

The present condition of the sacred groves is not in good condition. The maintenance and traditional belief have been declining. The vegetation is the same in sacred groves also. With the gradual decline of the belief system, the vegetation of such groves has also deteriorated. The main reasons are the deteriorating condition of the sacred groves, lack of knowledge, increasing aspiration of the local population for a better way of life with the advent of modernity, and changes in local religion. Apart from these reasons, recently, many changes have taken place in the management of sacred groves. Earlier, there was no idea about the abundance of species further devalued degradation or economic use of these resources. The customs and traditions of the Karbis support the view that the traditional management of forests is well balanced in the prevalent socio-political and socio-economic life of the community. As observed in recent times the traditional management of forest resources has changed with the new pattern of economic, social, and environmental conditions.

As a result, the people have failed to maintain and protect the sacred groves. The forest department has not paid special treatment or management on these sacred groves. The actual area has not been delineated so far, and the list of plants and animals found in such sacred groves is also not being made. The detailed history of sacred groves and the reason for constitution and maintenance practices are also different. In the olden days, 'Lyngdopoh' (head of the Karbi traditional king) played a crucial role in maintaining the sacred groves. His role has been reduced in the present structure of the current administration of forest resources. For instance, while the sacred groves of Socheng Anglong and Minder Anglong are old Kingdom and Killing Sarpo, Sumongpong and Chilling-Bichikri are linked with the preservation of animals like tigers, tortoises, and fish, respectively.





## CONCLUSION

As mentioned, the cultural life of Karbis has significantly been influenced by the ecology of their surroundings. They are the true worshipper of nature like any other tribe believes and maintains some bizarre relation with some plants and animal species. Moreover, they have their traditional belief of maintaining sacred groves to protect and conserve rare, endangered, threatened, and endemic species found in sacred groves. That is why the need to preserve the unique practice of maintaining sacred groves is now one of the essential management practices required for ecological importance. This paper sturdily proposes including all sacred areas in protected areas for proper maintenance. The following measures are prescribed for its preservation.

- Well preserved sacred groves should be brought under a protected area network. Ecological studies on specialized habitat requirements and regeneration of the threatened species need to be undertaken to work out suitable strategies to ensure adequate preparation.
- An urgent external intervention by way of a legal framework and other measures is necessary to construct sacred groves of forests and their biological contents. A group consisting of experts in different fields may be constituted by conducting research and consolidating and updating the sacred groves database.
- Local awareness campaigning programs among the local people regarding the importance of sacred groves conservation should be initiated. The scientific reason for traditional beliefs should be explained along with the beliefs' conservation values.

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## Studies on Physicochemical and Rhizosphere Mycobiota of *Helianthus annuus* L. (Sunflower) Crop fields in Davanagere District, Karnataka, India

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### ABSTRACT

Fungi are an important component of the soil micro biota typically constituting more of the soil biomass than bacteria depending on soil depth and nutrient conditions. This study were deals with the physicochemical analysis, screening and regional variations of mycobiota, isolated from six rhizosphere soil samples. The soil samples were collected from sunflower crop fields of six different locations of Davanagere district during Rabi season. Dilution plate technique was used to isolate rhizosphere fungi from various soil samples. Fungal isolates were screened on different culture media namely Potato Dextrose Agar and Martins Rose Bengal Agar media supplemented with 1% Streptomycin. Fungal colonies were counted and screened for the occurrence of different fungal species was identified with the help of relevant literature and standard manuals of rhizosphere fungi. The rhizosphere mycobiota including *Alternaria sp*, *Aspergillus* (10 Spp.), *Cladosporium cladosporoides*, *Curvularia lunata*, *Fusarium* (2 spp.), *Mucor flavus*, *Penicillium* (05 spp.), *Rhizopus* (3 spp.), *Talaromyces stipitatus* and *Trichoderma* (3 spp.) sps were identified. Physicochemical analysis reveals that soil is rich in mycoflora due to acidic pH, rich organic matter and optimum moisture content. Among the isolates the *Aspergillus* and *Penicillium* species is dominant due to their sporulation ability. The Physicochemical analysis and Percentage occurrence of the mycobiota was calculated by using data analysis.

**Keywords:** *Aspergillus*, Davanagere, Mycobiota, *Penicillium*, Rhizosphere, Sunflower



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## INTRODUCTION

Sunflower (*Helianthus annuus* L.) is an oilseed crop native to North America. It is cultivated throughout the world, and most of its products have been commercialized as culinary or livestock feed (Yegorov *et al.*, 2019). The adaptation of sunflowers to different climatic and soil conditions has enhanced its cultivation as an oilseed plant throughout the world (Forleo, *et al.*, 2018). The growth of sunflower requires fertile soil, moderate rainfall, viable seeds, etc. Among the three leading oilseed crops, that is, soybean, rapeseed, and sunflower in the world today, sunflower has been recognized as a major source of high-quality edible oil importantly used for culinary purposes (Pal *et al.*, 2015). Sunflower is one of the important oilseed crops grown throughout the world as a source of premium oil and dietary fibre that significantly contributes to human health (Khan *et al.*, 2015). The root system of a plant is important while considering drought tolerance breeding programs (Rauf, 2008). The fungi co-exist with other organism do to the many biotic and a biotic factor in the environment which are favorable to the occupation of common habitat, the term rhizosphere is the defined as the soil volume adjacent to the root and influence by them and represent an area of intense microbial activities in which the organic nutrient is coming from the root favored the development of microorganism these nutrient are originated by decimation of the cell and exudates such sugar organic acid amine compound as well as other substance released by the root (Meting and Dekker, 2002). Rhizosphere is also known to be a hot spot of microbial activities (Brimecomb *et al.*, 2007). Soil micro flora plays a pivotal role in evaluation of soil conditions and in stimulating the plant growth (Kiran Singh *et al.*, 1999). Microorganisms in the soil and rhizosphere are beneficial in increasing soil fertility and plant growth as they are involved in several biochemical transformations and mineralization activities in soils. Type of cultivation and crop management practices found to have greater influence on the activity of soil. The quality and quantity of organic materials present in the soil have a direct effect on the fungal population of the soil. The distribution of these organisms was influenced by the abundance and nature of the organic context of the soil, as well as by other soil and climatic conditions, surface vegetation and soil texture. The numbers and kinds of micro-organisms present in soil it depends on many environmental factors such as amount and type of nutrients available, available moisture, degree of aeration, pH, temperature etc. Continuous use of chemical fertilizers over a long period may cause imbalance in soil micro flora and thereby indirectly affect biological properties of soil leading to soil degradation. Some studies dealt with the influence of plant community and others attempted to examine seasonal trends on soil microorganisms. Advantage district occupies the total geographical area 5913.4 sq.km. In this district consist of different types of soil like, Black & Red soil, Red Sandy soil mixed with clay soil and patches of black soil and Black Cotton soil. It consist of hot humid monsoon type of climate, the annual rainfall is 637mm and the temperatures ranges from 43°C, depending upon the climatic season. The major oil yielding crops are Ground nut, Sunflower, Mustard, Sesame, Niger and Castor. The aim of study is deals with the physicochemical and to isolation, identification and enumeration of the percentile contribution of rhizosphere mycobiota of Sunflower fields. The investigation on soil mycobiota becomes significant in the view of conservation of soil ecosystem and soil microbial diversity and sustainable agriculture.

## MATERIALS AND METHODS

### Study Area

Davanagere region is an agricultural and food treasury of Karnataka state located in central part of Northern Karnataka. Total area of district is 54, 98,397 sq.km. It lies in 13° 45' 00" N and 14° 50' 00" N latitude and 75° 30' 00" E and 76° 30' 00" E longitudes.

### Collection of samples and isolation of fungi

The Davanagere district is consists of six Talks. The study was conducted in different locations of each talk. The soil samples were collected twice in a year of Rabi and Kharif Season from March 2020 and September 2020. The rhizosphere soils collected randomly from a depth of 0-15cm near the rhizosphere region of plants, with the help of a sterilized metal spatula into a small sterilized Zipper polythene bags and brought to laboratory stored at 4° C for the

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mycological examination. For the analysis of soil nutrients, one kg of soil was separately collected in polythene bags. Each sample bag was labeled appropriately by indicating the site of collection and date. The soil fungi were enumerated by using serial dilution method [Waksman, 1994] on PDA media within 24 hours. The remaining soil samples were sieved through 2 mm mesh size to remove coarse material and used for physicochemical analysis. The Petri dishes are incubated in an inverted position for 3-7 days at room temperature  $25 \pm 2^\circ \text{C}$ . There replicate plates are prepared for each sample. Slides of isolated fungi were prepared in lacto phenol cotton blue method and were examined under stereo-binocular microscope and compound microscope. Isolates were identified on the basis of colony morphology, cultural, colony character and spore structure by using relevant literature (Barnet., 1972; Gilman., 1957, Nagamani *et al*, 2006).

#### Presentation of Data

Population density expressed in terms of Colony Forming Unit (CFU) per gram of soil with dilution factors (Rakesh and Raju 2013). The percentage contribution of each isolate calculated by using the formula,

$$\% \text{ Contribution} = \frac{\text{Total No. of CFU of an individual Sps}}{\text{Total No. of CFU of all Sps}} \times 100$$

CFU= Colony forming unit

## RESULTS AND DISCUSSION

The rhizosphere soil fungal diversity which depends on a large number of factors of the soil such as pH, organic content and soil moisture. The Physicochemical analysis of soil showed that  $7.26 \pm 0.320$  to  $7.886 \pm 0.011$ , and soil textures were determined the fungal population and their diversity in sunflower crop fields of Davanagere district. The soil moisture content showed regional variation which was maximum in Nyamti taluk  $12.97 \pm 0.23$  and Harihara taluk  $12.46 \pm 0.467$  as shown in fig.1. Soil analysis showed 60% of sand, 20% of clay and 20% of silt of Nyamti taluk. 45% of sand, 22% of clay and 33% of silt of Harihara taluk (Table-1), which helps in retention of moisture content and availability of nutrients in the soil and provides optimum condition for the growth of fungi. The pH is slightly neutral to alkaline in all the taluks (table-2). The organic carbon, nitrogen, phosphorus and potassium were important for fungi. The organic carbon concentration was higher in Nyamti region  $2.2 \pm 0.1$  compared by other taluks. The available Nitrogen was higher than the critical value (less than  $140 \text{ kg / ha}^{-1}$  during  $309.86 \pm 0.228$  of Chennagiri taluk followed by other taluks. The available phosphorus is higher in Chennagiri taluk  $98.71 \pm 0.62$  as compared to other taluks. The concentration of potassium is higher  $512 \pm 0.597$  in Nyamti taluk as shown in table-2 and graphically representing in fig.5. Copper availability is higher in Honnali taluk of  $2.4 \pm 0.1$ . Availability of zinc is higher in Davanagere region  $1.66 \pm 0.057$  as compared to the other taluks. The availability of Iron is higher in Chennagiri taluk  $24.5 \pm 0.5$ . Manganese availability was found to be higher in Chennagiri taluk  $35.39 \pm 0.01$  as shown in Fig.5. A total of 28 fungal species were isolated from six rhizosphere soil samples. The identification of these isolates resulted in ten genera of rhizosphere fungi including *Aspergillus* (10 species), *Penicillium* (5 species), *Rhizopus* (3 species), *Trichoderma* (3 species), *Fusarium* (2 species), *Alternaria*, *Cladosporium*, *Curvularia*, *Mucor* and *Talaromyces* (1 species). The rhizosphere mycobiota of six samples were screened and the associated mycobiota were identified. The fungal isolates of *Alternaria alternate*, *Aspergillus flavus*, *A. fumigatus*, *A. nidulens*, *A. niger*, *A. ochraceus*, *A. parasiticus*, *A. quadrilineatus*, *A. sydowii*, *A. terreus*, *A. versicolor*, *Cladosporium cladosporoides*, *Curvularia lunata*, *Fusarium oxysporum*, *F. solani*, *Mucor flavus*, *Penicillium aurantiogriesum*, *P. chrysogenum*, *P. citrineum*, *P. commune*, *P. purpureogenum*, *Rhizopus nigricans*, *R. microspores*, *R. stolonifer*, *Talaromyces stipitatus*, *Trichoderma atroviridae*, *T. harzianum* and *T. viridae* (Table – 4), species were identified along with the macro and microscopic observations. A total of 538 colonies were screened. Among the isolates Davanagere taluk of 96 colonies followed by Nyamti 94 colonies, Honnali 92 colonies, Jagalur 89 colonies, Harihara 84 colonies and Chennagiri 83 colonies were isolated as shown in table-3. Among the isolates *Aspergillus* and *Penicillium* species were dominant. According to Gaddeyya Gandipilli *et al.*, 2013 were also reported the *Aspergillus* and *Penicillium* species were dominant in the agricultural



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field soil samples of Salur Mandal, Andhra Pradesh. The result obtained in this research indicated that *Aspergillus fumigatus* and *Aspergillus niger* has the higher percentages and high number of occurrences. The highest number of fungal species isolated from the rhizosphere is not surprising, due to the production of substrate by growing root in the form of root exudates containing amino, sugar, organic acid, nucleotide and other substrate (Shinkafi 2018). The observations of this study have analyzed and discuss here that consistent with previous reports. The findings revealed that the maximum fungi were recorded in Davanagere region. During the study it was noticed that maturing and fertilizer applications have a significant impact on species diversity.

**CONCLUSION**

Findings of present investigation reveals that significant changes occur in diversity of important mycobiota, Therefore there is need to understand the aspects of mycodiversity in order to conserve in order to conserve and sustain the soil productivity on a long term basis. It was noticed that the fungal population were not equivalent whole the year they shows a regional variation. These findings conclude diversity of fungal community of rhizosphere fungi isolated from Davanagere District. The fungal population was observed mostly in the monsoon season as the soil moisture was high. Among the isolates *Aspergillus* and *Penicillium* species were dominant in all the crop fields due to high sporulation. The toxins produced by the *Aspergillus* species and antibiotics produced by *Penicillium* species may be preventing the growth of other fungal species.

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**Table: 1. Physico-Chemical parameter analysis of soil sample**

| Name       | Soil Type      | Soil Colour    | Soil Texture |        |        |
|------------|----------------|----------------|--------------|--------|--------|
|            |                |                | Sand %       | Clay % | Silt % |
| Jagaluru   | Silt clay loam | Reddish Brown  | 20           | 18     | 62     |
| Davanagere | Loam           | Light Brown    | 20           | 20     | 60     |
| Harihara   | Clay loam      | Black          | 45           | 22     | 33     |
| Honnali    | Silt clay loam | Brownish Black | 40           | 16     | 44     |
| Nyamti     | Sandy loam     | Black          | 60           | 20     | 20     |
| Chennagiri | Clay loam      | Brownish Black | 20           | 60     | 20     |

**Table: 2. The pH is slightly neutral to alkaline in all the taluks**

| Region     | Parameters           |             |                         |             |              |               |              |             |              |             |              |
|------------|----------------------|-------------|-------------------------|-------------|--------------|---------------|--------------|-------------|--------------|-------------|--------------|
|            | Moisture Content (%) | pH          | EC (dS/m <sup>3</sup> ) | OC (%)      | N kg/hac     | P kg/hac      | K kg/hac     | Cu PPM      | Zn PPM       | Fe PPM      | Mn PPM       |
| Jagaluru   | 6.12±0.112           | 7.71±0.005  | 0.452±0.001             | 0.596±0.005 | 257.66±0.577 | 100.02±0.0057 | 162.41±0.357 | 1.92±0.0057 | 1.17±0.01    | 0.83±0.0057 | 19.42±0.026  |
| Davanagere | 6.74±0.557           | 7.426±0.20  | 0.451±0.009             | 0.423±0.005 | 154.8±0.115  | 81.81±0.32    | 186.88±0.103 | 1.47±0.01   | 1.66±0.057   | 1.67±0.01   | 18.85±0.0057 |
| Harihara   | 12.46±0.467          | 7.886±0.011 | 0.393±0.005             | 0.67±0.026  | 154.266±1.1  | 51.69±0.306   | 160.34±0.571 | 1.23±0.057  | 0.6±0.1      | 1.16±0.057  | 10.84±0.142  |
| Honnali    | 7.89±0.011           | 7.31±0.005  | 0.502±0.001             | 0.783±0.005 | 206.4±0.01   | 56.77±0.196   | 123.66±0.028 | 2.4±0.1     | 0.523±0.0057 | 1.1±0.1     | 28.84±0.18   |
| Nyamti     | 12.97±0.23           | 7.853±0.127 | 0.012±0.001             | 2.2±0.1     | 257±1        | 82.14±0.79    | 512.31±0.597 | 1.983±0.2   | 0.916±0.073  | 1.943±0.089 | 19.916±0.135 |
| Chennagiri | 6.99±0.205           | 7.26±0.327  | 0.48±0.016              | 1.066±0.208 | 309.86±0.228 | 98.71±0.62    | 247.43±0.51  | 0.4±0.1     | 1.263±0.02   | 24.5±0.5    | 35.39±0.01   |

Note: Mean ± Standard Deviation (SD)

**Table: 3. Occurrence of rhizosphere mycobiota in Sunflower crop fields in Davanagere District**

| Region                | Average no of total colonies | Altemaria sps | Aspergillus (10 sps) | Cladosporium sps | Curvularia sps | Fusarium (2 sps) | Mucor sps | Penicillium (5 sps) | Rhizopus (3 sps) | Talaromyces sps | Trichoderma (3 sps) |
|-----------------------|------------------------------|---------------|----------------------|------------------|----------------|------------------|-----------|---------------------|------------------|-----------------|---------------------|
| Jagaluru              | 89                           | 5             | 25                   | 6                | 3              | 6                | 3         | 20                  | 7                | 2               | 12                  |
| Davanagere            | 96                           | -             | 29                   | 10               | 2              | 3                | 2         | 25                  | 5                | 5               | 15                  |
| Harihara              | 84                           | 2             | 32                   | 2                | -              | 8                | 7         | 19                  | 4                | -               | 10                  |
| Honnali               | 92                           | 2             | 37                   | 3                | 4              | 5                | 4         | 22                  | 8                | -               | 7                   |
| Nyamti                | 94                           | -             | 33                   | 9                | -              | 10               | 1         | 28                  | 2                | 1               | 10                  |
| Chennagiri            | 83                           | 3             | 24                   | 4                | 5              | 2                | 9         | 24                  | 4                | -               | 8                   |
| Total no. of Colonies | 538                          | 12            | 180                  | 34               | 14             | 34               | 26        | 138                 | 30               | 8               | 62                  |





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Table-4. Percentage contribution of fungal species of Sunflower crop fields in Davanagere District

| Sl. no | Fungal Species Obtained            | Region   |                   |           |                   |          |                   |         |                   |        |                   |            |                   |
|--------|------------------------------------|----------|-------------------|-----------|-------------------|----------|-------------------|---------|-------------------|--------|-------------------|------------|-------------------|
|        |                                    | Jagaluru |                   | Davangere |                   | Harihara |                   | Honnali |                   | Nyamti |                   | Chennagiri |                   |
|        |                                    | TN C     | % of Contribution | TN C      | % of Contribution | TNC      | % of Contribution | TN C    | % of Contribution | TNC    | % of Contribution | TNC        | % of Contribution |
| 1.     | <i>Alternaria alternata</i>        | 6        | 6.7               | -         | 0                 | 2        | 2.4               | 2       | 2.1               | -      | 0                 | 3          | 3.6               |
| 2.     | <i>Aspergillus flavus</i>          | 4        | 4.5               | 5         | 5.2               | 6        | 7.1               | 2       | 2.1               | 3      | 3.2               | -          | 0                 |
| 3.     | <i>Aspergillus fumigatus</i>       | 3        | 3.4               | 5         | 5.2               | -        | 0                 | 4       | 4.3               | 5      | 5.3               | 6          | 7.2               |
| 4.     | <i>Aspergillus nidulens</i>        | 2        | 2.2               | 3         | 3.1               | 4        | 4.7               | -       | 0                 | 4      | 4.2               | -          | 0                 |
| 5.     | <i>Aspergillus niger</i>           | 5        | 5.6               | 10        | 10.4              | 7        | 8.3               | 9       | 9.8               | 8      | 8.5               | 7          | 8.4               |
| 6.     | <i>Aspergillus ochraceus</i>       | 3        | 3.4               | -         | 0                 | 2        | 2.4               | 4       | 4.3               | -      | 0                 | 3          | 3.6               |
| 7.     | <i>Aspergillus parasiticus</i>     | 3        | 3.4               | -         | 0                 | 3        | 3.6               | 5       | 5.4               | 6      | 6.3               | 4          | 4.8               |
| 8.     | <i>Aspergillus quadrilineatus</i>  | -        | 0                 | 2         | 2.1               | 1        | 1.2               | 1       | 1.1               | 2      | 2.1               | -          | 0                 |
| 9.     | <i>Aspergillus sydowii</i>         | 2        | 2.2               | 3         | 3.1               | -        | 0                 | 3       | 2.2               | -      | 0                 | 1          | 1.2               |
| 10.    | <i>Aspergillus terreus</i>         | 3        | 3.4               | 2         | 2.1               | 4        | 4.7               | 4       | 4.3               | -      | 0                 | 1          | 1.2               |
| 11.    | <i>Aspergillus versicolor</i>      | -        | 0                 | 3         | 3.1               | 5        | 5.8               | 5       | 5.4               | 5      | 5.3               | 2          | 2.4               |
| 12.    | <i>Cladosporium cladosporoides</i> | 5        | 5.6               | 6         | 6.2               | 2        | 2.4               | 3       | 2.2               | 9      | 9.5               | 4          | 4.8               |
| 13.    | <i>Curvularia lunata</i>           | 3        | 3.4               | 2         | 2.1               | -        | 0                 | 4       | 4.3               | -      | 0                 | 5          | 6.1               |
| 14.    | <i>Fusarium oxysporum</i>          | 4        | 4.5               | 1         | 1.1               | 5        | 5.8               | 3       | 2.2               | 4      | 4.2               | 2          | 2.4               |
| 15.    | <i>Fusarium solani</i>             | 2        | 2.2               | 2         | 2.1               | 3        | 3.6               | 2       | 2.1               | 6      | 6.3               | -          | 0                 |
| 16.    | <i>Mucor flavus</i>                | 3        | 3.4               | 2         | 2.1               | 7        | 8.3               | 4       | 4.3               | 1      | 1.1               | 9          | 10.8              |
| 17.    | <i>Penicillium aurantiogriseum</i> | 4        | 4.5               | 6         | 6.2               | 4        | 4.7               | -       | 0                 | 8      | 8.5               | 9          | 10.8              |
| 18.    | <i>Penicillium chrysogenum</i>     | 5        | 5.6               | 6         | 6.2               | 4        | 4.7               | 7       | 7.6               | -      | 0                 | 8          | 9.6               |
| 19.    | <i>Penicillium citrinum</i>        | 3        | 3.4               | 5         | 5.2               | 8        | 9.5               | 6       | 6.5               | 9      | 9.5               | -          | 0                 |
| 20.    | <i>Penicillium commune</i>         | 5        | 5.6               | 4         | 4.1               | 3        | 3.6               | 4       | 4.3               | 7      | 7.4               | -          | 0                 |
| 21.    | <i>Penicillium purpurogenum</i>    | 3        | 3.4               | 4         | 4.1               | -        | 0                 | 5       | 5.4               | 4      | 4.2               | 7          | 8.4               |
| 22.    | <i>Rhizopus nigricans</i>          | 2        | 2.2               | 1         | 1.1               | -        | 0                 | 2       | 2.1               | 2      | 2.1               | 2          | 2.4               |
| 23.    | <i>Rhizopus microsporus</i>        | 2        | 2.2               | -         | 0                 | 2        | 2.4               | 3       | 2.2               | -      | 0                 | -          | 0                 |
| 24.    | <i>Rhizopus stolonifer</i>         | 3        | 3.4               | 4         | 4.1               | 2        | 2.4               | 3       | 2.2               | -      | 0                 | 2          | 2.4               |
| 25.    | <i>Talaromyces stipitatus</i>      | 2        | 2.2               | 5         | 5.2               | -        | 0                 | -       | 0                 | 1      | 1.1               | -          | 0                 |
| 26.    | <i>Trichoderma atroviridae</i>     | 4        | 4.5               | 6         | 6.2               | -        | 0                 | -       | 0                 | 4      | 4.2               | 3          | 3.6               |
| 27.    | <i>Trichoderma harzianum</i>       | 5        | 5.6               | 5         | 5.2               | 6        | 7.1               | 3       | 2.2               | 3      | 3.2               | 5          | 6.1               |
| 28.    | <i>Trichoderma viridae</i>         | 5        | 5.6               | 4         | 4.1               | 4        | 4.7               | 4       | 4.3               | 3      | 3.2               | -          | 0                 |

TNC: Total Number of Colonies





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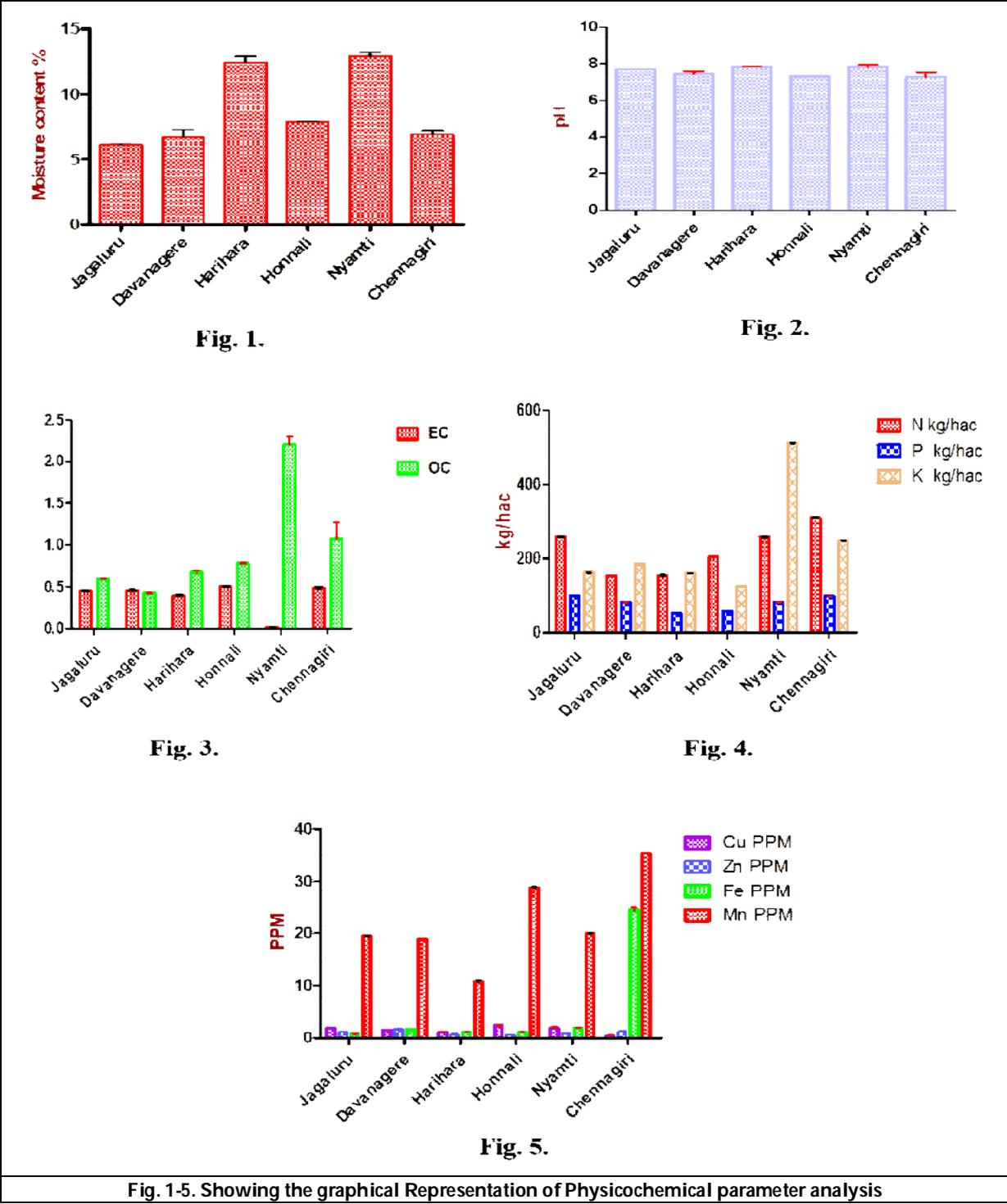
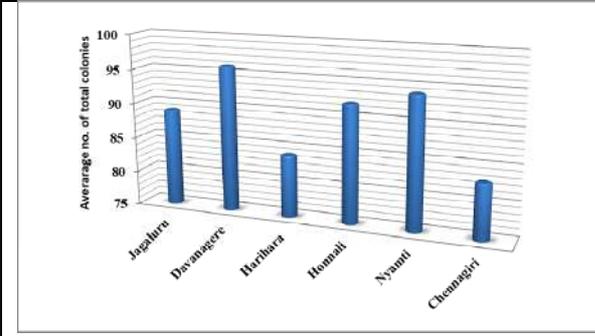


Fig. 1-5. Showing the graphical Representation of Physicochemical parameter analysis

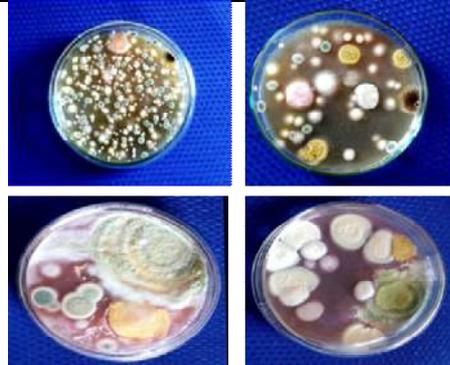




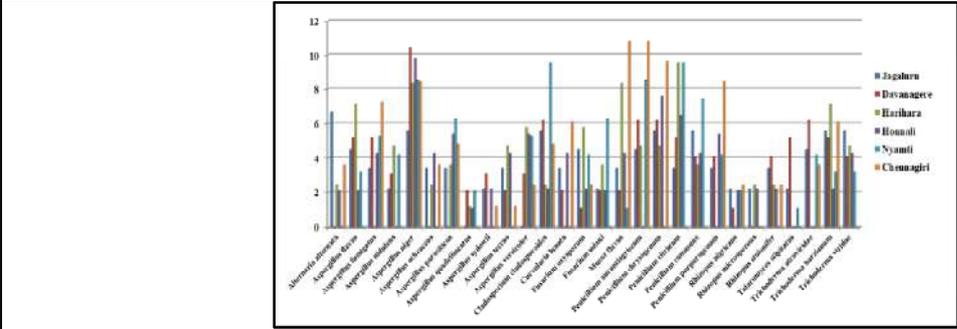
**Shaila and Nafeesa Begum**



**Fig.6. Average number of total colonies in each taluk of Davanagere District**



**Fig.7. Isolated Rhizosphere Fungal Colonies**



**Fig.8. Percentage contribution of each fungal species in each taluk of Davanagere District**





## RESEARCH ARTICLE

## Traffic Flow Physiognomies and Clashes in the NH 20 and NH 49 in Keonjhar District, Odisha

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### ABSTRACT

Modernization and escalation in demography, the traffic accidents are on the rise trend. The majority of the accidents resulted in injury or, in the worst-case scenario, death. The biggest cause of the rise in mortality is traffic accidents. Equipment failure, speed of operation, road design, road maintenance, weather, and driver conduct are all elements that lead to an accident car. Road traffic accidents (RTAs) have arisen as a major public health concern that requires a multidisciplinary strategy to address. The main focus of this study is on road conditions (potholes, damaged roads, eroding road combining rural roads with highways, diversions, and unlawful speed breakers), which can result in accidents. Poor road design, such as a lack of sufficient guardrails, blind curves, extremely narrow lanes, no shoulder or a dangerous shoulder; absence of an enough shoulder area for vehicles to stop, if necessary extraordinary grades, Visual obstructions like as plants or trees that were not adequately cleared after construction, lack of suitable signage advising safe speed, upcoming curves, or approaching hazards Inadequate Road drainage and short merging lanes, for example. Poor road maintenance, such as failing to trim overgrown plants that may be obstructing the view of the road or a sign, failing to maintain lost or damaged traffic signals and also other traffic signs, untreated potholes, guardrail and median malfunction, excessive oil or gravel due to repaving or highway maintenance procedures, weathered paint markings, such as the centre - line or road edge markings, and un - treated roads in cold weather, are all causes of frequently occurring accidents.

**Keywords:** Accidents, Traffic Flow, Highway Maintenance, Public Health, RTA



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## INTRODUCTION

Many developing countries, such as India, have quite a major problem with road accidents. In comparison to developed countries, fatality rates (measured as road accident deaths per 10,000 vehicles) are relatively high. Accidental deaths on Indian roads are increasing at an alarming rate. In India, many road accidents are caused by poor road design, particularly single-lane roads with abrupt curves, as well as infrastructural deficiencies, negligence and dangers, distracted driving, overloading, and lax vehicle safety standards. National Highway 49, which connects Kolkata and Mumbai and passes through Keonjhar district (NH 215 or New NH 20), is in poor condition due to a lack of maintenance. Traffic jam on this dilapidated road causes frequent accidents, turning it into a death trap that kills and injures people almost every day. Recognizing the importance of this highway and the increasing traffic, the Central Government has promised to four-lane the NH49, and the work tender to build the highway has been awarded to a firm called Monte Carlo. This contractor company has set up camp on the site and is busy cutting down trees and clearing the roadside in preparation for construction. While this exercise has been ongoing for months, the highway authorities have not repaired this road in three years, resulting in rapid destruction and damage. This highway's 110-kilometer stretch from Turumunga to Binjabahal is in poor condition, making it difficult for buses and passenger vehicles to use. At least four people were killed and 45 were injured in road accidents. Similarly, 17 accidents occurred within the Kanjipani police station limits, killing 5 people and injuring 25 others. The large ditches and deep potholes on the carriageway cause an imbalance, exacerbating drivers to lose control and cause accidents. Crossing the 20-kilometer kanjipaniGhat stretch now takes more than three hours, as opposed to 30 minutes previously. Frequent traffic jams add to the misery of travelers on this rough road.

## LITERATURE REVIEW

The following are the main factors influencing the efficiency of the safe traffic operating system: irregular operating temperature conditions; recurring watering with groundwater and surface water; profound seasonal freezing; blotchy thawing of pavement layers; static and dynamic impact of transport load; fatigue in structural materials [1]. Drones are extremely useful for planning large-scale and complex building projects. Its ability to capture massive amounts of data in a short length of time results in significant cost reductions, as well as project expenses for these tasks. Moreover, 3D models of the surface (DSM-digital surface model) or of the terrain (DTM-digital terrain model) can be built from the high-resolution aerial photographs captured by drones [2].

Any city's road network is its lifeline, and assessing its performance is critical for future transportation systems, design, operations, and maintenance. The majority of Indian cities have mixed traffic characteristics, and traffic congestion is a typical occurrence [3]. Transportation system is crucial for any community engagement, from economic function to emergency response. The need of keeping infrastructure in good working order must be weighed against the impact that maintenance services may have on the communities served by roads [4]. Inadequate bituminous mixes with low-quality materials, excessive traffic loading, heavy downpours, and inferior pavement drainage are all possible reasons of flexible pavement failures. Due to a lack of effective planning, inspections, and treatments, the failure rate gradually increases. These failures result in a variety of negative consequences, including traffic congestion, passenger and driver discomfort, increased vehicle operating and maintenance costs, and so on [5].

A country's development is dependent on its transportation system, which should be well-developed in terms of roads, railways, rivers, and airways. Transportation networks that are well-developed are essential not only for a nation 's development but also for cutting communication costs and ensuring the delivery of daily commodities [5]. Congestion cost analysis aids broader aspects of policy and planning by identifying potential solutions. Because most people experience the daily discomfort of an excessive delay, air pollution, and health issues, traffic congestion has a direct impact on our quality of life. The increase in roadway traffic congestion has become a major worry for engineers, planners, and legislators in urban centers around the world in recent years. It comes at a high cost to the community, and every major city is working hard to mitigate the negative effects of this phenomena [11].





## CASE EVALUATION

Considering the state of the aforementioned highways, it may be proposed to review the site for the construction of additional slip/ramp roads, as well as highway maintenance and widening. Slip roads are being proposed as a means of making it easier for motorists on the road to commute. Smoother vehicular movements will be ensured with the installation of the two new ramps (slip roads). Slip roads should be built with the goal of improving connectivity, expanding the road network, and reducing traffic congestion on highways. By adding lanes for vehicles, road widening will increase the capacity of a traffic corridor. The requirements of the original route are maintained during the widening. Because the entire exercise is constrained to widening within the ROW, there are rarely any issues with trees, land, or changes in the specifications of the crust and or alignment. And for the existing highway, the bituminous surface treatments application process include-

Potholes and fissures in the road surface must be repaired. A rotary broom or other permitted technique should be used to clean the road surface to be treated with the surface treatment. Depending on the type and grade of material, the bituminous substance is sprayed at a specific pace and temperature. Spraying viscosities of 20-120 cSt are suggested. To obtain the maximum feasible chip wetting depth, the cover aggregate is distributed at a set pace immediately after the bituminous material spray application. This is essential in asphalt cement and road tar because of rapid rise in viscosity with cooling, but it is highly wanted in asphalt emulsions and cutback asphalts to optimize the meniscus effect. Within 2 minutes of the bituminous material being applied, the cover aggregate should be applied. To apply the aggregate, utilize a self-propelled mechanical spreader or another aggregate spreading device capable of uniformly distributing the aggregate at the specified rate and width. The spreader must be calibrated to apply the amount of cover aggregate required in the design specifications for the project. To seat chips in the bituminous membrane, the surface is rolled immediately after applying the cover aggregate, ideally using a pneumatic-tired roller. The roller's speed should not exceed 5 mph. Three passes of a 12 to 15-ton pneumatic-tired roller are often employed, depending on environmental factors, kind, and quantity of bituminous material. Within 5 minutes after the bituminous material being spread, the aggregate should be laid out, and the following three coverage's must be accomplished within 30 minutes. Slow down traffic until the bituminous material has set. For the first 4 hours after the surface treatment, traffic speeds should not exceed 20 mph. Repeat steps 3–6 for numerous surface treatments. Following coatings should only be applied once the preceding bituminous surface has set and hardened, which usually takes one day.

Construction of Bituminous Surface Treatments: Precautions

- During cold and wet weather, or both, surface treatment procedures should be avoided. While performing the work, the surface must be clean and dry.
- Before beginning the operation, the ambient temperature should be at least 50°F (10°C) in the sunlight and rising.
- When the temperature is below 60°F and dropping, the operation should be avoided.
- The procedure should not be performed in the rain or even when rain is forecast.

## CONCLUSION

Roads have a key role in economic development and progress, as well as providing significant social advantages. They are critical to a country's growth and development. A road network is also critical mostly in fight against poverty since it provides access to job, social, health, and education. Roads connect people and places, promoting economic and social development. As a result, transportation infrastructure is the most valuable of all capital infrastructures. According to surveys, maintaining road infrastructure is critical to preserving and enhancing those benefits. However, the road network has irreversibly deteriorated due to a backlog of unfinished maintenance. Roads can require replacement or extensive repairs after only a few years if they are not properly maintained. The rapid spread of deterioration over a road system leads in skyrocketing expenses and a significant financial impact on





the economy and citizens. A highway, as a complex of intricate engineering facilities, requires ongoing repair and maintenance to maintain optimal, safe traffic [1]. Highway maintenance refers to keeping a road in its original state, as built or updated, and suitable for motorized traffic. Routine maintenance keeps the road surface from rapidly deteriorating, which may necessitate frequent maintenance. Routine maintenance is far less expensive and equal to a fraction of the cost of periodic repairs; we can refer to it as a preventive measure because it is so simple and requires no skill. As soon as road construction or enhancement work is completed, maintenance should begin. Regular and timely maintenance extends the life of the road, deferring the need for reconstruction.

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20. IS: 2720 (pat-11)



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Table 1: Test Report on Water Sample

| Sl.No. | Sample ref. (If any) | Test Parameters  | Observed value | Method of test adopted as per standards | Requirement as per standard specification IS 456:2000 (Reaffirmed 2021) |
|--------|----------------------|--|----------------|---|---|
| 01     | Water Sample         | pH Value   | 6.21           | IS 3025 (part-11)                       | 6.0 (Min.)  |
| 02     |                      | Organic matter (mg/ltr)  | 80             | IS 3025 (part-18)                       | 200 (Max.)  |
| 03     |                      | Inorganic matter (mg/ltr)  | 160            | IS 3025 (part-18)                       | 3000 (Max.)   |
| 04     |                      | Chloride (mg/ltr)  | 12.99          | IS 3025 (part-32)                       | 2000 (Max.), for P.C.C.;<br>500 (Max.) for R.C.C.                       |
| 05     |                      | Sulphate (mg/ltr)  | 22.16          | IS 3025 (part-24)                       | 400 (Max.)  |
| 06     |                      | Total suspended solids (mg/ltr)  | 17.0           | IS 3025 (part-17)                       | 2000 (Max.)   |
| 07     |                      | ACIDITY-To neutralize the 100ml of water sample, the required amount of 0.02 normal NaOH (ml)                              | 0.8            | IS 3025 (part-22)                       | 5 (Max.)  |
| 08     |                      | ALKALINITY-To neutralize the 100ml of water sample, the required amount of 0.02 normal H <sub>2</sub> SO <sub>4</sub> (ml) | 5.1            | IS 3025 (part-23)                       | 25 (Max.)   |

Table 2: Test Report on Cement Sample

| Sl. No. | Sample reference (If any)                                  | Test Parameters   | Observed value | Method of test adopted as per standards  | Requirement as per standard specification IS 269: 2015 |
|---------|--|---|----------------|--|--|
| 01      | Cement Sample (Brand-Ramco, Type-OPC 43)                   | Standard Consistency (%)  | 28.0           | IS 4031 (part-4)-1988 (Reaffirmed 2019)  | 6.0 (Min.)   |
| 02      |  | Initial Setting Time (min)  | 155            | IS 4031 (part-5)-1988 (Reaffirmed 2019)  | 200 (Max.)   |
|         |  | Final Setting Time (min)  | 260            |  | 3000 (Max.)  |
| 03      |  | Specific Gravity  | 3.15           | IS 4031 (part-11)-1988 (Reaffirmed 2019) | 2000 (Max.), for P.C.C.<br>500 (Max.), for R.C.C.      |
| 04      |  | Soundness by Le- Chatelier Method (mm)                            | 1.1            | IS 4031 (part-3)-1988 (Reaffirmed 2019)  | 400 (Max.)   |
| 05      |  | Fineness by Blaine's air permeability method (m <sup>2</sup> /kg) | 285            | IS 4031 (part-2)-1988 (Reaffirmed 2019)  | 2000 (Max.)  |
| 06      |  | Avg. Compressive Strength at (72±1h) (N/mm <sup>2</sup> )         | 28.0           | IS 4031 (part-6)-1988 (Reaffirmed 2019)  | 5 (Max.)   |
|         |  | Avg. Compressive Strength at (168±2h) (N/mm <sup>2</sup> )        | 40.0           |  | 25 (Max.)  |
|         | Avg. Compressive Strength at (672±4h) (N/mm <sup>2</sup> ) | 52.0  |                |  |  |



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Table 3: Test Report on Cement Sample

| Sl. No. | Sample reference (If any)                | Test Parameters  | Observed value | Method of test adopted as per standards | Requirement as per standard specification IS 456:2000 (Reaffirmed 2021) |
|---------|--|--|----------------|---|---|
| 01      | Cement Sample (Brand-Ramco, Type-OPC 43) | Loss on ignition (% by mass)   | 2.58           | IS 4032: 1985                           | Max. 5.0  |
| 02      |  | Magnesia as MgO (% by mass)  | 3.1            |   | Max. 6.0  |
| 03      |  | Sulphuric anhydride (SO <sub>3</sub> ) (% by mass)   | 1.54           |   | Max. 3.5  |
| 04      |  | Insoluble residue (% by mass)  | 2.17           |   | Max. 5.0  |
| 05      |  | Chloride Content (% by mass)   | BDL            |   | Max. 0.1, 0.05 (for prestressed structures)                             |
| 06      |  | Ratio to Alumina to that of Iron Oxide   | 0.89           |   | Min. 0.66   |
| 07      |  | Tricalcium Aluminate Content (C <sub>3</sub> A)  | 4.6            |   | Max. 10.0   |
| 08      |  | Tricalcium Silicate Content (C <sub>3</sub> S)   | 50.3           |   | Min. 45.0   |
| 09      |  | Ratio of percentage of lime to percentage of Silica, Alumina & Iron Oxide when calculated by the formula:<br>$\frac{CaO-0.7SO_3}{2.8SiO_2+1.2Al_2O_3+0.65Fe_2O_3}$ | 0.81           |   | 0.66-1.02   |

Table 4: Test Report on Paving Bitumen

| Sl.No | Sample reference (If any)    | Test Parameters                        | Observed value               | Method of test adopted as per standards  | Requirement as per standard specification IS 73:2013 (VG-40 Grade) |
|-------|------------------------------|--|------------------------------|--|--|
| 01    | Bitumen Sample (Grade VG-40) | Homogeneity of bitumen                 | No foam is observed at 175°C | IS 73: 2013                              | Shall not foam when heated to 175°C                                |
| 02    |                              | Penetration at 25°C, 100 g, 5s, 0.1 mm | 54                           | IS 1203: 1978 (Reaffirmed 2014)          | 35 (Min.)  |
| 03    |                              | Absolute Viscosity at 60°C, Poises     | 4054                         | IS 1206 (part 2): 1978 (Reaffirmed 2014) | 3200-4800  |
| 04    |                              | Kinematic Viscosity at 135°C, cSt      | 488                          | IS 1206 (part 3): 1978 (Reaffirmed 2014) | 400 (Min.)   |
| 05    |                              | Flash Point (Cleveland open cup), °C   | 318                          | IS 1448 (part 69): 2013                  | 220 (Min.)   |
| 06    |                              | Solubility in                          | 99.50                        | IS 1216: 1978                            | 99.0 (Min.)  |





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|    |  |   |      |  |            |
|----|--|---|------|--|------------|
|    |  | trichloroethylene, Percent                        |      | (Reaffirmed 2014)                        |            |
| 07 |  | Softening Point (R&B), °C                         | 52.0 | IS 1205: 1978 (Reaffirmed 2014)          | 50 (Min.)  |
| 08 |  | Tests on residue from rolling thin film oven test |      |  |            |
|    |  | Ductility at 25°C, cm                             | 100  | IS 1208: 1978 (Reaffirmed 2014)          | 25 (Min.)  |
| 09 |  | Viscosity ratio at 60°C                           | 1.18 | IS 1206 (part 2): 1978 (Reaffirmed 2014) | 4.0 (Max.) |

**Table 5: Test Report on 10mm Coarse Aggregate**

| Sl. No. | Sample reference (If any)                               | Test Parameters       | Observed value   | Method of test adopted as per standards    | Requirement as per standard specification IS 456:2000 (Reaffirmed 2021)  |   |
|---------|---|-----------------------|------------------|--|--|---|
| 01      | Coarse Aggregate (10mm)<br>Source: Dhenkikote, Keonjhar | Sieve Analysis        | Sieve size in mm | % by wt. of material passing               | IS: 2386 (part I)-1963 (Reaffirmed 2016)   | % Passing for 10mm Single-sized aggregate of nominal size |
|         |   |                       | 12.5             | 100  |  | 100   |
|         |   |                       | 10               | 94.85                                      |  | 85-100  |
|         |   |                       | 4.75             | 4.3  |  | 0-20  |
|         |   |                       | 2.36             | 0.4  |  | 0-5   |
| 02      |   | Flakiness Index (%)   | 12.0             |  | ...  |   |
| 03      |   | Elongation Index (%)  | 11.0             |  | ...  |   |
| 04      |   | Bulk Density (Kg/lit) | 1.681            | IS: 2386 (part III)-1963 (Reaffirmed 2016) | ...  |   |
| 05      |   | Specific Gravity      | 2.82             |  | ...  |   |
| 06      |   | Water Absorption (%)  | 0.28             |  | 2000 (Max.)  |   |
| 07      |   | Crushing Value (%)    | 20.0             | IS: 2386 (part IV)-1963 (Reaffirmed 2016)  | Max. 30% for aggregate to be used in concrete for wearing surface (such as runways, roads & pavements, tunnel lining, carrying water, spillways and stilling basins) & 45% for aggregate to be used in concrete other than for wearing surface |   |
| 08      |   | Impact Value (%)      | 18.0             | IS: 2386 (part IV)-1963 (Reaffirmed 2016)  | Max. 30% for aggregate to be used in concrete for wearing surface (such as runways, roads & pavements, tunnel lining, carrying water, spillways and stilling basins) & 45% for aggregate to be used in concrete other than for wearing surface |   |
| 09      |   | Abrasion Value (%)    | 21.0             |  | Max. 30% for aggregate to be used in concrete for wearing surface (such as runways, roads & pavements, tunnel lining, carrying water, spillways and stilling basins) & 45% for aggregate to be used in concrete other than for wearing surface |   |





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**Table 6: Test Report on 20mm Coarse Aggregate**

| SI .N o. | Sample reference (If any)                               | Test Parameters       |                  | Observed value                               | Method of test adopted as per standards  | Requirement as per standard specification IS 456:2000 (Reaffirmed 2021) |
|----------|---|-----------------------|------------------|--|--|---|
| 01       | Coarse Aggregate (10mm)<br>Source: Dhenkikote, Keonjhar | Sieve Analysis        | Sieve size in mm | % by wt. of material passing                 | IS: 2386 (part I)-1963<br>(Reaffirmed 2016)  | % Passing for 10mm Single-sized aggregate of nominal size               |
|          |   |                       | 40               | 100  |  | 100   |
|          |   |                       | 20               | 89.72  |  | 85-100  |
|          |   |                       | 10               | 2.53   |  | 0-20  |
|          |   |                       | 4.75             | 0.13   |  | 0-5   |
| 02       |   | Flakiness Index (%)   |                  | 11.0   |  | ...   |
| 03       |   | Elongation Index (%)  |                  | 10.0   |  | ...   |
| 04       |   | Bulk Density (Kg/lit) |                  | 1.684  | IS: 2386 (part III)-1963<br>(Reaffirmed 2016)  | ...   |
| 05       |   | Specific Gravity      |                  | 2.84   |  | ...   |
| 06       |   | Water Absorption (%)  |                  | 0.21   |  | 2000 (Max.)   |
| 07       | Crushing Value (%)                                      |                       | 19.0             | IS: 2386 (part IV)-1963<br>(Reaffirmed 2016) | Max. 30% for aggregate to be used in concrete for wearing surface (such as runways, roads & pavements, tunnel lining, carrying water, spillways and stilling basins) & 45% for aggregate to be used in concrete other than for wearing surface |   |
| 08       | Impact Value (%)  |                       | 16.0             | IS: 2386 (part IV)-1963<br>(Reaffirmed 2016) | Max. 30% for aggregate to be used in concrete for wearing surface (such as runways, roads & pavements, tunnel lining, carrying water, spillways and stilling basins) & 45% for aggregate to be used in concrete other than for wearing surface |   |
| 09       | Abrasion Value (%)                                      |                       | 21.0             |  | Max. 30% for aggregate to be used in concrete for wearing surface (such as runways, roads & pavements, tunnel lining, carrying water, spillways and stilling basins) & 45% for aggregate to be used in concrete other than for wearing surface |   |





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Table 7: Test Report on Fine Aggregate

| Sl. No. | Sample reference (If any)                               | Test Parameters      | Observed value  | Method of test adopted as per standards    | Requirement as per standard specification IS 456:2000 (Reaffirmed 2021) |   |
|---------|---|----------------------|---|--|---|---|
| 01      | Fine Aggregate (River Sand)<br>Source: Belabahali River | Sieve Analysis       | Sieve size in mm                                      | % by wt. of material passing               | IS: 2386 (part I)-1963 (Reaffirmed 2016)                                | % Passing for 10mm Single-sized aggregate of nominal size |
|         |   |                      | 10  | 100  |   | 100   |
|         |   |                      | 4.75  | 92.224                                     |   | 90-100  |
|         |   |                      | 2.36  | 89.129                                     |   | 75-100  |
|         |   |                      | 1.18  | 81.126                                     |   | 55-90   |
|         |   |                      | 0.600   | 57.320                                     |   | 35-59   |
|         |   |                      | 0.300   | 14.120                                     |   | 8-30  |
| 0.150   | 1.398   | 0-10                 |   |  |   |   |
| 02      |   | Fineness Modulus     | 2.65  | ...  | ...   |   |
| 03      |   | Silt Content         | 0.94  | IS: 2386 (part II)-1963 (Reaffirmed 2016)  | 8 (Max.)  |   |
| 04      |   | Specific Gravity     | 2.64  | IS: 2386 (part III)-1963 (Reaffirmed 2016) | ...   |   |
| 05      |   | Water Absorption (%) | 0.78  | IS: 2386 (part III)-1963 (Reaffirmed 2016) | ...   |   |
| 06      |   | Soundness (%)        | With Sodium Sulphate, Na <sub>2</sub> SO <sub>4</sub> | 6.76                                       | IS: 2386 (part IV)-1963 (Reaffirmed 2016)                               | 10 (Max.)   |
|         |   |                      | With Magnesium Sulphate, MgSO <sub>4</sub>            | 7.51                                       |   | 15 (Max.)   |

Table 8: Laboratory Test Report of 8mm Deformed steel bar as per IS: 1786, Is: 1608 & IS:1599

| Sl. No. | Sample Reference | Test Parameter                        | Obtained Value   | IS: Limit                                       | Remarks   |
|---------|------------------|---------------------------------------|--|---|---|
| 1       | 8 mm Dia TMT Bar | Unit Weight in kg/m                   | 0.411  | 0.367-0.423                                     | Mechanical properties confirm to Grade Fe 500D as per IS: 1786 specifications |
|         |                  | Elongation on gauge Length in %       | 21.1   | Min. 16   |   |
|         |                  | Yield Stress in N/mm <sup>2</sup>     | 558.4  | Min. 500  |   |
|         |                  | Tensile Strength in N/mm <sup>2</sup> | 681.0  | Min. 614.2                                      |   |
|         |                  | Bend Test                             | No crack observed <u>Angle of Bend</u> : Sides are in parallel position through an angle of 180° | No crack shall be observed in the bend position |   |
|         |                  | Re-Bend Test                          | No crack observed <u>Angle of Re-bend</u> : 135° & 157.5°  | No crack shall be observed in the bend position |   |



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Table 5: Laboratory Test Report of 10 mm Deformed steel bar as per IS: 1786, Is: 1608 &amp; IS:1599

| Sl. No. | Sample Reference     | Test Parameter                        | Obtained Value   | IS: Limit                                       | Remarks   |
|---------|----------------------|---------------------------------------|--|---|---|
| 1       | 10 mm Dia<br>TMT Bar | Unit Weight in kg/m                   | 0.613  | 0.574-0.660                                     | Mechanical properties confirm to Grade Fe 500D as per IS: 1786 specifications |
|         |                      | Elongation on gauge Length in %       | 28.2   | Min. 16   |   |
|         |                      | Yield Stress in N/mm <sup>2</sup>     | 564.7  | Min. 500  |   |
|         |                      | Tensile Strength in N/mm <sup>2</sup> | 645.0  | Min. 621.2                                      |   |
|         |                      | Bend Test                             | No crack observed<br><u>Angle of Bend:</u> Sides are in parallel position through an angle of 180° | No crack shall be observed in the bend position |   |
|         |                      | Re-Bend Test                          | No crack observed<br><u>Angle of Re-bend:</u> 135° & 157.5°  | No crack shall be observed in the bend position |   |

Table 10: Laboratory Test Report of 12 mm Deformed steel bar as per IS: 1786, Is: 1608 &amp; IS:1599

| Sl. No. | Sample Reference     | Test Parameter                        | Obtained Value   | IS: Limit                                       | Remarks   |
|---------|----------------------|---------------------------------------|--|---|---|
| 1       | 12 mm Dia<br>TMT Bar | Unit Weight in kg/m                   | 0.889  | 0.844-0.932                                     | Mechanical properties confirm to Grade Fe 500D as per IS: 1786 specifications |
|         |                      | Elongation on gauge Length in %       | 23.0   | Min. 16   |   |
|         |                      | Yield Stress in N/mm <sup>2</sup>     | 562.9  | Min. 500  |   |
|         |                      | Tensile Strength in N/mm <sup>2</sup> | 659.3  | Min. 619.2                                      |   |
|         |                      | Bend Test                             | No crack observed<br><u>Angle of Bend:</u> Sides are in parallel position through an angle of 180° | No crack shall be observed in the bend position |   |
|         |                      | Re-Bend Test                          | No crack observed<br><u>Angle of Re-bend:</u> 135° & 157.5°  | No crack shall be observed in the bend position |   |

Table 11: Laboratory Test Report of 16 mm Deformed steel bar as per IS: 1786, Is: 1608 &amp; IS:1599

| Sl. No. | Sample Reference     | Test Parameter                    | Obtained Value | IS: Limit  | Remarks   |
|---------|----------------------|-----------------------------------|----------------|------------|---|
| 1       | 16 mm Dia<br>TMT Bar | Unit Weight in kg/m               | 1.57           | 1.50-1.66  | Mechanical properties confirm to Grade Fe 500D as per IS: 1786 specifications |
|         |                      | Elongation on gauge Length in %   | 23.9           | Min. 16    |   |
|         |                      | Yield Stress in N/mm <sup>2</sup> | 543.6          | Min. 500   |   |
|         |                      | Tensile Strength in               | 646.6          | Min. 597.9 |   |





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|  |  |                   |  |   |
|--|--|-------------------|--|---|
|  |  | N/mm <sup>2</sup> |  |   |
|  |  | Bend Test         | No crack observed<br><u>Angle of Bend:</u> Sides are in parallel position through an angle of 180° | No crack shall be observed in the bend position |
|  |  | Re-Bend Test      | No crack observed<br><u>Angle of Re-bend:</u> 135° & 157.5°  | No crack shall be observed in the bend position |

Table12: Laboratory Test Report of 20 mm Deformed steel bar as per IS: 1786, Is: 1608 & IS:1599

| Sl. No. | Sample Reference  | Test Parameter                        | Obtained Value   | IS: Limit                                       | Remarks   |
|---------|-------------------|---------------------------------------|--|---|---|
| 1       | 20 mm Dia TMT Bar | Unit Weight in kg/m                   | 2.49   | 2.39-2.54                                       | Mechanical properties confirm to Grade Fe 500D as per IS: 1786 specifications |
|         |                   | Elongation on gauge Length in %       | 24.3   | Min. 16   |   |
|         |                   | Yield Stress in N/mm <sup>2</sup>     | 556.8  | Min. 500  |   |
|         |                   | Tensile Strength in N/mm <sup>2</sup> | 666.9  | Min. 612.5                                      |   |
|         |                   | Bend Test                             | No crack observed<br><u>Angle of Bend:</u> Sides are in parallel position through an angle of 180° | No crack shall be observed in the bend position |   |
|         |                   | Re-Bend Test                          | No crack observed<br><u>Angle of Re-bend:</u> 135° & 157.5°  | No crack shall be observed in the bend position |   |

Note: Brand of Steel: SHYAM STEEL; Grade: FE 500D

Test Condition

Temperature: 26.3° C

Humidity: 63%

Dia of Bend Test Mandrel: 60 mm

Dia of Re-bend Mandrel: 120 mm

**Slip/Ramp Road Design Specifications**

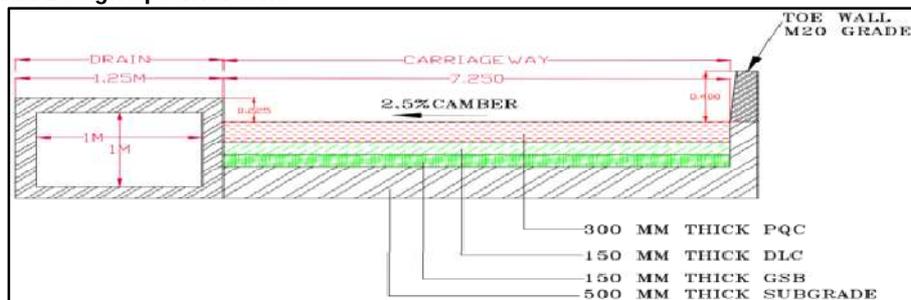


Figure 1: Typical Cross Section of Slip Road



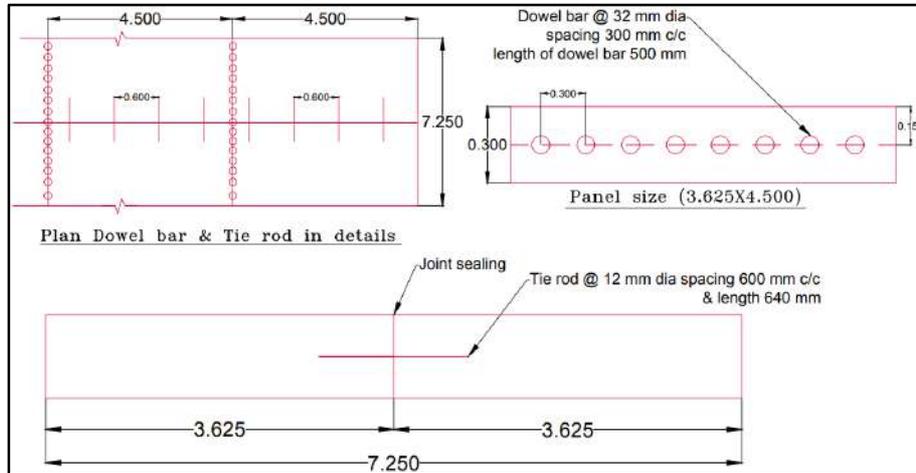


Figure 2: Cross Section of Slip Road showing Panel details of PQC with Dowel Bars and Tie Rods

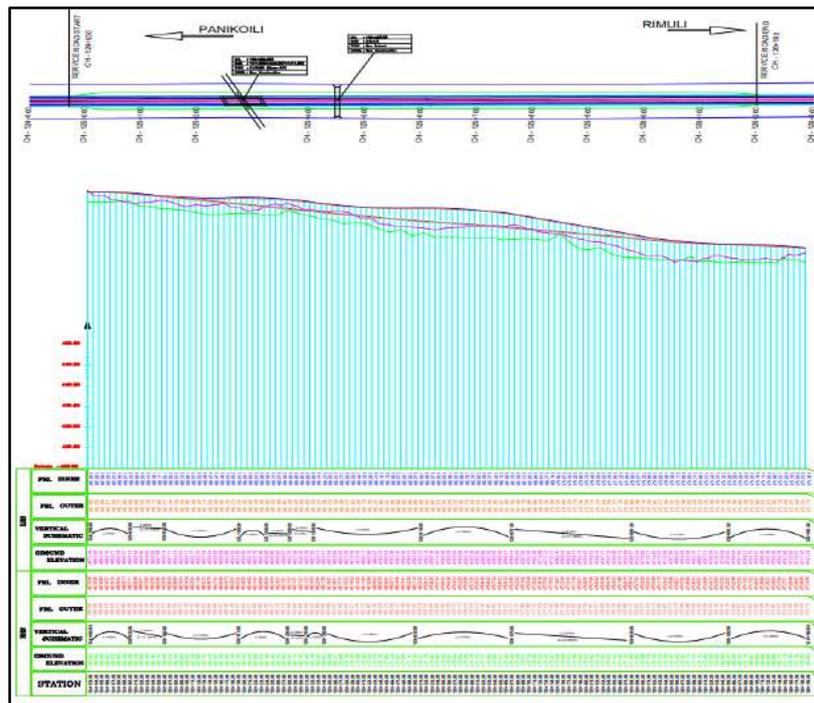


Figure 3: Plan and Profile of Slip Road from CH: 6+150 KM to CH: 7+538 KM





### Highway Design Specifications

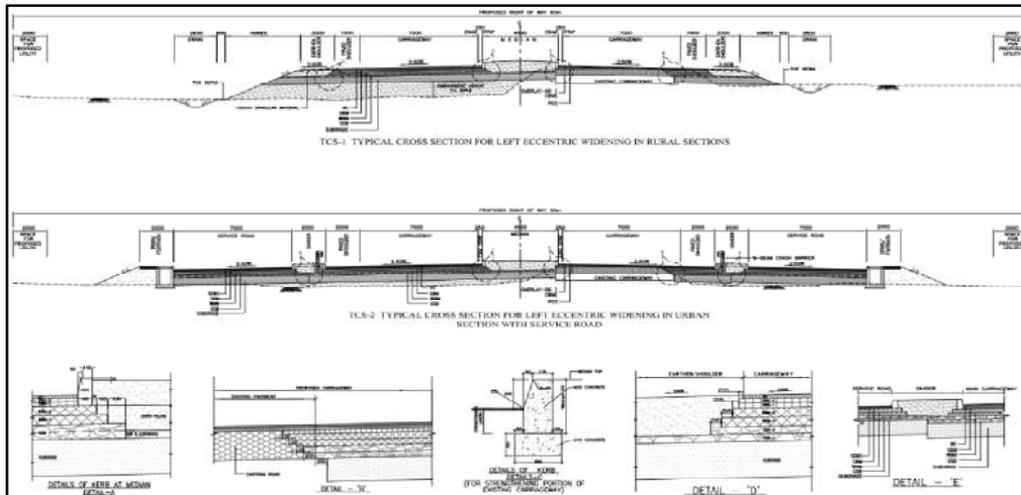


Figure 4: NH 215 (New NH 20)-RD-TCS-001

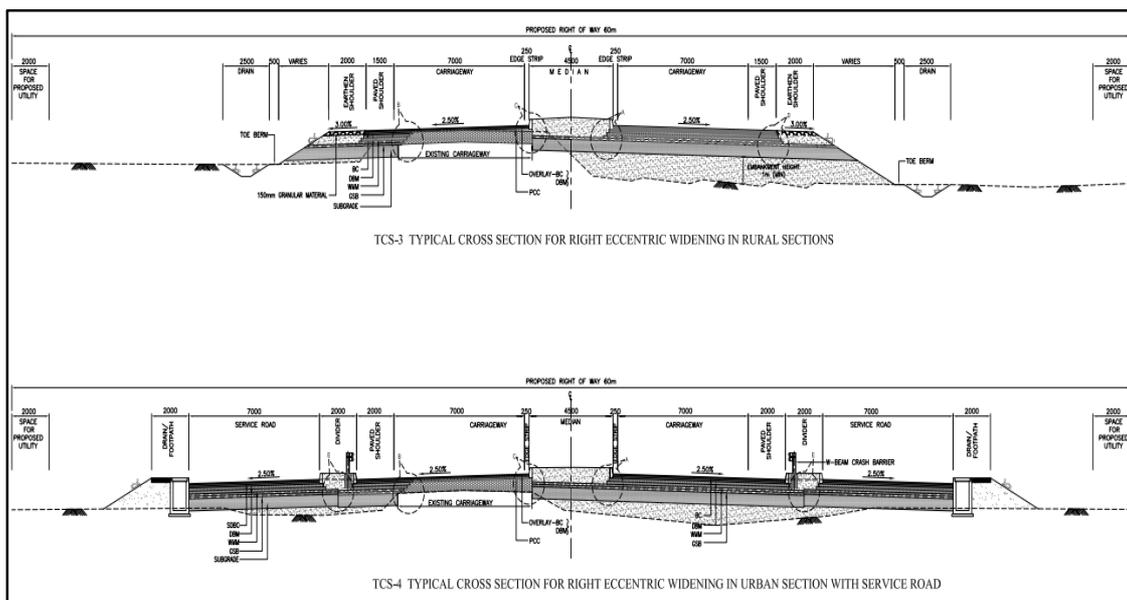


Figure 5: NH 215 (New NH 20)-RD-TCS-002





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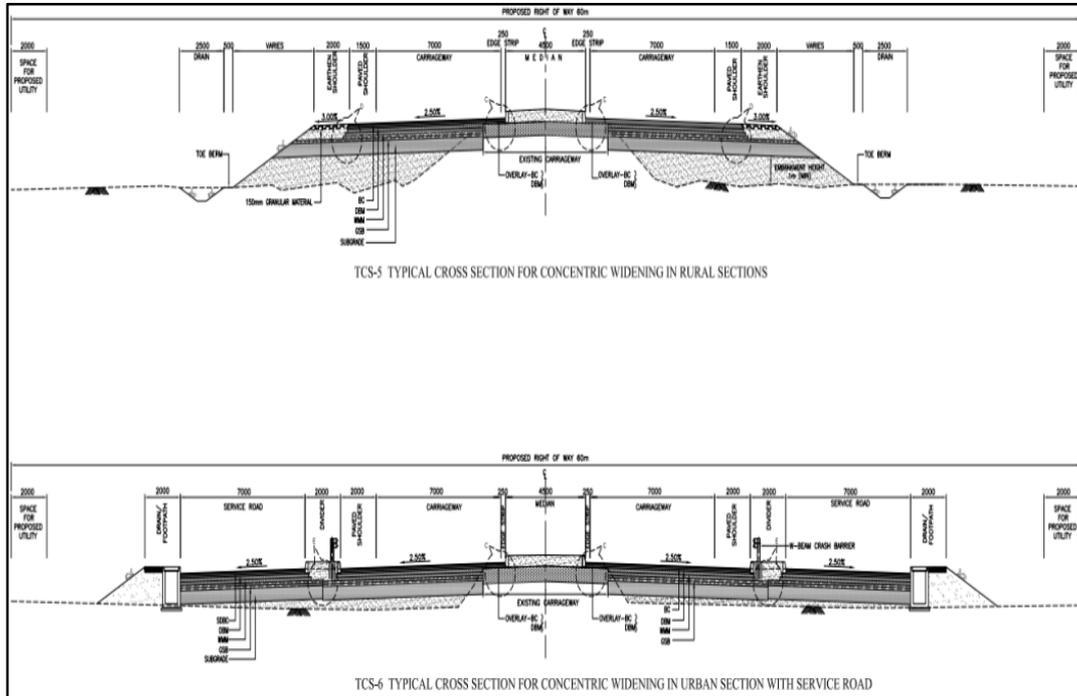


Figure 6:NH 215 (New NH 20)-RD-TCS-003

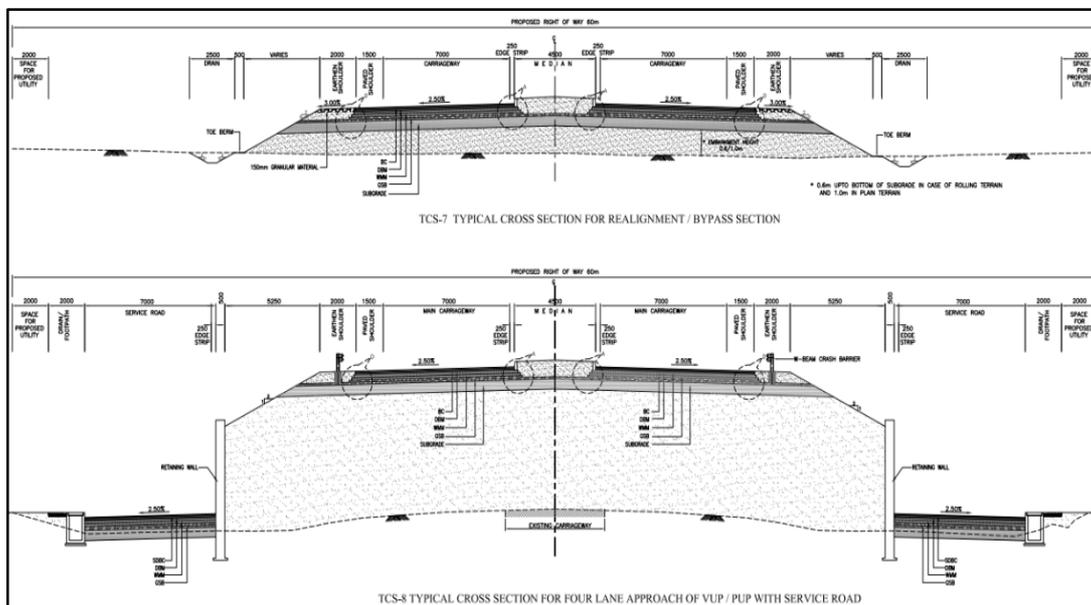


Figure 7:NH 215 (New NH 20)-RD-TCS-004





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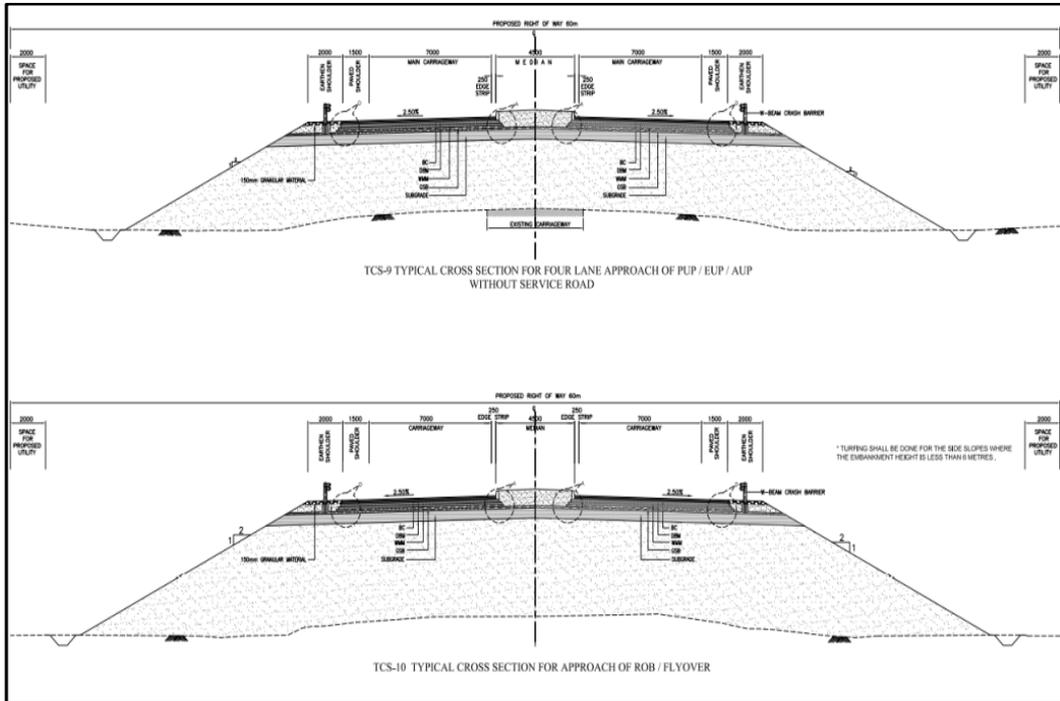


Figure 8:NH 215 (New NH 20)-RD-TCS-005

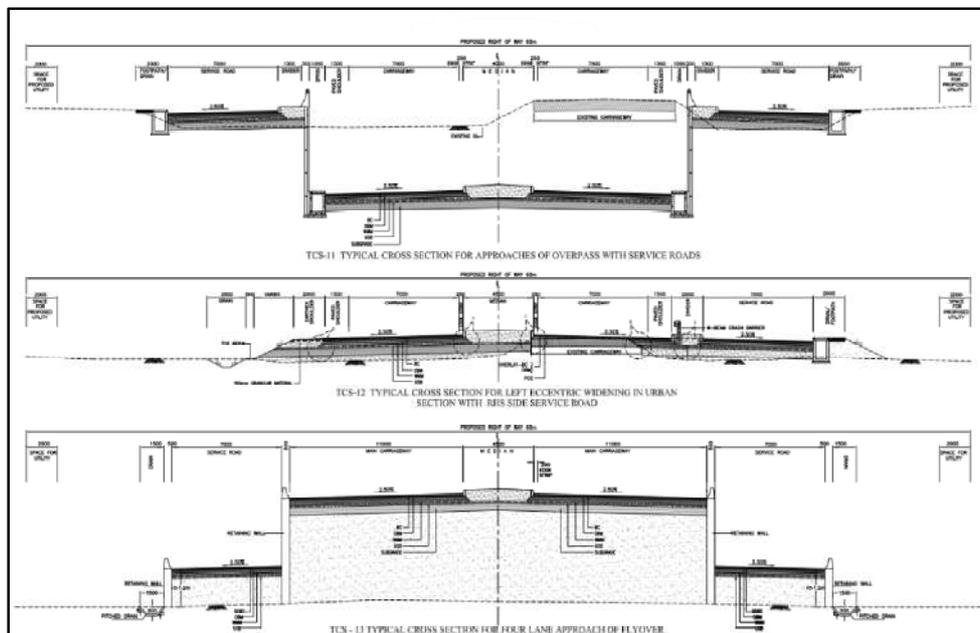


Figure 9: NH 215 (New NH 20)-RD-TCS-006









## Comparative Study on Bioprotective Profile of Roots and Leaves of *Boerhaavia diffusa* Extracts against Isolated MDR Non-Fermenting Gram-Negative Bacteria

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### ABSTRACT

Non-fermenting gram-negative bacilli (NFGNB) have arisen as a major source of health-care-related disorders as a result of multidrug resistance. Traditional medicinal plants are continually being explored for their therapeutic utility in treating infections that have developed drug resistance to most antibiotics as a result of their overuse. *Boerhaavia diffusa* has a long history of use in the treatment of bacterial infections, and several recent investigations have demonstrated its antibacterial properties. Furthermore, antioxidant, antibacterial, and wound-healing properties have been identified for *Boerhaavia diffusa*. The purpose of this study is to exploit the disease curing properties of *Boerhaavia diffusa* extracts against NFGNB infections. NFGNB pathogens were isolated and characterized. Plant extracts were prepared using the Soxhlet extraction method in a succession of various organic and aqueous solvents with increasing polarity index (Ethyl acetate (4.4), Methanol (5.1), and Water (9.0)). The antibacterial activity of crude plant extract was tested using agar well diffusion and MIC assay. The results show that the various extracts of *Boerhaavia diffusa* have strong antibacterial activity and effective MIC, MBC, and MIC index values. The inhibitory activity of the extract was compared to that of conventional antibiotics. Plants with medicinal properties have been discovered and have long been recognized as useful and inexpensive





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sources of a variety of phytoconstituents that are widely used in the creation of medications to treat a variety of ailments.

**Keywords:** *Boerhaavia diffusa*, Antibiotics, NFGNB, plant extracts

## INTRODUCTION

NFGNBs nowadays become significant pathogens in healthcare. These non-fermenting gram-negative bacilli have a vast range of infections that can cause superficial to deep-seated infections. As these pathogens are gaining resistance to the available antibiotics so the physician is facing difficulty to treat the patient infected with them. Due to the excessive or frequent use of antibiotics number of drug resistance pathogens has been increasing in past few years. It is now very difficult to treat these multidrug-resistant pathogens. The NFGNB are resistant to many available antibiotics and are known to produce extended-spectrum beta-lactamases and Metallo beta-lactamase. Medicinal plants are a common phenomenon in various continents and are also an essential source of different medicines (1). Medicinal plants have become one of the leading choices for treating different injuries and diseases. A large number of plant species have been identified as valuable sources of a natural antibacterial compound that can be used to treat antibiotic resistance bacterial illnesses (2), as the number of MDR pathogens increases due to antibiotic abuse, alternative and reliable treatments are needed. Today, herbs are getting a lot of attention because they are cheap and have very few side effects on patients. Medicinal plants have all the plant components that serve as a source of bioactive chemicals needed for significant pharmacological effects without side effects. Herbal plants contain several phytochemicals and these phytochemicals are known to exhibit anti-inflammation, antimicrobial, and antifungal activities (3). They can be used to develop potentially safe new classes of medicines and medicines that cure various illnesses. Non-fermentable Gram-negative bacteria (NFGNB) have become a major cause of medical-related infections because they have acquired resistance to multiple drugs. NFGNBs prevalence and drug susceptibility are required to effectively treat infections caused by them. Increased resistance to antibiotics available today is causing problems worldwide due to the widespread use of antibiotics. Chinese herbs have historically been used to treat a variety of illnesses due to the wide range of safety profiles they offer. Plants are the source of a novel medication inspiration, as plant-derived medicine has a sustainable impact on human health and well-being. More than 80% of the world's population, particularly in underdeveloped nations is still treated with traditional medicine based on plant extract [4]. The goal of the present study is to use *Boerhaavia diffusa* extracts to fight NFGNB infections.

## MATERIALS AND METHODS

### Chemicals and Reagents

Analytical grade chemicals and reagents were used. Ethyl acetate, Methanol, Mueller Hinton agar, and DMSO was purchased from Hi-media (Mumbai). Redistilled, deionized, and sterilized water is utilized for extraction and experimental activities. The chemicals and reagents used in the study were of pure quality.

### Isolation and characterization of NFGNB pathogens

This study was conducted at Dehradun's SMI hospital. The various clinical specimens collected were pus, urine, BAL, sputum, CSF, endotracheal tube tips, blood, and other specimens from patients of various age groups. The Vitek 2 compact system was used for antimicrobial susceptibility testing and identification [5]. The isolated NFGNBs were *Pseudomonas aeruginosa* (P1), *Acinetobacter baumannii* (P2), *Achromobacter xylosoxidans* (P3), *Stenotrophomonas maltophilia* (P4) and *Burkholderia cepacia* (P5).





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### Plant collection

*Boerhaavia diffusa* plants (roots and leaves) were collected from Raipur in Dehradun. The authentication of the plant is verified through the BSI Dehradun.

### Preparation of plant extracts

The plant parts were chosen based on the plant's documented traditional uses. *Boerhaavia diffusa* roots and leaves were air-dried and processed into a fine powder using a grinder. The Soxhlet extraction process was used to extract the air-dried plant material. Ethyl acetate, Methanol, and water were used as solvents containing different polarities. The plant powder (25g) was taken to obtain the crude extract of *Boerhaavia diffusa* (roots and leaves) respectively {ethyl acetate (S1), methanol (S2), water (S3) and ethyl acetate (S4), methanol (S5) and water (S6) extraction were done in succession using Soxhlet extraction method. [6]. All the six extracts were made solvent-free and concentrated using a rotary evaporator and preserved at 4°C in the airtight bottle until further use.

### Antimicrobial Susceptibility testing

#### Agar well diffusion method

The Sterile Petri Plate containing MHA medium were cultured with fresh bacterial colonies by using a sterile cotton swab, and wells were made in the agar plates by using a sterile well borer. The wells were loaded with different concentrations of extracts 0.5mg/100µl and 1mg/ 100µl (ethyl acetate, methanol, and aqueous) of *Boerhaavia diffusa* (roots and leaves) to check the antimicrobial activity of the extracts [7,8,9]. To produce concentrations of 0.5mg/100µl and 1mg/ 100µl, the extracts were diluted in DMSO (dimethylsulphoxide). Colistin (0.5mg/100µl and 1mg/100µl) was utilized as a positive control, whereas DMSO was employed as a negative control. The experiments were carried out in triplicates, with the mean zone of inhibition and standard deviation calculated as the final results.

#### Broth Dilution MIC test

The MIC of the plant extracts was evaluated by the broth dilution method or we can say the macro broth dilution method. With the help of Mueller Hinton agar, a serial dilution of all the extract was made in well plates. In each well of well plates, 20µl of the test organism (NFGNB isolates) were injected that has a concentration of  $5 \times 10^5$  CFU/ml.[8,9]. The experimental negative and positive controls were a two-fold serial dilution of DMSO and Colistin and levofloxacin, respectively. The plates were incubated for 24hrs at 37°C. After the incubation, the wells were examined for turbidity.

#### Determination of Minimum Bactericidal Concentration

To evaluate the MBC of all extracts 20µl solution of MIC plates was inoculated in sterile MHA plates and incubated at 37°C for 18-24hrs. The concentration at which no bacterial growth is seen on the MHA plate was considered as MBC of the plant extract. To check whether the extract is bacteriostatic (MIC/MBC>4) or bactericidal (MIC/MBC<4) in nature MIC index (MIC/MBC) was calculated. Bacteriostatic is defined as having a MIC index of more than 4 but less than 32 [10].

## RESULTS AND DISCUSSION

### Isolation and Characterization

Different clinical samples (Pus, Urine, BAL, sputum, CSF, endotracheal tube tip, Blood and another specimen) were inoculated on MacConkey agar and Blood agar media for isolation of bacterial colonies. Followed by subjection to Vitek-2 for Identification and determination of Antimicrobial sensitivity. Results were obtained as *Pseudomonas aeruginosa*, *Acinetobacter baumannii*, *Achromobacter xylosoxidans*, *S. maltophilia*, and *B. cepacia*.

### Extraction of the plant samples

Using the Soxhlet extraction method, extracts were prepared in a series of various organic and aqueous solvents with increasing polarity index (Ethyl acetate (4.4), Methanol (5.1), and water (9.0)). The results revealed that the solvents





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have different extraction powers. For Root extract, the highest amount of yield was obtained in the aqueous extract followed by ethyl acetate and the least yield was obtained in methanol. In the case of *Boerhaavia diffusa* leaf extracts, it was observed that the amount of yield was increased with the increasing polarity of the solvents (Table 1)

### Antimicrobial Susceptibility testing

The antimicrobial screening results show that (S1, S2, S3, S4, S5, and S6) extracts have a substantial inhibitory impact on the pathogens tested (Fig1). S3 extract considerably inhibited *P.aeruginosa* (P1) and *Achromobacter Xylooxidans* (P3), but S2 extract greatly inhibited *A. baumannii* (P2). All six extracts were observed to inhibit *S. maltophilia* (P4) and *Burkholderia cepacia* (P5). S3 extract, out of all the extracts tested and evaluated, was shown to have the strongest inhibitory effect on all infection-causing pathogens. The antibacterial activity of several polarity based crude extracts of *Boerhaaviadiffusa* (root and leaves) was comparable to that of Colistin and levofloxacin, two commonly used antibacterial drugs (positive control). When compared to the extract, the highest degree of sensitivity was observed against Colistin and levofloxacin. The minimal concentration required to prevent the growth of bacteria in reference was determined to be between 0.5-0.0156mg/ml (Table: 2) and was considered effective. The extracts were characterized to be bactericidal as the MIC index values were below 4. The methanol extract (S5) of Leaf was found to have the highest ZOI values against all the tested pathogens followed by ethyl acetate (S4) and aqueous extracts (S6). Based on data obtained from the comparative analysis of the antibacterial activity of root and leaf extracts of selected plant in reference, it was concluded that root extracts are more potent than leaf extracts.

## DISCUSSION

The historic knowledge of these herbal concoctions is well known among indigenous and local groups. Plants are still the only source of medicine for tribal tribes today. Many bioactive compounds like tannins, flavonoids, alkaloids (punarnavine), glycosides, steroids, terpenoids, phenolic compounds, and rotenoids (boeravinones A-O) etc. are reported in *B. diffusa* plants [11]. Traditional medicinal plants are constantly being studied for their therapeutic use in treating infections that have developed multi-drug resistance to most antibiotics as a result of their overuse. *Boerhaavia diffusa* has a long history of use in the treatment of microbial illness, and various recent studies have shown its antibacterial capabilities. The bioactive phytochemicals present in the *B.diffusa* leaves exhibit antibacterial activity against several human pathogenic bacteria [12]. The medicinal effects of *B.diffusa*, which is utilized in traditional Indian medicine, The antimicrobial screening results show that (S1, S2, S3, S4, S5, and S6) extracts have a substantial inhibitory impact on the pathogens tested (Fig1). S3 extract considerably inhibited *P.aeruginosa* (P1) and *Achromobacter Xylooxidans* (P3), but S2 extract greatly inhibited *A. baumannii* (P2). All six extracts were observed to inhibit *S. maltophilia* (P4) and *Burkholderia cepacia* (P5). S3 extract, out of all the extracts tested and evaluated, was shown to have the strongest inhibitory effect on all infection-causing pathogens. The antibacterial activity of several polarity based crude extracts of *Boerhaavia diffusa* (root and leaves) was comparable to that of Colistin and levofloxacin, two commonly used antibacterial drugs (positive control). When compared to the extract, the highest degree of sensitivity was observed against Colistin and levofloxacin. The minimal concentration required to prevent the growth of bacteria in reference was determined to be between 0.5-0.0156mg/ml (Table: 2) and was considered effective. The extracts were characterized to be bactericidal as the MIC index values were below 4. The methanol extract (S5) of Leaf was found to have the highest ZOI values against all the tested pathogens followed by ethyl acetate (S4) and aqueous extracts (S6). Based on data obtained from the comparative analysis of the antibacterial activity of root and leaf extracts of selected plant in reference, it was concluded that root extracts are more potent than leaf extracts.

## ACKNOWLEDGEMENT

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**Table 1: Showing the yield, yield% of *Boerhaavia diffusa* (root) extract (S1,S2,S3) and *Boerhaavia diffusa* (leaves) extract (S4,S5,S6).**

| S.No | Solvent used        | Extraction method         | Weight of crude extract (g/500ml) |        | Percentage Yield (%) |        |
|------|---------------------|---------------------------|-----------------------------------|--------|----------------------|--------|
|      |                     |                           | Root                              | leaves | Root                 | Leaves |
| 1    | Ethyl acetate (4.4) | Soxhlet Extraction Method | 1.59                              | 1.10   | 0.353                | 0.244  |
| 2    | Methanol (5.1)      |                           | 0.56                              | 14.32  | 0.142                | 3.62   |
| 3    | Water (9.0)         |                           | 6.46                              | 56.81  | 1.292                | 11.362 |





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**Table 2: The MIC, MBC and MIC Index values of control and *Boerhaavia diffusa* extract (S1, S2, S3, S4, S5, and S6) against NFGNB isolates.**

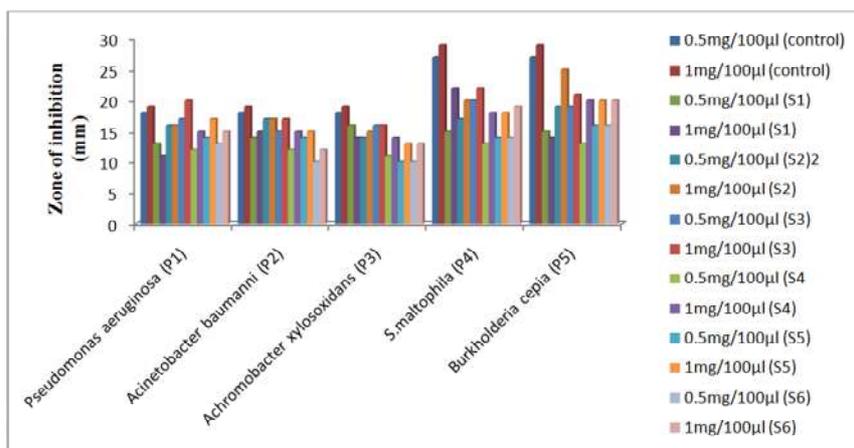
| Extracts                     | Isolates                        | Range (mg/ml) | MIC mg/ml | MBC mg/ml | MIC Index mg/ml |
|------------------------------|---------------------------------|---------------|-----------|-----------|-----------------|
| Control                      | <i>P. aeruginosa</i> (P1)       | 0.5- 0.0156   | 0.0156    | 0.0312    | 0.5             |
|                              | <i>A.baumannii</i> (P2)         | 0.5- 0.0156   | 0.0156    | 0.0312    | 0.5             |
|                              | <i>Achro.xylosoxidans</i> (P3)  | 0.5- 0.0156   | 0.0156    | 0.0312    | 0.5             |
|                              | <i>S.maltophila</i> (P4)        | 0.5- 0.0156   | 0.0156    | 0.0312    | 0.5             |
|                              | <i>Burkholderia cepcia</i> (P5) | 0.5- 0.0156   | 0.0156    | 0.0312    | 0.5             |
| ethyl acetate (roots) S1     | <i>P. aeruginosa</i> (P1)       | 0.5- 0.0156   | 0.25      | 0.5       | 0.5             |
|                              | <i>A.baumannii</i> (P2)         | 0.5- 0.0156   | 0.25      | 0.5       | 0.5             |
|                              | <i>Achro.xylosoxidans</i> (P3)  | 0.5- 0.0156   | 0.25      | 0.5       | 0.5             |
|                              | <i>S.maltophila</i> (P4)        | 0.5- 0.0156   | 0.25      | 0.5       | 0.5             |
|                              | <i>Burkholderia cepcia</i> (P5) | 0.5- 0.0156   | 0.25      | 0.5       | 0.5             |
| Methanol extract (roots) S2  | <i>P. aeruginosa</i> (P1)       | 0.5- 0.0156   | 0.25      | 0.5       | 0.5             |
|                              | <i>A.baumannii</i> (P2)         | 0.5- 0.0156   | 0.25      | 0.5       | 0.5             |
|                              | <i>Achro.xylosoxidans</i> (P3)  | 0.5- 0.0156   | 0.25      | 0.5       | 0.5             |
|                              | <i>S.maltophila</i> (P4)        | 0.5- 0.0156   | 0.25      | 0.5       | 0.5             |
|                              | <i>Burkholderia cepcia</i> (P5) | 0.5- 0.0156   | 0.25      | 0.5       | 0.5             |
| Aqueous extract (roots)S3    | <i>P. aeruginosa</i> (P1)       | 0.5- 0.0156   | 0.125     | 0.25      | 0.5             |
|                              | <i>A.baumannii</i> (P2)         | 0.5- 0.0156   | 0.25      | 0.5       | 0.5             |
|                              | <i>Achro.xylosoxidans</i> (P3)  | 0.5- 0.0156   | 0.25      | 0.5       | 0.5             |
|                              | <i>S.maltophila</i> (P4)        | 0.5- 0.0156   | 0.25      | 0.5       | 0.5             |
|                              | <i>Burkholderia cepcia</i> (P5) | 0.5- 0.0156   | 0.25      | 0.5       | 0.5             |
| ethyl acetate (leaves) S4    | <i>P. aeruginosa</i> (P1)       | 0.5- 0.0156   | 0.25      | 0.5       | 0.5             |
|                              | <i>A.baumannii</i> (P2)         | 0.5- 0.0156   | 0.25      | 0.5       | 0.5             |
|                              | <i>Achro.xylosoxidans</i> (P3)  | 0.5- 0.0156   | 0.25      | 0.5       | 0.5             |
|                              | <i>S.maltophila</i> (P4)        | 0.5- 0.0156   | 0.25      | 0.5       | 0.5             |
|                              | <i>Burkholderia cepcia</i> (P5) | 0.5- 0.0156   | 0.25      | 0.5       | 0.5             |
| Methanol extract (leaves) S5 | <i>P. aeruginosa</i> (P1)       | 0.5- 0.0156   | 0.25      | 0.5       | 0.5             |
|                              | <i>A.baumannii</i> (P2)         | 0.5- 0.0156   | 0.25      | 0.5       | 0.5             |
|                              | <i>Achro.xylosoxidans</i> (P3)  | 0.5- 0.0156   | 0.25      | 0.5       | 0.5             |
|                              | <i>S.maltophila</i> (P4)        | 0.5- 0.0156   | 0.25      | 0.5       | 0.5             |
|                              | <i>Burkholderia cepcia</i> (P5) | 0.5- 0.0156   | 0.25      | 0.5       | 0.5             |





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|                                      |                                 |             |      |     |     |
|--------------------------------------|---------------------------------|-------------|------|-----|-----|
| Aqueous<br>extract<br>(leaves)<br>S6 | <i>P. aeruginosa</i> (P1)       | 0.5- 0.0156 | 0.25 | 0.5 | 0.5 |
|                                      | <i>A.baumannii</i> (P2)         | 0.5- 0.0156 | 0.25 | 0.5 | 0.5 |
|                                      | <i>Achro.xylosoxidans</i> (P3)  | 0.5- 0.0156 | 0.25 | 0.5 | 0.5 |
|                                      | <i>S.maltophilia</i> (P4)       | 0.5- 0.0156 | 0.25 | 0.5 | 0.5 |
|                                      | <i>Burkholderia cepcia</i> (P5) | 0.5- 0.0156 | 0.25 | 0.5 | 0.5 |



**Fig 1: Comparative analysis of the antimicrobial activity of *B. diffusa* roots and leaves extract (S1, S2, S3, S4, S5, and S6) against NFGNB isolates along with controls.**





## Preclinical Guidelines for Recently Developed Pharmaceutical Excipients

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### ABSTRACT

Pharmaceutical excipients play an important role in medication formulations, but their importance has been overlooked, the lack of processes to examine excipient safeness outside of the new medication registration process demonstrates. It is now deemed "approved when a novel drug formulation utilizing an excipient wins regulatory approval, it is now deemed "approved. "Existing legislation and recommendations state that excipients that are novel (unique) should always be treated as new compounds and subjected to extensive toxicity testing. There is no guidance for potentially beneficial compounds (essentially novel excipients) that may be obtained from other industries, such as food additives or existing excipients with a new use, such as changing the dosing route. Despite this, pharma firms are actively investigating new materials or putting existing excipients into new applications. Excipients that have recently been developed (e.g., components that provide medical preparations "sugar-free" status, cyclodextrins, and hydro fluoroalkane inhalation propellants), as well as excipients that are still in progress and all, are discussed. Given how many other elements of drug development have lately benefited from new or revised regulatory guidelines, excipient manufacturers require immediate support. Moreover, an excipient testing technique will be a relevant topic for the International Conference on Harmonization to examine (ICH). This type of guideline would be in addition to the present improvements in pharmacopoeia excipient quality standardization. As a result, a worldwide

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pharmacopoeia committee may be able to assess excipients, with safety information evaluated by elected experts.

**Keywords:** Excipients, Quality, Safety, Toxicity, FDA, IPEC, ICH (Guidelines)

## INTRODUCTION

The finished medical product typically contains inactive chemicals (API) in addition to the active pharmacological component (1,2). An inactive aspect is defined by the Food and Drug Administration (FDA) as "any material of a medicinal product other than the active component. By guaranteeing the physical and chemical stability of active substances in solid dosage form, excipients can improve product effectiveness (e.g., antioxidants and stabilizers), during storage and usage, they are protected against microbial contamination (e.g., preservatives), and enhancing their pharmacodynamic and pharmacokinetic (for example, solubilizers, permeation enhancers, and agents that change the release of the drug from dosage forms) (4-5). The country of origin of excipients is used to classify them. There is lanolin, honey, beeswax, gelatin, stearic acid, lactose, and other animal-derived ingredients. Starch, peppermint, turmeric, guar gum, and acacia are all ingredients. Other mineral sources include calamine, asbestos, kaolin, paraffin, calcium phosphate, silica, talc, and others. Polyethylene glycols, polysorbates, povidone, boric acid, saccharin, lactic acid and other synthetic acids are all examples of acids. (6-9) Excipients are classified according to the functions they perform, such as a binder, diluent, lubricant, disintegrating agent, plasticizer, and so on. For example, in tablet formulations, 5% starch functions as a binding agent. But if administered in a dry state, it may act as a disintegrant. Solvents, co-solvents, buffers, antimicrobial agents, gelling agents, sweeteners, and other additives, flavours, as well as other excipients are employed in liquid formulation. Excipients with therapeutic properties are classified as follows: - Anesthesia: chloroform, ether, and so on. Bentonite, psyllium, xanthan gum (11), guar gum, and other laxatives are examples. The pH of the solution is adjusted by using citric acid. Astringent ingredients include Zinc sulphate, cinnamon, and aluminium. Carminatives include anise water, dill water, and cinnamon (13). Agar is a nutrient source. (10-13) Excipients are classified into 3 types: Excipients that are well-known ("authorized"), novel, and fundamentally new. Excipients which have been used in pharmaceutical industries for a long period are referred to as recognized excipients. From 1964 to 1984, the top 12 excipients in United States safety evaluations have also been solvents, stearic acid, lactose, microcrystalline cellulose, sugar, talcum, gelatin, gum, Silicon dioxide, dibasic calcium phosphate were all first introduced in 1904, with the majority of them appearing in 1949. As shown in a recent survey, the most widely utilized Waters, Magnesium stearate, povidone, sodium chloride salts, stearic acid, and dextrose are all excipients included in UK-licensed pharmaceuticals. Some of the most recent contributions to the ranks of recognized excipients are substances that make medicinal preparations "sugar-free," cyclodextrins, and Aerosol propellants based on hydro fluoroalkane (HFA). A new excipient is a substance that has never been used or authorized in a medication formulation previously. A chemical developed by changing the structure of a well-known food ingredient (or cosmetic component), a physically altered food item, and an "authorized" excipient or a unique excipient is a component found in over-the-counter (OTC) medicines. While there has recently been an increase in industry understanding of the application and security of current and novel substances in developing drugs, this has resulted in a flurry of new articles (14). There seems to be a resurgence of interest after a period of neglect. Chemical and manufacturing (quality) data, as well as preclinical (safety) data, are widely used in excipient synthesis. The former is frequently discussed at national and international levels and in monographs of pharmacopoeia. Meanwhile, despite knowing that worldwide standardized monographs for some substances are developing, a major worry is that the quality requirements for comparable excipients in different product standards regularly differ (e.g., lactose). (15,16)

The following factors have affected preclinical evaluation:

- An absence of a unified world wide a regulation that is directly related to the examination of the safety of substances;
- An insufficient support in dealing with the problem of authorizing an excipient as a distinct entity;



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- The absence of an authorized excipient
- Industry has challenges in creating techniques for preclinical evaluation of both wholly innovative and known excipients, along with potentially beneficial substances.
- This article outlines why preclinical testing for excipients is essential, what different firms have achieved and are doing in terms of assessment, and what the future may hold. (17,18)

**Current regulatory situations**

Concerns about safety, toxicity, and precedence of use. Before bringing an excipient into the healthcare organization, potential excipient manufacturers must have looked into a variety of safety problems. Firstly, see if the substance has also been utilized in medication or a statistically significant relationship like a nutritional supplement or a contact with food packaging material. If some substance's safety could be established in applications which require human exposure, it will already be appropriate in the drug industry, it will be utilized as an excipient. The Food and Drug Administration (FDA) of the United States publishes an excipient database called the Inactive Ingredient Database (IID), which would be available on the official website (19). Because it details each excipient which has only been approved based on its existence in a unique drug ingredient that has been approved, the IID will be utilized to indicate the preponderance of its usage. As a result, each excipient is classified according to the medication name, dose type, and maximum dosage amount permitted in an approved medicine containing that active component. Be attention while searching the databases whereas an excipient is included under a variety of names, such as brand names, compendium names, chemical names, or general descriptions (for dyes and flavors). To determine the precedence of its use in Japan, the Japan Pharmaceutical Excipients Council, in collaboration with the Ministry of Health, Labor, and Welfare, will publish the Japanese Pharmaceutical Excipients Dictionary (JPED). The JPED would be a list of all excipients and has been used in Japanese pharmaceutical products in the past. It comprises Japanese Pharmaceutical Excipients (JPE) monographs along with all earlier used non-monograph excipients. The non-proprietary title and synonyms, and also the applications and maximum doses for the different methods of administering, are all included in the monograph of an authorized drug [20].

The Eu Commission (EC) has agreed to change the regulations on "Excipients for Human-Use Medicinal Products Labeling and Packaging Leaflets" (EU, 2003). This document provides insight into current regulatory thinking on several essential excipients. In 2011, a multipurpose subsection (CHMP Excipients Drafting Group (ExcpDG)) was formed. The Safety Working Party (SWP), Quality Working Party (QWP), Pediatric Committee (PDCO), and Pharmacovigilance Risk Assessment Committee make up the ExcpDG (PRAC), CMD(h), Vaccines Working Party (VWP), Biologics Working Group (BWP), and Blood Products Planning Committee are all members of the Coordination Organization for Mutual Recognition and Decentralized Guidelines (BPWP). Other working groups and organizations include the Patients' and Consumers' Working Party (PCWP), the Healthcare Professionals' Working Party (HCWP), and the Working Group on Document Quality Audit (WGDV). The ExcpDG's main goal is really to keep updating the labeling of selected excipients by the guidelines above, as well as, as indicated in an attached concept paper, adding more excipients to the database (CPMP, 2012). For every excipient under assessment, the ExcpDG generates a series of questions (Q&As) papers, containing one most up-to-date information, such as labeling and packaging leaflets, as well as a background scientific research if appropriate. Up to this time, seven additional excipients may have gotten Q&A documents: The three preservatives (EMA, 2014a), benzoic acid/benzoates (EMA, 2014b), and benzalkonium chloride (EMA, 2014c), ethanol (EMA, 2014d), and propylene glycol/esters as co-solvents (EMA, 2014e), and a new diluents/filler (wheat starch) are now introduced (EMA, 2014f). The relevant information and material that make up the Q&As are now being made accessible in stages as well. Similarly, the European Medicines Agency (EMA) issued three early papers on propylene glycol (EMA, 2013), parabens (EMA, 2014h), and cyclodextrins (EMA, 2014). Furthermore, the European Medicines Agency (EMA) publishes strategic regulatory guidance on antioxidants and antimicrobial preservatives, as well as regulatory rules on excipients (EMA, 1997). (EMA, 1997). (1997, EMA). EMA (European Medicine Agency) (2007) (21).



**Excipients: Guidance from the FDA**

As per the U.S. food and drug administration 21 CFR 210.3(b), excipients are any elements of a drug substance which are not the active ingredient (22). The FDA's Inactive Ingredient Database (2013a), which was launched in 2009, collects data on excipients found in pharmaceuticals sold in the United States. Industries could utilize the papers in this data that help them produce pharmaceutical medications. Whenever an excipient emerges in a permitted medical product over a certain mode of administration, such as oral, it is no longer be considered "new" for both the advantages of new drug development but it may need a less thorough regulatory examination at a later time. But whether or not the specified excipient in a specified quantity in a specific pharmaceutical preparation has been authorized, A sponsor may think it's okay to employ it in a similar product that's already on the market. (23)

**Necessary of a preclinical assessment of excipients**

Excipient components that can be used in challenging medication formulations are being developed at a rapid pace by pharmaceutical companies. The substance's safety is a major consideration. Excipients are no longer considered inert components in medications. It's crucial to understand their safety and efficacy. Preclinical investigations are used to determine the safety and efficacy of treatments before moving forward with clinical trials and Absorption, distribution, metabolism, excretion, pharmacokinetics, genotoxicity, and carcinogenicity are all investigated during product licensing safety studies. In the creation of new drugs, the use and safety of current and novel excipients are now being prioritized. When designing excipients, chemical, manufacturing, and preclinical data are currently the most important factors to address. The lack of worldwide criteria for excipient safety evaluation, a list of authorized excipients, and a method for excipient preclinical examination all impact preclinical assessment in excipient development (25). Excipients are not inactive compounds, in contrast to the common assumption. When it is used alone or with a medication preparation, it may produce undesirable toxicological effects, excipients must be evaluated in a preclinical setting before being used in a formulation. Instead of serving several functional roles in a therapeutic formulation, excipients induce a variety of undesirable events such as hypersensitivity, allergy, or anaphylaxis nature. When it comes to a new excipient, a preclinical study is much more important (26). Novel excipients from an intermediate category include substances that come from structural modifications to an 'authorised' excipient, a recognized food additive, a structurally modified food additive, or a part of an over-the-counter (OTC) drug. A novel excipient, as per the Centre for Drug Evaluation and Research (CDER) and the Centre for Biologics Evaluation and Research (CBER) criteria, is any compound that has never been assessed for safety. On a worldwide scale, inactive compounds are present in medical and diagnostic items; nevertheless, it is considered that all of these inactive components have already reached their intended amount, even though experts are working to optimize product distribution. There is also no therapeutic impact (e.g., promoting greater absorption on controlled release of active substance); regrettably, existing safety information in the form of presently scheduled exposures, length of exposure, or delivery method has not yet fully qualified them. (26)

**Recently Developed Excipients**

A variety of novel excipients have evolved in the treatment of type 2 diabetes as a result of concerns about using sugar in several health domains, including dental care, obesity, and diabetes. Sugar-free medicinal treatments have grown in popularity during the last 15 years. These compounds include Aspartame, saccharin, and cyclamate are examples of sweetening agents, and Bulk sweeteners also including polyols are also used. Mannitol, orbital, lactitol and xylitol are all sugar alcohols that are either naturally occurring or synthesized with some of them being permitted for food usage. Preclinical research on these excipients, such as carcinogenicity bioassays, is ongoing have been described before in the literature. In addition to investigating the safety, several of these studies are based on particular toxicological challenges, such as saccharin-induced bladder tumour formation and polyol-induced adrenal/testes proliferation. (As seen in Table 1) (27) Cyclodextrins (CDs) bind to enhance the stability and solubility of hydrophobic medicines in water. CD correlation allows for the preparations of water-insoluble medications that would have been difficult to administer using more standard methods. Currently, CD formulations are used to market ten pharmaceutical products. A CD-based composition undergoes the very same safety and quality testing just like any other product. CD and their methyl (M), hydroxypropyl (HP), and self-butyl ether (SBE) derivatives are the six CDs that are now employed in medicinal goods. The influence of the structural properties of these CDs on



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complex formation performance is assessed. The best standards, production value, and safety for every CD are offered. The present and prospective regulatory procedure for excipients, and also CDs' legal position in Japan, the United States, and Europe are briefly described. (28)

### **Lipid excipients' regulatory status**

Excipients were formerly regarded to be inert compounds utilized largely in the design of innovative medicine formulations, just a few examples include diluents, fillers, binders, lubricants, coatings, solvents, and colors [29]. However, advancements in pharmaceutical science and technology have increased the availability of a diverse spectrum of innovative excipients throughout time. In rare cases, an excipient and an active substance may interact, another inactive ingredient(s), biological surrounds, or even the container closing mechanism [30–44]. As a response, it's now recognised that not all excipients are harmless, even though some of them may contain poisons [45]. In the United States, GRAS (generally recognized as safe) substance lists have been published in the Code of Federal Regulations (CFR) [46] by the Food and Drug Administration (FDA). The Organization has also maintained several excipients which have been certified and utilized in marketed goods over the years, termed the Inactive Ingredient Guide (IIG) [47,48]. This guideline is important since it offers a dataset of allowed excipients, and also the maximum dose level for every excipient by administration method or dose form. All these Industries can make use of GRAS listings and IIG data to assist manufacture medicinal goods. Once an inactive component in an authorized medicine has been found, it can be exploited to generate new drugs. Because the inactive component is not deemed novel, it may be subjected to a less comprehensive the next time it's incorporated into a new medication product, it'll be evaluated. for a specific route of administration. For example, if a certain inactive component has been approved for use in specific pharmaceutical formulations and strength, sponsors may believe it is safe to employ similarly in a similar product.

Before a novel excipient may be utilised, nonclinical and clinical investigations are usually necessary. In this connection, The US Food and Drug Administration (FDA) has published a white paper for industries on the use of non-clinical research to assess the safeness of innovative excipients [45]. The excipients' safety assessments approved for use in OTC and generic medication products are explained in this advice as well as the kind of toxicity data things should be considered while deciding on the safety of a potential new excipient. The paper also includes pharmaceutical testing methods for short, medium, and lengthy use. More significantly, this proposal emphasises the necessity of conducting risk-benefit studies on proposed novel pharmaceutical excipients, as well as establishing excipient limitations that are both safe and legal. As proven, with adequate preparation, it is usually possible to test the toxicity in a sufficiently effective manner as an excipient [45]. Nonclinical safety testing can be replaced with human data for some excipients. Additionally, an excipient has a history of human exposure. The FDA presently lacks a procedure or mechanism for independently assessing the safety of an excipient.

Excipients, on the other hand, are assessed and authorized as 'ingredients' of pharmaceuticals. In applications for medication or biological product that is undergoing pre-marketing approval, the term "bioproduct" is used. A full battery of toxicity studies may not have been required under conditions relevant to the intended usage [45]. Excipients are a necessary element of the formulation and cannot be examined apart from the drug substance; the regulatory method is scientifically sound. Because of their unique physical and chemical characteristics and the potential for interrelations with some other substances or the physiological environment in vivo lipid excipients are especially vulnerable.

### **Pharmaceutical excipient development**

Excipients are important ingredients in pharmaceuticals. They could also be toxic. Kidney failure and death caused by diethylene glycol, as well as osmotic dysentery produced by ingested mannitol, are examples of excipient-induced toxicity, Propylene glycol causes cardio toxicity and hypersensitivity to lanolin. The safety of excipient exposure must be investigated to test or commercialize novel medicinal products in the United States. Data on acute, repeated-dose, sexual, and genetic toxicity, as well as carcinogenicity and highly specialized toxicological knowledge also including hypersensitivity or topical discomfort details, may be necessary based on the particular context. There

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are many multiple recommendations available to assist in pharmaceutical development. The Food and Drug Administration's Centre for Drug Evaluation and Research (FDA/CDER) provides pharmacology and toxicology guidance, as well as publications from the International Conference on Harmonization (ICH). "Nonclinical Studies for the Development of Pharmaceutical Excipients," a new industry recommendation from the FDA/CDER, was just released. Its main goal is to generate safety evidence to guide the clinical usage of pharmaceutical excipients. This post presents the new guideline paper and digs deeper into it.

**Excipients Toxicity Guidance**

The FDA CDER has prepared a guideline document on the excipients that may be used as excipients are evaluated for safety as part of its Inactive Components Subcommittee. The International Pharmaceutical Excipients Council (IPEC; Steinberg et al. 1996) and the International Conference on Harmonization of Technical Requirements for Pharmaceuticals for Human Use were influential in the development of the idea (ICH). In an attempt to obtain public acceptance, the FDA produced a paper for the industry titled " Nonclinical Research for Pharmaceutical Excipient Development" in September 2002. (Source: Federal Register, 2002) (49). The preliminary advice covers the safety in light of plans in the United States to employ excipients in new medicinal formulations, there are several hazards which should be discussed in a new drug application (NDA) or an investigational new drug application (IND) (NDA). The following are the difficulties that should be handled under different exposure situations. It is crucial to realise that the CDER regards these "problems" as a collection of issues that should be effectively addressed in a certain form inside of an IND or NDA, instead of as a detailed list of non-clinical studies that has the potential to be presented must be provided. The preliminary advice demonstrates that the obligation to present supporting evidence that results in a favourable risk-benefit evaluation does apply just to novel molecular entities (NMEs).

By referring to current nonclinical and clinical data sources, and also marketing, it may be able to appropriately address all or some of the safety issues for excipients having a track record of usage. The compound's history or regulatory status as a direct food additive (e.g., "GRAS") [generally regarded as safe] might be enough to warrant oral intake of that chemical up to the authorised levels in foods. Furthermore, if there will be any gaps in the data source, fresh nonclinical research should be done to fill them. Earlier human usage informs us there is a scarcity of information concerning certain possible safety concerns, for example, carcinogenic effects and genotoxic effects. There is a common misunderstanding that once an excipient is authorised (and appears in the CDER's Nonactive Ingredient Guide), the agency would automatically deem it acceptable to use in any subsequent product with the same modes of action and degree of exposure. Even when an excipient has been accepted to be used in some other product (excipients are not "approved"), it is safe and reliable for use in other products with similar circumstances, the organization may, however, request that the databases be brought up to date. Excipients use for over-the-counter medications (OTC) pharmaceutical products also shouldn't interact with a product's effectiveness or quality, and excipients should be avoided for medications having a limited therapeutic index, also including such as digoxin and enoxaparin. Excipients, along with concentration, must not influence the product's therapeutic efficacy for safety purposes. Except for antioxidants, buffers, and preservatives, the regulations (21 CFR 314.94 (a) (9) indicate that generic prescription products designed for intravenous, ocular, or optic administration must include the same excipients in the same proportions as pharmaceutical goods. Therefore, in all of these cases, the inert ingredients do not affect the drug's safety. Excipients of drugs intended for alternative routes of administration might vary, as a result, they must be appropriate for the indication and population of patients. The scope and kind of safety standards that apply to the approved use of a novel excipient are subject to various exceptions. For example, in the development of a new excipient for use in life-saving drugs, it may be justified that toxicity information requests are minimised (as compared to the low indications) or finalized after authorization. Moreover, significant information from a larger polymer's database may be extrapolated to evaluate comparable polymers with a wide range of molecular weights (chain length). The organization would start investigating such circumstances on an individual basis all safety tests must be completed. done in compliance with good laboratory practice requirements and utilising cutting-edge techniques. (50)



**Dayashankar et al.,****Development Strategies for New Excipients**

The FDA will need to review extensive toxicity data to certify new excipients that haven't been commercialised before. New excipients, like unapproved drug substances, should be subjected to safety pharmacology studies to determine potential hazards, and actions of pharmacological. S-7A is an ICH safety pharmacology advice document (2001) document should be monitored, with an emphasis on the CNS, CVS, and respiratory systems, since they've been recognised as vital functions in the ICH M-3 document (1997). If all these methods identify activity, the next step is to see what happens plan may be modified. Conducting detailed investigations to evaluate the excipient's effects on the afflicted system(s), and also the degrees of no-observed-effect (NOELs) and defining tolerated daily doses, are examples of additional tasks (50-51)

**The Future Aspects of Excipient Development**

Excipient safety has been impeded by the lack of regulatory criteria for analysing these crucial components of drug formulations. The advantages of employing the new material had to be carefully weighed against the additional cost, workload, and potential regulatory interruptions. Further to that, because excipients aren't passive or inert substances that can bioavailability is influenced by the drug but also cause toxicities, they must be taken into consideration when developing new drugs. Plenty relating to sugar replacement species-specific goods have been created as a result of the product's toxicity concerns that have nothing to do with humans, yet these assessments have consumed time, effort, money and expenses to help solve regimen use of these excipients has been discontinued. The use of CDs in dosage forms is still challenged by uncertainty regarding the regulatory approval of preparation including an "out-of-the-ordinary" inactive component. Anyway, with pressure from the government to enhance a formulation, developing the HFAs took a significant period, commitment, and funds. As a result, well-known excipients, such as those that have been worldwide pharmacopoeias mentioned and also have strong published safety information have been used. Even after this, companies are continuously testing new components or adapting existing excipients to the new application. Several strategies for preclinical studies have been utilised in development in the case studies of components under this article describes a development, but while many of the other components have been in the early stages, as a result, there is no published evidence on the whole development model. readily accessible. The assessment process also includes an evaluation package like that offered by IPEC; these reviews are useful as guidelines, they have yet to get official regulatory agency comments, as well and they are equivalent to the extensive preclinical testing necessary for the development of a specific chemical.

- Ames analyse manages the risk of genotoxicity.
- A single-dose toxicological study will be conducted to analyse adverse effects at high dose levels.
- A large-scale autoradiography research can provide important data on uptake, delivery, metabolic activity, and efflux.
- Metabolic studies in vitro (e.g., hepatocytes) to determine type variation.
- To evaluate whether increasing dosage cause toxicity, just one toxicology study (plus pharmacological and toxicological satellite animals) will be conducted.

The findings of all these studies are then evaluated by appropriate regulatory organisations, and advice is required on whether extra testing, in addition to the standard toxicology examinations needed for the new drug product, is required. Evaluating systemic toxicity is a typical concern in the monitoring of the safety of too many new excipients. The component medication can be pharmacokinetically labelled (or cold tested) and its metabolism can be followed in the absence and presence of the novel excipient during the ordinary development of new drugs. However, labelling the excipient material, such as PEG, PVP, or PLA, can be difficult in many cases because they are rapidly metabolised into normal cellular components. Some researchers have successfully overcome this problem; for example, PEG absorption HPLC can also be used to monitor urinary excretion. Able to wait whether an excipient is "authorised" by authorization of the new medication development and therefore is a constituent will be neither useful nor acceptable in the present regulatory regime. It's also the concept that excipients that are new to the market should be labelled as such and subjected to significant preclinical study. However, some additional drug development regions have lately benefitted from new or amended regulatory guidance, such as suggestions on in



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vitro experiments that are necessary. Nowadays as result, special advice to aid companies in the development of excipients is desperately required, and a method for testing excipients have been an appropriate issue for discussion at the Harmonization International Conference (ICH).A guideline like this would seem to be a welcomed contribution to the present work in pharmacopoeia standards of excipient safety. As a consequence, excipients could be examined by a worldwide pharmacopoeia committee, with clinical evidence analysed and published by authorized authorities; this data will be acceptable to international regulatory agencies.

## CONCLUSION

Excipients are a key component of a dosage form and have an impact on the formulation's qualities. Excipients were once thought to be inert components; however, it has now been shown that they can have substantial negative effects. In comparison to Active Pharmaceutical Ingredients, however, the regulatory supervision over the use of excipients is still unclear. Excipients require strict control and law to minimise unwanted side effects and interactions with the medicines. Excipients should undergo numerous assessments before being included in a formulation, such as toxicity tests, preclinical studies, compatibility studies, and so on. As a result, regulatory agencies and industries should evaluate excipients in the same way that APIs are evaluated.

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**Table -1. Toxicological Effects with common Excipients**

| Excipients                 | Toxicological effects   | Explanation  | Reference   |
|----------------------------|---|--|---|
| Polyols and lactose        | Proliferative alterations in the adrenal medullary /tumours, as well as hyperplastic/neoplastic testicular changes, have been observed in rats. | It's assumed to be rat-specific, and it's only linked to calcium homeostasis disturbances as a result of large doses administered, but it does not apply to humans.                            | Lynch and colleagues (1996)<br>Bamford and Baldrick (1997); Bar (1988,1989)<br>Roe (1989); Roe (1992) |
| Saccharin                  | Male rat bladder epithelium undergoes proliferative changes.  | Large doses are thought to be species-specific. Proteins in the urine that aren't ordinarily seen in people could be involved in the mechanism of action.                                      | Wisner and Williams (1996); Cohen (1998); Golightly et al.  |
| Polyvinylpyrrolidone (PVP) | The accumulation of "foam cells" within rodent reticulate - endothelial systems.  | The literature is unclear about the toxicological significance of the findings, but they may be related to the use of high-dose regimens. Long-term storage in humans had no negative effects. | Robinson et al. (1990)  |





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|  |  |   |  |
|--|--|---|--|
| Menthol  | Sensitization reaction in guinea pigs is limited.  | The literature does not indicate any toxicological significance, though the presence of menthol, relatively rare human allergic responses have been observed.                 | Sharp (1978)   |
| Limonene   | The formation of hyaline droplets in the kidney of a male rat  | The presence/accumulation of a 2-microglobulin is thought to be male-specific.  | Alden (1986);<br>LehmanMcKeeman et al. (1989); Flamm and Lehman-McKee man (1991) |
| Talc   | (I) Female rats having lungs tumour<br>ii) Neoplasms of the adrenal gland (pheochromocytomas) in rats                    | (I) I am Concerned with high-dose levels and the subsequent chronic toxicities.<br>(ii) The tumours were not produced by the therapy, according to an assessment of the data. | Goodman (1995)   |
| PEG (low molecular weight) stands for polyetheneglycol | In mice, it was teratogenic, causing increased foetal loss, lower body weight, and abnormalities.                        | In rats, it is not teratogenic. It isn't regarded to be useful for humans.  | Vanier et al. (1989);<br>Gupta et al. (1996)                                     |
| Maltodextrin   | In a chronic rat inhalation study, 4% maltodextrin caused Laryngeal discomfort that is reversible (squamous metaplasia). | It's assumed to be a background discovery unrelated to humans.  | Baldrick (2000)  |
| Mannitol   | Severe kidney and cardiac damage, Apoptosis was induced in the kidneys and the heart.                                    | In the design that was utilised (old male spontaneously hypertensive rats), this could be related to osmolality.  | Zhang et al. (1999)  |
| CFCs   | Cardiac arrhythmias, particularly in dogs  | CFC propellants are safe because of their strong safety tolerances and long/wide usage in MDIs  | Wolff and Donato (1993)  |
| Aluminium salts  | In the guinea pig and rat, there was the dosage location, there is a local tissue response.                              | Aluminium adjuvants have also been linked to Skin nodules, granulomas, and local injection site reactions are all common side effects.  | Vogel and Powell (1995);<br>Martindale (1999)                                    |
| Thimerosal   | The guinea pig has hypersensitivity.   | There have been hypersensitivity is becoming more common, especially with immunizations.  | Kibbe (2000)   |





## A Prospective Study on Utilization Pattern of Drug Dosage forms in Mild to Moderate Asthma

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### ABSTRACT

A Prospective study of utilization pattern of drugs used in bronchial asthma with special reference to dosage forms. This study become carried out to assess the numerous dosage forms in the treatment of mild to moderate bronchial asthma, to evaluate the acute exaggerations during seasonal variations, and to find out the adverse drug reactions in comparison to dosage forms. This is a prospective, cross-sectional, observational study. This potential study was performed for six months, from October 2019 to March 2020, wherein 100 patients were selected for the observation by considering the inclusion and exclusion criteria. The prescriptions of 100 respiratory patients diagnosed with acute exacerbation of bronchial asthma have been evaluated from the general department, and the collected data were analyzed using MS Excel. Out of the total number of patients analyzed, 54 (54%) patients were female, and 46 (46%) patients were male. Patients of the age group 61-70 mainly were found to have bronchial asthma (42%). Among Bronchodilators, the most frequently used drug is oral theophylline (61%), among Corticosteroids, methylprednisolone (51%) are commonly administered. Compared with systemic therapy, anti-asthma drugs used as inhalation therapy are more beneficial to patients. Therefore, their maximum utilization in asthma patients will also significantly reduce the occurrence of acute asthma and the adverse effects of anti-asthma drugs.

**Keywords** :asthma, treatment, inhalation, respiratory disease, patient, Drug therapy, drug utilization pattern



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## INTRODUCTION

Asthma means "dyspnea" in Greek and was first described 3000 years ago. It is a broad term used to refer to respiratory diseases that cause episodes of respiratory dyspnea(1). According to the GINA definition, asthma is a heterogeneous disease, commonly characterized by chronic airway inflammation(2). Asthma is described as a chronic inflammatory disease of the respiratory tract. Chronic inflammation is associated with airway hyperresponsiveness (excessive airway narrowing response to particular triggers (such as viruses, allergens, and exercise)), leading to recurrent episodes of wheezing, chest tightness, and coughing that may over time and intensity and change(2)(3). Its functional feature is the existence of airflow obstruction, which is variable in a short period or reversible in treatment. There are several inflammatory mediators that can cause the characteristic pathophysiological changes of asthma(4). In India, it is estimated to be 15-20 million, morbidity and mortality comprising about 3-11% of adults, 3-5% of pediatric population(4)(5). Air allergens, drugs, chemicals, exercise, dry air, infections, and emotions can aggravate symptoms and accelerate attacks(6).

According to the GINA (Global Asthma Initiative) guidelines, it's far endorsed to use a variety of drugs to treat asthma, including long-acting and short-acting  $\beta_2$  agonists (salbutamol, salmeterol, formoterol), glucocorticoids (fluticasone, prednisolone, Budesonide), xanthine derivatives (theophylline) and leukotriene receptor antagonists (montelukast). These drugs can be used alone or in combination with other anti-asthmatic drugs(7).

Inhaled short-acting  $\beta_2$  receptor agonists (SABA) can reduce airway narrowing and related symptoms (cough, chest tightness, wheezing) by relaxing the smooth muscles in the airway wall, thereby quickly alleviating symptoms. Current guidelines recommend SABA as a treatment option for mild intermittent asthma. Because ICSs can control airway inflammation, it is the most important treatment for asthma (including mild intermittent asthma). The effects of ICS treatment include alleviating asthma symptoms, enhancing lung function, reducing the frequency and severity of exacerbations, and improving quality of life. The consequences of ICS treatment encompass alleviating asthma symptoms, improving lung function, reducing the frequency and severity of exacerbations, and improving quality of life(8). The present study was done to describe the utilization pattern of drugs used in mild to moderate asthma in our tertiary care center, Salem, Tamil Nadu.

## AIM AND OBJECTIVE

### Prospective study of utilization pattern of drugs used in bronchial asthma with special reference to dosage forms

- To find out the various dosage forms in the treatment of mild to moderate bronchial asthma.
- To evaluate the acute exaggerations during seasonal variations.
- To evaluate the adverse drug reactions in comparison to dosage forms.

## MATERIALS AND METHODS

### Study design

Prospective, observational, cross-sectional study.

A prospective empirical study was carried out in the outpatient department of General Medicine of VMKV Medical College & Hospital. This study will be done for 6 months after getting approval from the institutional ethical committee. The Patient concerned form will be obtained before the start of the study. It involves the collection of all relevant data related to demographic details, principle diagnosis of mild to moderate asthma, and principle diagnosis made by the physicians will be taken into account. After proper scrutinizing from the OPD case sheet, we



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plan to design a questionnaire with special importance being given to the type of dosage form used by the patients and the frequency of acute exaggeration of mild to moderate asthma with its treatment.

**Inclusion criteria**

- All adult patients of both sexes in the age group of more than 21 years will be included in the study.
- The Patients diagnosed with a general physician with mild to moderate asthma will be included in the study.

**Exclusion criteria**

- Inpatients and patients with severe asthma, COPD patients, children, lactating women, pregnant women, and other comorbid conditions such as severe lung disease, cardiovascular disease, diabetes mellitus, and tuberculosis will be excluded from the study.

**Analysis**

Microsoft Word and Excel have been used to calculate the percentages and to generate graphs, tables

**RESULT**

Demographic analysis of data revealed that there have been 54 (54%) female patients and 46 (46%) male patients in the study and also showed that maximum asthmatic patients belong to 61-70 years age group, which is 42%. It was also observed that only 33 patients (33%) had a family history of asthma [Table 1]. The Global Initiative for Asthma (GINA) subdivided asthma by severity based on the level of symptoms, airflow limitation, and lung function variability into four categories: Intermittent, Mild Persistent, Moderate Persistent. In intermittent asthma, symptoms were <2 times/week, for mild persistent, symptoms >2 times/week, and daily symptoms for moderate persistent. In this study, the severity of asthma was mild intermittent in 59 (59%) patients, mild persistent in 32 (32%), and moderate persistent in 9 (9%) of patients. Only 22% of patients hospitalized for acute asthma exacerbation during the study period were studied for their prescription pattern [Table 1].

Among the 100 patients on anti-asthmatic drugs, 51 patients presented with ten types of adverse drug reactions. Resting tremors were the most common adverse drug reaction (11%) among all ADRs, followed by nervousness (7%), throat irritation (6%), anxiety & restlessness & dyspepsia (5%), inability to sleep (4%), diuresis & headache (both 3%), palpitation (2%) in patients treating with anti-asthmatic drugs [Table 2]. Anti-asthmatic drugs were prescribed to asthmatic patients as oral inhalation and parental. 60% of patients were administered in the inhalation route, 36% in the oral route, 4% in the parenteral route [Table 3].

Table 4 shows the prescription pattern of anti-asthmatic drugs. When analyzed consistent with the percentage of prescriptions containing a particular drug or combination, the most common individual drug category present in the maximum number of prescriptions were bronchodilators, of which theophylline (methylxanthines) in the oral form was the most common, followed by salbutamol (beta-agonist) in inhalational form. Approximately 61% of prescriptions were found to contain theophylline. The subsequent most prescribed class of medication become steroids led by methyl Prednisolone present in 23% of the prescriptions. Further analysis based on the combination drugs, wherein Salmeterol and budesonide combination is about 16%. The most typically used special drug dosage form in our study is rotahaler, in which salbutamol was the most common drug [Table 5].

**DISCUSSION**

Drug utilization research is a vital tool to evaluate current treatment methods and serves as a background for modifying and rationalizing disease management to reduce the economic and social medical burden (9). This study was conducted to monitor the use of anti-asthmatic drugs. According to research, women are much more likely to be afflicted by asthma than men. Gender differences in the incidence, prevalence, and severity of asthma have been



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reported worldwide. After puberty, asthma becomes more common and severe in women. In women with early menarche or multiple births, the incidence of asthma is the highest, which indicates the role of sex hormones in the occurrence of asthma(10)(11). The death rate of asthma in the elderly is higher than that in younger patients, continuing to rise with age. The overall drug utilization pattern shows that Methylxanthine is the first choice for asthma patients, followed by  $\beta_2$  agonists and corticosteroids. Prescription salbutamol and theophylline are taken more frequently because of the relatively low cost of the drug. This pattern has been seen in previous studies too(12).

## CONCLUSION

Our study showed a female preponderance with the majority of the patients is using the inhalational route rather than the oral route of administration. The combination therapy of long-acting beta-2-agonists with steroids as inhalational therapy proved to be better in mild to moderate cases of bronchial asthma. This pattern in drug utilization could be due to ethnic differences in our study population in Salem. To conclude, the inhalational route avoids systemic toxicity, increases the bioavailability of the drug, and better patient compliance. This is possible with the newer drug delivery system promoted for inhalational drugs in bronchial asthma

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**Table 1: Characteristics of recruited patients**

| Patient variables         | Percentage |
|---------------------------|------------|
| <b>Gender</b>             |            |
| Female                    | 54%        |
| Male                      | 46%        |
| <b>Age group</b>          |            |
| 21-30                     | 2          |
| 31-40                     | 4          |
| 41-50                     | 4          |
| 51-60                     | 31         |
| 61-70                     | 42         |
| 71-80                     | 11         |
| <b>Family history</b>     |            |
| Absent                    | 67%        |
| Present                   | 33%        |
| <b>Severity of asthma</b> |            |
| Intermittent              | 59%        |
| Mild persistent           | 32%        |
| Moderate persistent       | 9%         |
| <b>Acute exacerbation</b> |            |
| Absent                    | 78%        |
| Present                   | 22%        |

**Table 2: Distribution based on adverse drug reaction**

| NAME OF ADR        | PERCENTAGE |
|--------------------|------------|
| Resting tremors    | 11%        |
| Nervousness        | 7%         |
| Throat irritation  | 6%         |
| Anxiety            | 5%         |
| Restlessness       | 5%         |
| Dyspepsia          | 5%         |
| Inability to sleep | 4%         |
| Diuresis           | 3%         |
| Headache           | 3%         |
| Palpitation        | 2%         |

**Table 3: Route of administration wise distribution of patients**

| ROUTE OF ADMINISTRATION | PERCENTAGE |
|-------------------------|------------|
| Inhalation              | 60%        |
| Oral                    | 36%        |
| Parenteral              | 4%         |





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**Table 4: Distribution of study subjects according to anti-asthmatic drugs**

| Drugs                    | Oral | Parenteral | Inhalation |
|--------------------------|------|------------|------------|
| <b>Bronchodilators</b>   |      |            |            |
| Salbutamol               | 9    | 0          | 24         |
| Theophylline             | 37   | 8          | 0          |
| Doxophylline             | 15   | 0          | 0          |
| Ipratropium bromide      | 0    | 0          | 10         |
| Salmeterol               | 0    | 0          | 10         |
| Formoterol               | 0    | 0          | 11         |
| <b>Corticosteroids</b>   |      |            |            |
| Budesonide               | 0    | 0          | 8          |
| Fluticasone              | 0    | 0          | 14         |
| Methyl prednisolone      | 23   | 0          | 0          |
| <b>Combination drugs</b> |      |            |            |
| Salbutamol+ theophylline | 7    | 0          | 0          |
| Salmeterol + budesonide  | 0    | 0          | 16         |
| Formoterol + fluticasone | 0    | 0          | 5          |

**Table 5: Distribution of study subjects according to special dosage forms**

| DRUGS               | INHALER | ROTAHALER | NEBULIZER |
|---------------------|---------|-----------|-----------|
| Salbutamol          | 8       | 14        | 4         |
| Salmeterol          | 4       | 6         | 0         |
| Formoterol          | 2       | 7         | 2         |
| Ipratropium bromide | 2       | 8         | 0         |
| Budesonide          | 2       | 6         | 0         |
| Fluticasone         | 3       | 11        | 0         |





## Finalizing Alignment of Connector to NH-117a in Hilly Terrain from Kokrajhar to Bilasipara: Assam

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### ABSTRACT

To establish the alignment of a highway length 21.300 km from “Bilasipara” to “Kokrajhar” for extension of highway from two 2-lane with paved shoulders and evaluation of soil strength on the field. It is an existing road already but now its road width is extended so the aim is to design the highway alignment to carry out the detailed profile leveling which includes longitudinal section and cross-section, fixing up the formation level from the plotted longitudinal section according to prevailing gradients. For an estimate, the earthwork has been estimated, in the graphical format, and finally collecting the soil samples from the site and testing in the laboratory manually. Survey equipment like the dolomites, total station, and traditional survey instruments is used for the purpose. The proposed two-lane highway alignment with three options and the best alignment under present LULC strategies is finalized. The ground realities for that alignment, which is based upon emphasizing the straight path, horizontal deviation, and negotiation of curves shall help the planners for taking judicious and practical option.

**Keywords:** Highway Alignment, Traffic movement, Traffic analysis, Culvert, Carriageway, Shoulder,

### INTRODUCTION

North-East India roads are hilly. Roads in the northeastern region (NER) are in hilly areas. They are constructed with different terrain alignments and are different from the plain terrain category. It depends on terrain conditions. Hilly area roads come under steep mountainous terrain in the eastern Himalayas. So, the proposed upgrading of Kokrajhar to Bilasipara road needs to be materialized based on the rising traffic volume and increase of black spots urban extension, which have substantial stimuli on anthropogenic activities, the ecology, biological environment,

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and socioeconomic development in the undulated mountainous terrain with many sharp turns (Shi et al., 2019[1], Nayak et al., 2020[2]). The Assam state in the North eastern states of India has 337777km of various types of roads in 2017 except JRY roads, including district road of 4379km, and most neglected ODR and village roads of length 300123 km (MoRTH road statistics 2016-17[3], Sajida Siyahi, 2022[4]). The NE states including Assam is highly prone to earthquake and flood disasters and road construction and maintenance poses problem (The road length is 21.300km in Assam under the jurisdiction of The National highway authority of India (NHAI) Assam Public works Deptt. (APWD NH) (Gouj et al., 2022[5]). The MoRTH has allocated (INR 105.65 billion) funds to develop connectivity in the accessible areas in Assam through the Special Accelerated Road Development Programmed in North East (SARDP-NE) during 2022-23 as Externally Aided Projects (EAP), PRS legislative report, MoRTH 301<sup>st</sup> report[6].

### Geomorphology Kokrajhar District

Kokrajhar district in the state Assam is existing in land of reserved forests (covering 55%) its total geographic area of 78438sqkm and population density of 398perso/ Sq. Km. including endangered species the golden langur in the Chakrasila Wildlife Sanctuary. The Survey Corridor in the state Assam considered to pass through rural areas with micro or small enterprises which (approx. 41 km away) from the intersection between the Survey Corridor at Srirampur and NH31C (MoRTH, NHI 127b, 2020[7]). The road from Phutkibari to Kokrajhar of length 10.6km is under jurisdiction of the Assam PWRD, List of Major District Roads (MDR) in PWRD. The highway 117A is beginning from NH-17 junction near Bilasipara to Kokrajhar and finished near NH-27 junction near Garubhasa, Assam, as per the list of NH in India, [https://morth.nic.in/sites/default/files/Details-of-National-Highways-as-on-31.03\\_1.pdf](https://morth.nic.in/sites/default/files/Details-of-National-Highways-as-on-31.03_1.pdf)

### Road status in North East India

The Nagpur plan/Lucknow plan depicts the district roads navigating through more than one district, attending production areas/ markets and connecting them or with National Highways (NH) or state High ways (SH) or Railways with each other can be subdivided as Major district road (MDR connects the village with 1500 population) or Other district roads (ODR) depending upon traffic carrying capacity (Fig 2). The Phutkibari – Kokrajhar of length 7.50km is categorized under MDR whereas the rest part of the road segment from Bilasipara to Kokrajhar is categorized as other district roads not well developed Phutkibari Kokrajhar from 0.0km to 10.6km

## REVIEW OF LITERATURE

The North-East India houses in Indo-Malayan hot-spot biodiversity, which cover many endemic species. The deteriorating biodiversity needs conservation in north east region (NER) i.e comprising of 10 states (Arunachal Pradesh, Assam, Meghalaya, Mizoram, Manipur, Nagaland, and Tripura, Chakravarty et al., 2012[8], Davis et al., 2021[9]). Bilasipara to Fakiragram section of the Sherfanguri Road from Khalishabhita - Kokrajhar to the Dhubri district boundary 12.9km and Phutkibari - Shefanguri 12.9km to 24.0km Kokrajhar district coming under state of Assam PWRD, and Phutkibari Kokrajhar Road (Phutkibari - Kokrajhar) runs from 0.0 to 10.6km <https://pwwroads.assam.gov.in/sites>. Present traffic glitches fronting the society are, less road network in hilly areas, traffic jams, road traffic accidents, atmospheric pollution, fuel scarcity, unaffordable insurance cost etc. (Kakade et al., 2013[10], Toho et al., 2020[11]). Regional rural network of roads should meet the social development requirements accommodating the traffic volume needs. The Assam mala road project acknowledged various 31 priority sections of SH, MDR and OSRs of length 1296km for better connectivity and even provide short cut route between two adjacent district, poverty elevation of indigeneous communities (ADB report 2022[12]). The district, Dhubri has two sub-divisions (Dhubri, and Bilasipara), and six revenue circles (Tehsils), twelve blocks with population of 1444043, covering rural strich of 2810.76km<sup>2</sup> (2011 census data[13]). The Dhubri district, western corner of Assam, 30m above mean sea level (MSL) and allows the river Gaurang a tributary to Brahmaputra River to flow through the proposed Kokrajhar – Bilasipara Village road Das et al., 2019[14]. The Dhubri district is bounded by the Kokrajhar district to the north. The Dhubri district has an area of 2176 km<sup>2</sup>, and 290km from Dispur, the capital of Assam (JICA report-2018[15]). Spurts of road building accomplishments since independence have multifolded but the impediments like terrain, climate, insurgency, and mismanagement of resources have put a brake to the progress Das



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et al., 2019[16]. After independence the earthquake prone, nine districts namely Nagaon (78.53), Marigaon (74.15), Metro (72.87), Jorhat (71.94), Golaghat (70.82), Dhubri (69.35), Barpeta (68.13), Kokrajhar (58.16), and Kamrupand Darrang (57.60) belong to the moderateroad density region(Gogoi et al, 2013[17], Tanyas et al, 2022[18]) The road is planned considering three terrain alignments. They areroads through plain areas where the land use pattern is commercial, settlements, residential built-up area, cultivable land, and government land. Horizontal geometric is needed for the improvement in this reach along with vertical geometric alignment. The pavement condition is good. The bitumen pavement exists from Beltola (Kokrajhar) from (0.00km) to Futukibari (10.60km). Gravel roadsexist from Futukibari to Bhatipara (19.500 km). Good bituminous pavement exists from Bhatipara onwards. Bilasipara to Fakiragram (16.2 km) road is under construction and partly completed .<https://mdoner.gov.in/activities/list-of-roads> Existing carriageway is 5.50 m. The existing shoulder is 1.0 m to 1.50 m. The existing right of way (R.O.W) varies from 14m to 18m. The minor bridge provided is at 7/130km. The major bridge is to be provided 11/at 790km. 12 numbers culverts, 18 numbers box culverts, and 2 numbers slab culverts are enumerated as physically surveyed<https://pwdroads.assam.gov.in/sites/default/files/swf>. The NH emerging from the junction with NH-17 from Bilasipara to Kokrajhar, and ending at its intersection with New NH-27 adjacent to Garubhasaof length 39.85km in the Assam State (2019),[morth.nic.in/sites/default/files/Details-of-National-Highways-as-on-31.03\\_1.pdf](http://morth.nic.in/sites/default/files/Details-of-National-Highways-as-on-31.03_1.pdf)

**OBJECTIVE**

From Kokrajhar to Bilasipara is partly MDR and Partly ODR needs to be upgraded by APWD. Present study deliver an knowledge of the existing roads of the Dhubri district of Asom (Old Assam), the general status of expansion of roads, the spatial variation of roads and bridges and prepare few alternate road network from Kokrajhar to Bilasipara. Some relevant strategies are discussed to opt for the for the policy makers to opt for the best one. The present study is to set up various alternatives and compare their suitability for adoption in reality. The pros and cons of each alternative are compared and the best alignment is to be recommended.

**METHODOLOGY**

The existing road is showing the road start point is Bilasipara(Beltola) and the endpoint is Kokrajhar. The total alignment passes through the plain area. Land use pattern is the commercial, residential built-up area, cultivable land, and government land. Horizontal geometric design attains improvement in places. Vertical geometric provide improvement in approaches. Pavement condition is good bitumen pavement has been observed from Beltola (0.00 km) to Futukibari (10.60 km). Gravel road exists from Futukibari to Bhatipara (19.500km) next onwards good. The feasibility study of the proposed route with 3 alternative alignments has been designed. The final alignment is selected out of the three proposed alignments to finalize the best alignment and accordingly design the road (**fig 2**).

**ALIGNMENT PROPOSAL**

The total length of alignment is 21.300 km. There are 12 numbers of HP culverts are provided (10 culverts to be widened on both sides & 2 culverts to be replaced).18 numbers of box culverts are provided. ( 6 numbers to be widened on both sides & 12 nos. to be replaced). Here , 2 numbers of slab culverts to be provided as per ground trothing and satellite imagery. The geometric alignment is fair. The alignment is designed as per40 kmph speed, without land acquisition. The alignment passes through mainly built-up areas, agricultural and barren land.1 no. of the existing minor bridge at chainage-7/130km(16.80 m) is to be widened from both sides.1 no. of an existing major bridge at chainage-11/790 km (142 m) over the Gaurang river, is to be retained & in good condition. Connectivity is preferred in the thickly populated town of Bilasipara (Beltoli), udamari, lakhiganj, futukibari, boruapara, kasipara, Batipara,& Kokrajhar. The total cost of construction of this alignment will be approx. 64.74 crores, which includes a civil cost of approx. 51.68 crores.



**Suchismita Sejpada et al.,****ALIGNMENT PROPOSAL-II**

The total length of alignment is 21.170 km. There are 12 nos. of hp culverts ( 10 nos. to be widened on both sides & 2 nos. to be replaced).20 nos. of box culvert are provided ( 6 nos. to be widened at both sides & 14 nos. to be replaced).2 nos. of slab culverts are replaced. The geometric alignment is good and as per IRC norms. The alignment is designed for 100 kmph. Design speed( Except at Bhatipara Town & Futukibari in.) where the speed will be 60 kmph& 30 kmph. The alignment passes through mainly built-up areas, agricultural & barren land.1 no. existing minor bridge at ch- 7/130 km (16.80 m), is to be widened from both sides.1 no. existing major bridge at ch-11/790 km (142.0 m) over Gaurang river, is to be retained & in good condition. Proposal- II will provide connectivity to the thickly populated town of Bilasipara (Beltoli), Udamari, Lakhiganj, Futukibari, Boruapara, Kasipara, and Batipara& Kokrajhar.6.80 acre land acquisition will be required for this alignment, for straightening of curves & to achieve the required design speed.The total cost of construction of this alignment will be approx.65.02 cores which include a civil cost of approx. 54.58 crores.

**ALIGNMENT PROPOSAL-III**

The total length of alignment is 19.450 km. Here, 1 major bridge is provided.1 no. of box minor bridge is provided.14 nos. of box cell culverts are proposed along this alignment.10 nos. of hp culverts to be widened & 6 nos. of box culverts to be widened. The geometry of the alignment is good and as per I.R.C norms. The alignment is designed for 100 kmph (design speed). The alignment passes through the main built-up area, agricultural land, and barren land. The length of the proposed bridge at chainage-11/790 km over the Gaurang river is 244.Proposal -III will provide connectivity to the thickly populated town of Bilasipara (Beltoli), udamari, lakhiganj, futukibari, boruapara, kasipara, batipara& Kokrajhar. 65.4-acre land acquisition will be required for this alignment.The total cost of construction of this alignment will be approx.. 94.75 crores which include a civil cost of approx..65.68 crores.

**RECOMMENDATION**

The final alignment is Alignment-II has been recommended due to following reasons, Proposal-II has better geometry and uniformity compared to proposal-I. The cost of construction of proposal -II is slightly higher than Proposal -I. The cost of construction of proposal -II is much less than Proposal-III, due to minimal land acquisition & no proposed bridge. Minimum compensation is required along the alignment. Proposal-II will provide connectivity to the thickly populated town of Bilasipara(Beltoli), Lakhiganj, Futukibari, Boruapara, Kasipara, Batipara& Kokrajhar. Proposal -II will be safer for operation as it has less number of sharp curves. Proposal-II has the minimum number of junctions compared to other alignments and hence is preferable from the safety point of view. Proposal-II will have minimal interference to the surrounding agriculture & connect to the maximum habitation.

**TRAFFIC MOVEMENT**

Traffic movement is designed by the above shown in fig.6. NH-31 C ends with Karigaon and the Kokrajhar road is start with the junction of NH-31C and Koregaon. Futukibari road is start from Kokrajhar. Futukibari road ends from Beltoli (Bilasipara) our destination point.From the left side of Beltoli, the road is continuing and the destination point is Gauripur and the design speed is 39kmph. From right onwards, NH-31 is continuing and the first junction point is Chhapar& the design speed is 25 Kmph. The next junction point is Tulungia and the design speed is 25 kmph. The last junction is Jalukbari, and the design speed is 170 Kmph. The diagram shall help to know the design speed of the vehicle and the junction point. The vehicle movement from our 1<sup>st</sup> destination point to our last destination. The road user can easily know about the traffic condition of every junction. They can move safely.

**TRAFFIC ANALYSIS**

Traffic analysis is to calculate to know the volume of traffic carried by that pavement. Table -1 is showing how much traffic is carried. This table shows which type of the lane is, the numbers of commercial vehicles as per the last count, the initial traffic count in the year of completion, growth rate per annum and the design life of the road, the vehicle damage factor, numbers of years between last count and the year of completion of the construction period, lane distribution factor. To analyze the design traffic as per the above formula.





### PAVEMENT LAYER DESIGN

The Project Road which is proposed is to be constructed with Flexible pavement which has a designed life period of 15 years.

#### Design Traffic

The Design cumulative standard axles are calculated from the traffic survey which is found to be 16.00 MSA. Therefore, for pavement design, a design traffic of 20 MSA is considered. (as per IRC: SP-73-2018<sup>[19]</sup>, clause 5.4.1)

#### Requirement of C.B.R. for Sub-Grade

The minimum CBR of sub-grade for pavement design shall be 8% for traffic intensity more than 450 CVPD as per IRC 37<sup>[20]</sup> clause 5.1.

#### Pavement Composition

The following pavement thickness is proposed for the development of the Project Road as per IRC 37-2018, Plate no. 4, for 8% CBR and 20 MSA.

### TYPICAL CROSS-SECTION

The typical cross-section of (Raising/ New alignment portion) is shown in the above fig-7 is the earthen road is laid down. Above earthen road drainage layer is provided, above drainage layer GSB is provided, above GSB WMM layer is provided, above WMM DBM and BC is provided. Moorum shoulder is provided and above the moorum shoulder, the paved shoulder is provided. The typical cross-section of (the Widening & Strengthen portion) is shown in the above fig-8. In this cross-section, the existing road is 5.50m is exist. The drainage layer is provided. GSB, WMM, DBM & BC are provided accordingly. 100 mm moorum shoulder provided and above moorum shoulder, the paved shoulder is provided The typical- cross-section of (Built-up portion) is shown in the fig-9. Above the earth filling Drainage layer, GSB, WMM, DBM, and BC are provided accordingly. RCC drain, 100mm moorum shoulder is provided, above moorum shoulder paved shoulder is provided.

### SITE PHOTOGRAPHS

Fig: 1 to 12

### CONCLUSION

In the present study, an attempt has been made to establish the alignment of a highway of length 21.300km from "KOKRAJHAR to BILASIPARA" for extension of the highway from two lanes to four-way lane and evaluation of soil strength on the field in the form of an open transverse. The road was categorized as a village road and developed to ODR. The Proposal-II has better geometry and uniformity compared to proposal-I, though the cost of construction of proposal -II is slightly higher. To make the road to 2-lane road, the Detailed profile leveling has been aimed out along the alignment; the formation level of the road has been fixed according to the prevailing topography.

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**Table-1 Traffic Analysis of Bilasipara-Kokrajhar**

| Type of lane  | 2 LANE                      |
|---|-----------------------------|
| No. of commercial vehicle as per last count(p)                                      | 1488                        |
| Initial traffic count in the year of completion                                     | $A=P(1+r)^x=1640.52$        |
| Growth rate per annum(r)  | 0.05                        |
| Design life(n)  | 15                          |
| Vehicle damage factor (f)   | 2.5                         |
| No. of year between last count and the year of completion of construction period(n) | 2                           |
| Lane distribution factor(d)   | 0.5                         |
| Design traffic  | $N=365X[(1+r)^n-1]XAXDXF/r$ |
| Final million standard axle   | = 16 MSA                    |





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**Table-2 Pavement Composition**

| Specifications                 | Thickness     |
|--------------------------------|---------------|
| Bituminous concrete            | 40 MM         |
| Dense bituminous macadam       | 60 MM         |
| Wet mix macadam                | 250 MM        |
| Granular sub-base (full width) | 200 MM        |
| <b>TOTAL THICKNESS</b>         | <b>550 MM</b> |



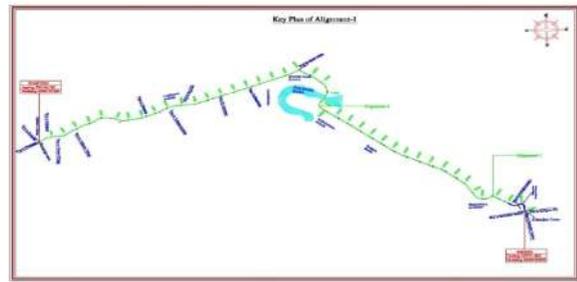
**Fig. 1. The NH, SH, MDR and ODR roads in the NE region**



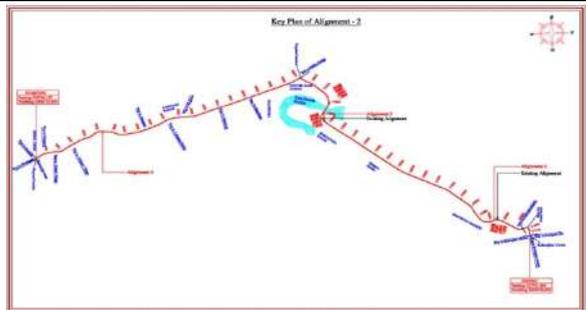
**Fig. 2. Existing road alignment from Kokrajhar to Bilashipara**



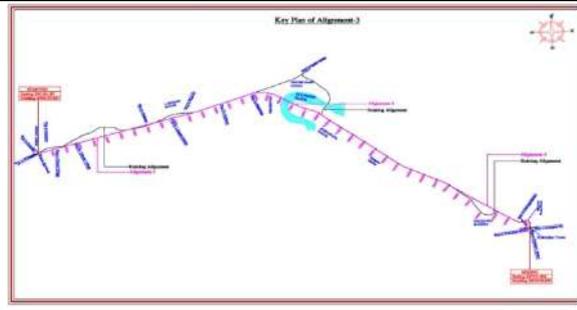
**Fig. 3. Proposed road alignment from Kokrajhar to Bilashipara**



**Fig. 4. Key plan proposal of Alignment-I (Kokrajhar to Bilashipara)**



**Fig. 5. Key plan of alignment-II: (Bilashipara to Kokrajhar road)**

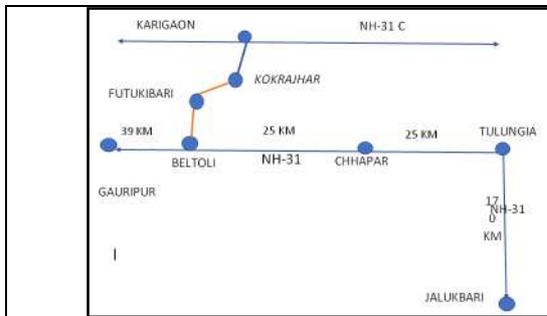


**Fig. 6. Key plan of alignment-III: (Bilashipara to Kokrajhar)**

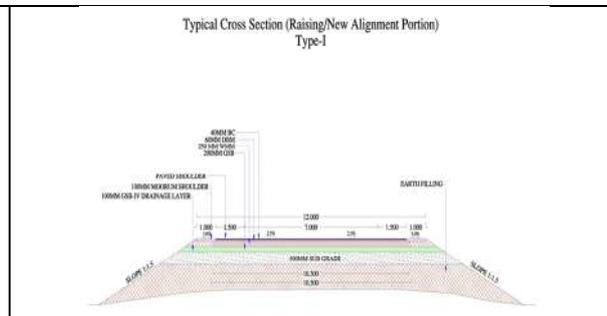




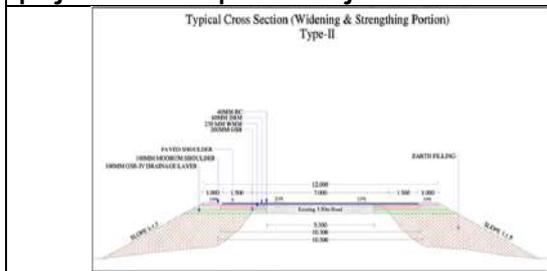
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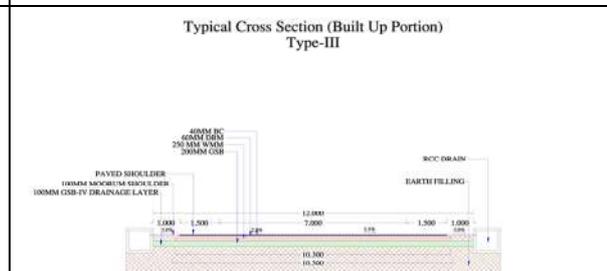
**Fig.7. Traffic movement along the two-lane road project from Bilasipara- Kokrajhar**



**Fig .8. Typical C/S of raising portion**



**Fig. 9. Typical c/s of widening & strngthning portion**



**Fig. 10. Typical c/s of built-up portion**



**Fig. 11. Chainage – 0/00 Km (Beltola - Chariali)**



**Fig. 12. Chainage – 7/130 Km (Minor Bridge)**



**Fig.13. Chainage – 8/250 Km**



**Fig.14. Chainage – 10/050 Km**





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(Phutkibari - Tiniali)

Fig .15. Chainage – 10/750 Km



(Gaurang River)

Fig .16. Chainage –11/790km



Fig .17. Chainage – 14/400 Km



Fig.18. Chainage – 16/850 Km



Fig.19. Chainage – 17/900 Km



Fig.20. Chainage – 18/650 Km (Existing Drain)



Fig .21. Chainage – 19/260 Km



Fig.22. Chainage – 20/500 Km (Kokrajhar Town)





## Fast Dissolving Oral Thin Buccal Films: An Effective Oral Dosage Form for Rapid Release

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### ABSTRACT

Oral drug delivery is among the most preferable routes of delivery since of their affordable cost and efficiency of delivery in order to increase the patient acceptance. Numerous patients, particularly old age and paediatric patients, facing difficulty to swallowing hard gelatin film and capsules. The FDDDS (fast-dissolving drug delivery system) was designed as a replacement for capsules, tablets and syrups. For all of them, rapidly dissolving oral flakes can be used for children, old age patients who are or incapacitated or developmentally disabled and patients who are facing in difficulty to swallow the hard gelatin capsules or films. It is a substitute platform for molecules that experience high first-pass metabolism. The fast-dissolving oral thin film is a comparatively recent active ingredients during which a coating of hydrophilic polymer is used, which disintegrates or disperse quickly in the tongue either oral cavity. This is the review reports on the alternative formulations of mucoadhesive buccal oral thin films.

**Keywords:** First-pass metabolism, Solvent evaporation method, Hot melt Extrusion method, Fast dissolving buccal films, Hydrophilic polymers.

### INTRODUCTION

In most cases, the fast-dissolving oral buccal cavity, film delivery system is the mucoadhesive buccal film includes active ingredients that can quickly dissolve or disintegrate in saliva in a matter of few seconds in the absence of water either by chewing. More or less, medications are well received when saliva reaches the stomach via the mouth,





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pharynx, and oesophagus. The Oral thin films that dissolve in the mouth provide a graceful route for systemic administration and improve systemic bioavailability due to the adequate supply of blood vessels and lymphatic drainage, thus escape the first-pass effect and its give better permeability. In addition, has a large absorption surface area, is easy to ingest and swallow, and avoids pain, making systemic administration is appealing and preferential for the oral mucosa. The drug's bioavailability is much greater in this situation than in the traditional tablet dosage form. Most fast-dissolving release systems films should contain ingredients that conceal the flavour of the active ingredient. Afterward, both soluble and insoluble excipients are swallowed by the patients, along with marked active components either active substance [1,2].

Oral administration is an important form of administration. Oral administration avoids that it is possible to destroy the drugs in the gastrointestinal environment due to the high first-pass metabolism. The evolution of the oral dosage form has resulted in the improvement of the pharmaceutical several formulations ranging from standard pills and capsules to extended-release tablet and capsules are available, orally disintegrating tablets and wafer tablets and most significantly rapid dissolving Oral thin film Formulation [3,5]. Compared to tablet, it can rapidly increase drug absorption. In fact, one of the main properties of the thin film used in the oral cavity is that it has large surface area and can become wet quickly since it has a large surface area. The oral mucosa is rich in blood supply, it is the perfect and fast place for drug absorption. [6]

#### **Oral Mucosa Structure and function.**

The Oral Mucosa is consisting of Three layers of cells,

- 1.Stratified Squamous Epithelium
- 2.Sub Mucosa membrane.
- 3.Lamina Propia

#### **Stratified Squamous Epithelium**

It is the mouth's outermost layer of the cavity. The basement membrane separates connective tissue from the epithelium.

#### **Sub Mucosa membrane**

Located inside the mouth, it is the deepest layer.

#### **Lamina Propia**

It is a form of connective tissue. That exists below the basement membrane.[7](Figure 1)

#### **ADVANTAGES OF BUCCAL FILM**

- Providing faster onset of effect at lower doses by avoiding first-pass metabolism.
- The stability is good.
- Dosing accuracy.
- There is no need to use water.
- Palatability.
- Easy to administer film to patients with dysphagia, repeated vomiting, exercise mental illnesses and disorder.
- The increased surface area allows for quick disintegration and dissolution in the oral mucosa. [8,9]
- Dosage form is suitable for old age and paediatric patients with dysphagia or nausea and patients with mental illness or physical disability.[10]

#### **DISADVANTAGES OF BUCCAL FILMS**

- It is fragile and must be waterproof, requires special packaging.
- Huge quantities of the medications cannot be used in the oral thin film.
- Drugs that Cause Mucosal irritation cannot be used.[11]
- Also shows the characteristics of brittle effervescent particles.



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- Product require particular packaging to ensure the stability and safety of the product.
- It is hygroscopic, so it should be stored in dry environment.[12]

**Oral dissolving films have the following concept**

- A thin film is used as part of this delivery system.
- Upon placing it on the tongue tip, the film melts immediately, thus preventing first-pass metabolism. This may increase the bio-availability of the metabolism.
- As the Salivary rapidly wets, the increased surface area allows it to breakdown and dissolve in the buccal mucosa within seconds
- Oral dissolving films are flexible, so they are not so brittle and do not require any special packaging to protect compared to fast-dissolving tablets during transportation and storage.
- Patients with aphasia are more satisfied and received better during the trip without water.
- Compared with instant tablets, there is no need to worry about suffocation.
- The high surface area provided in the medicinal type of the film form allows it to swiftly wet saliva and afterwards break down, allowing it to be directly assimilated and absorbed.
- It can reach the systemic circulation and does not have to be processed by the liver. Furthermore, it enhances bioavailability.
- This can be avoided by reducing the first-pass effect, which can reduce side effects caused by the molecule.
- The form of medicine can be taken anywhere and at any time according to the convenience of individuals.
- Patients with dysphagia, repeated vomiting, high blood pressure, congestive heart failure, asthma, motion sickness, paralysis ,thus because these patients can't gulp a lot of water ,they prefer this dosage form .
- When compared to other existing pharmaceutical dosage formulations, rapid dissolving oral thin film provides equivalent, more consistent, long lasting, fasterad vantages: avoiding pleasant taste, first-pass metabolism, rapid duration of action, exact dosage, and no need for dilution, liquid and it is a patient cooperation. [13,18]

**Types of Oral Films**

1. Fast dissolving (Quick Release).
2. Mucosal adhesion fusion release.
3. Sustained release of mucosal adhesion.[19]

**COMPOSITION OF THE SYSTEM**

1. Active Pharmaceutical Ingredients.
2. Polymer that forms films.
3. Agents that stimulate saliva.
4. Plasticizers.
5. Surfactant.
6. Sweetening agent.
7. Colouring agents.
- 8.Flavouring agent.

**Active Pharmaceutical Ingredients**

An ideal filmcomprises01-30% of weight /weight of an effective pharmaceutical component. It is essential to the effective formulation to incorporate micronized API as it provides fast dissolution and improves film texture and uniformity in the fast-dissolving oral buccalfilm. The drug dose should be in mgs (less than 20mg/day) for successful formulations.[20]

**Polymers that form films**

Films are modified with water soluble polymers since they offer express disintegration, pleasant mouth sensation, and quick dissolution. A speed in the polymer disintegration is slowed by raising the molecular mass of polymeric





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membrane bases. Polymers could be employed alone or in conjunction with some other materials to provide desirable film qualities such as hydrophilic nature, mouth feel, dissolution and elasticity.

The polymers should have been utilised in oral mucosal thin films:

- It should have long shelf life.
- Excellent film formation capability.
- Water transparent and low in molecular weight.
- Cost Effective.
- Non-irritant and non-toxic.
- Easily Accessible.
- Exhibit adequate peel, shear, and tensile strength.
- Free of Leachable Impurities.
- Elements of good wetting and spreading wettability's.

There are numerous polymers widely accessible for creation of quick dissolving sublingual films. The sheet is generated must be robust enough to breakage which may occur during ability to handle or transits. On the way to producing the necessary film abilities, the polymers can be used alone or in combinations. The films with high resolution are often made from polymers such as cellulose or cellulose derivatives guar gum, acacia gum, HEC (hydroxyl ethyl cellulose), HPMC (hydroxypropylmethylcellulose), pullulan, HPC (hydroxyl propyl cellulose), gelatin, PVP (polyvinyl pyrrolidone), CMC (Car boxy methyl cellulose), sodium 0alginat, xanthine gum, PVA (polyvinyl alcohol), gum tragacanth, hypromellose and MMA (methyl methacrylate copolymer) are the films with a fast dissolve rate is the most commonly used. Numerous polymers have been investigated considering the use to fast dissolving oral strips.

Pullulan is a natural polymer that is not derived from animals but does not involve any organic solvents. Pullulan was employed to create fast-acting buccal films; using the solvent pour method. The mixture of MCC [Micro-Crystalline Cellulose] and Maltodextrineithercould be utilised towards producing fast dissolving buccal film up to 50-80 per cent w/w. Various polymers such as PVA, PVP, HPMC E15, Eudragit RL100, HPMC K4M, and Gelatin. Findings indicated that pullulan was prevalent in fast dissolving oral strips. Klucel HXF Pharm (hydroxy propyl cellulose) stayed active as a bio-adhesive polymer within the manufacture of the sublingual film containing apolyphenol [21,22].

#### **An agent that stimulates saliva**

The saliva stimulant's primary function would be to enhance saliva production hence aid therein faster dissolution of the buccal film. Its ratios either concentration involved varied among in per cent that is 2% to 6% [23].

#### **Plasticizers**

Plasticizers contribute to the mechanical properties of oral thin films by improving the elasticity and tensile strength of bio-adhesive oral thin films. They also reduce the crumbliness of the film. Additionally, they progress as flow and boost the polymers. The correct choice of plasticizer is extremely important. That must remain compatible with the drug, the polymers and the other excipients. Incorrect collection can make happen film to tear, split, and peel. The most generally make used plasticizers are glycerine, Propylene glycol, Polyethylene glycol, dimethyl, acetyl citrate, dibutyl, tributyl, diethyl pthalate, triethyl, triacetin, and Castor oil [24,28].

#### **Surfactant**

The commonly used surfactant is Sodium lauryl sulphate, poloxamer-407, Benzalkonium chloride, benzethonium chloride, tweens, etc. These are commonly used to proliferate the solubility, wetting then dispersibility of membranes subsequently the membranes dissolve within seconds and release the drug rapidly. [29,30]



**Ganavi et al.,****Sweetening Agent**

Sweeteners serve an important function in medicinal preparations that are intended to dissolve or disintegrate in the mouth. Sucrose, glucose, fluid glucose, fructose, dextrose, and iso-maltose are the classic sweetener sources. The sugariness of fructose is instantly felt around the mouth, as opposed to the sweetness of sucrose and dextrose. Fructose is also sweeter than mannitol and sorbitol, among other Polyhydric alcohols are also included.

Polyhydric Alcohols have a lower risk of cancer and don't have a bitter aftertaste, which is an important consideration for making oral preparations. Herbal sweeteners can also be utilised, such as Rebiana, which is derived from the South American herb *Stevia rebaudiana* and has 200–300 times the sweetness of sucrose. Saccharin Sodium, an artificial sweetener, was also used in the production of the buccal film.[31,33]

**Colouring Agent**

The FD & C approved dye (concentration does not exceed 1 %; w / w) is used in the production of oral fast-soluble films for example Titanium Dioxide, Silicon dioxide and Zinc dioxide.[34]

**Flavouring Agent**

Flavourings remain consumed to add flavour to the product, another factor to consider in patient compliance. A flavouring agent is consumed to advance the flavour strength and increase the pleasant composition of the product, refrigerants such as adding monomethyl succinate are an option. The flavours can be used alone or in combination with each other. The flavours can be used individually or in one or more combinations. Peppermint Oil, nutmeg oil, spearmint oil, and cinnamon oil are examples of aromatic oils, while Vanilla, Cocoa, Coffee, Chocolate and Citrus fruity flavours are derived from fruits. Aromatic substances, such as synthetic oil, oleoresin oil, as well as extracts obtained from various parts of plants, such as leaves, fruits, and flowers, can all be used to create flavours. The amount of flavour necessary for masking the taste of the original drug be influenced by the flavour category and its potency. Typically, equal to 10%w/w flavour is attached to in buccal film formulations. [35,36]

**Methods of preparation**

One or more methods or combination methods following processes are employed to prepare the oral buccal films,

- Solvent casting method.
- Hot-melt extrusion method.
- Semisolid casting method.
- Solid dispersion extrusion method.
- Rolling.

**Solvent Casting Method:**

- Using an appropriate volatile solvent such as ethanol either distilled water, dissolved in water-soluble polymers and plasticizers are prepared into a transparent, viscous solution.
- After the solution has been mixed in support of 2hrs in the magnetic stirrer it is stored at room temperature.
- In third step, in aqueous solvent with other ingredients are rendered with bulk of the solution.
- Then the deoxygenated air is purged via vacuum.
- Lastly, the final solution is poured either casted into a relevant Petri dish and dried in an oven at 50°C for 24 hrs.
- The film is cropped to the required size and shape.[37,38] (Figure 2).

**Hot-Melt Extrusion Method**

Granules, prolonged-release tablets, transdermal and transmucosal drug delivery devices are all made by hot metal extrusion.

Since 1971, melt extrusion has been employed in the pharmaceutical sector as a manufacturing tool.[39]

- In addition, drug delivery systems, such as sustained-release tablets, granules, transdermal patches, and transmucosal, can be prepared using this technology.
- Firstly, a solid dosage form is combined with carriers.



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Secondly, the mixture is evaporated by a heater through the extruder.

- Lastly, this melt is moulded into films by moulds. [40,43](Figure 3)

#### **Semisolid casting method**

- Mixed solutions of water-soluble film-forming polymers have been synthesised.
- This Obtained product is put into an acid-insoluble liquid medium [example: cellulose acetate phthalate as well as cellulose acetate butyrate are two types of cellulose acetate.].
- The needed quantity of plasticizer as utilized to release a gel's volume.
- Now the final move, the gel bulk exists converted into films or strips using high-temperature containers.
- The width of the film must be between 0.015- and 0.05.
- The acid impermeable polymer should be used in a ratio 1:4 with the film-forming polymer. [44] (Figure 4)

#### **Solid Dispersion Extrusion**

Extrusion of solid dispersion

This is the term used to describe "Solid dispersions" to the solid-state dispersion and it may contain one or more active ingredients in a chemically inactive medium. Amorphous hydrophilic polymers can be found with in the presence of amorphous hydrophilic polymers.

1. A suitable liquid solvent is used to dissolve the medication.
2. After that, the solution is mixed with liquid polyethylene glycol, when heated to a temperature of over 70°C, the desired result is obtained.
3. The solid dispersions are moulded into the films by the end of the process, and dies are employed While using this, some safety precautions must be performed.

Methods such as the solvent used or the dissolved medicine may incompatibly contain the polymorphic form of the medication and liquid polyethylene glycol. The liquid solvent may modify the precipitation in the solid dispersion used [45](Figure 5).

#### **Rolling**

The rolling technique involves rolling a solution or suspension containing medication onto the carrier. Water either a mixture of water and/or water and alcohol constitutes a large proportion of the solvent. On the rollers, the film is cured and cut into the necessary shapes and sizes. Using a high shear processor, further ingredients, together with the active substance, are dissolved in a tiny amount of aqueous solvent. A homogenous viscous solution is formed when hydrocolloids soluble in water are dissolved in water [46](Figure 6).

#### **Evaluation parameter for Buccal film.**

- Weight variation
- Thickness
- Tensile strength
- Surface pH
- Folding endurance
- Drug content uniformity
- Percentage moisture loss test
- Swelling index
- Percentage moisture uptake
- In vitro disintegrating time
- In vitro dissolution study
- In vitro drug release.
- Stability Studies





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### Weight variation

All films are weighed, via calculating their average weight and by measuring their actual weight and that can be determined. The buccal film was weighed using a calibrated weighing balance [47].

### Thickness

The dosage accuracy of the medicine in the film is determined by the thickness of the film. It's measured with a micrometre screw gauge or calibrated digital Vernier callipers at five distinct crucial places, with the mean value indicating the film's final thickness. The film thickness should be in the range of 5-200 m [48,49].

### Tensile strength

The tensile strength indicates the maximum load applied as a point where the strip specimen breaks. Using the equation below, the tensile strength is determined by dividing the applied load by the strip's cross-sectional area.

$$\text{Tensile strength} = \frac{\text{Load at breakage}}{\text{Strip thickness} \times \text{Strip width}}$$

By using the above equation tensile strength of film can be calculated.[50]

### Surface pH

2% w/v agar was dissolved in a heated phosphate buffer solution to form buccal films. After one hour of swell they were placed on an agar plate, pH 6.8, under sterile conditions, stirring, then pouring the solution into the petri dish until it reached the desired consistency. At room temperature, the gelling/solidification process begins. The pH of the surface was pH paper was placed on the surface of the water and was used to measure it, on the bloated film. The average of three readings came to record [51].

### Folding endurance

Three films were clipped to the suitable size for measuring folding endurance. It is possible to test the folding endurance of a film by folding it repeatedly in the same position or by folding it until it breaks, up to 300 times. When a film does not break even after being folded several times, it is said to have high folding endurance [52].

### Drug content uniformity

The buccal film is dispersed individually in 100 mL of buffer pH 6.8, and the resulting solution is then diluted appropriately. At 242 nm, the amount of medication in the film is determined by absorbance spectrophotometry. It's worked out what the typical drug content [53].

### Percentage moisture loss test

This is used to ensure the quality of films. The film is weighed and cut out .Next that, place in it a desiccator with fuse anhydrous calcium chloride. It is weighted and removed after 72 hours. The formula below is used to compute the average % moisture loss [54].

$$\text{Percentage Moisture Loss} = (\text{Initial weight film weight}) \times 100 / \text{Initial weight}$$

### Swelling index

Sweeling Index for every buccal oral thin film were independently measured (w1) and placed in a petri plates containing a phosphate buffer solution with such a pH 6.8 . Buccal film were withdrawn out from petri plate with Whatman filter paper to remove additional surface of water , which would then be measured again (W2). The Swelling Index (SI) calculation method were performed [55].

$$SI = (W2 - W1) / W1$$





Where;

W1 = Initial weight

W2 = Final weight

SI = Swelling index

#### Percentage moisture uptake

Films were stored in a desiccator with saturated potassium chloride solution at room temperature for 24 hours, maintaining an 84 percent relative humidity. After 24 hours, the films were removed and weighed. The following formula can be used to calculate the percentage of moisture uptake [56].

Percentage moisture uptake = [(Final weight – Initial weight) / Initial weight] × 100.

#### In vitro disintegrating time

When a film is exposed to water or saliva, it breaks or disintegrates at a certain point. Placing the film in the phosphate buffer is how this test is done. Disintegration time should be between 5 and 30 seconds. The disintegration time can also be measured using a disintegration device from the United States Pharmacopeia (USP). [57,58].

#### In vitro dissolution study

The USP type II apparatus (Basket type apparatus) is used to conduct an in vitro dissolution investigation. At 50 rpm and 37°C temperature, a pH 6.8 buffer (50 mL) is utilised as a dissolving media. 1 ml samples were taken at predetermined intervals and replaced with an equal amount of new dissolving medium. Buccal films are filtered using 0.45 m Whatman filter paper and spectrophotometrically evaluated at the active pharmaceutical ingredient's maximum concentration [59,60].

#### In vitro drug release.

In vitro drug release investigations were conducted using the Franz diffusion cell assembly. It is made up of two compartments, one of which contains a buffer solution with a pH of 6.8 and the other of which contains 10 mg of the medicine. To separate these compartments, a dialysis membrane (Mol. Wt 12000–14000) was put in between them after being soaked in receptor media for 2 hours. To avoid disrupting the process, no air bubbles were allowed to form between the membrane and the liquid surface. A flowing water bath kept the temperature at 37°C during the procedure. 0.5 ml of the sample was taken from the receptor chamber and replaced with new buffer at regular intervals until 8 h. The amount of medication released was spectroscopically evaluated after a suitable dilution. The flux value was identified by the following formula [61].

Flux = Amount of drug released (mg)/Time (hr) × Area (cm<sup>2</sup>)

#### Stability Studies

Stability studies are carried out in order to identify any changes that occur during the storage of any product. All of the formulations were stored in triplicate at 40°C, 25°C and 75°C, 5 percent RH in stability chambers for three months. To assess the stability, we analysed their folding endurance, in vitro release of drug and drug content [62].

#### The packing material chosen must have the following characteristics

To safeguard the integrity of the film, extreme caution and precaution should be taken when choosing packing material. Special consideration, manufacturing and excellent quality, packaging is important throughout the creation and storage of these dosage forms.

1. It should be approved by the FDA (Food and Drug Administration).
2. It must meet the tamper-resistant criteria.
3. It should be immune to the effects of the outside world.
4. It should be safe to use.
5. It should have no effect on the product [63].



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Plastic, Foil or Paper pouches, unit pouches (single pouches), aluminium pouches, blister cards with several unit protective films are common packaging options for oral films. Rapid film technology is a primary package made composed of a sealing bag with considerable area for instructions, logos, codes, and other information, developed by Lab tech GmbH. The laminating operation was carried out at a cost comparable to that of tablets [64].

**Foil, Paper or Plastic Pouches**

The flexible pouch is a packaging design capable of offering not only a temperature-resistant package, but also a package with a high level of environmental protection due to good material selection. A flexible pouch is usually made by vertical or horizontal forming, filling, or sealing machinery during the product filling operation. Single pouches or aluminium pouches can be used [65].

**Single Pouch and Aluminium Pouch**

A peel able pouch for "rapid dissolve" soluble films with high barrier qualities is a soluble film drug delivery pouch. For product display, the pouch is transparent. The usage of a two-structure combination allows one side to be clear and the other to be laminated with a cost-effective foil. Both gas and moisture transmission are virtually non-existent via the foil lamination. For nutraceutical and pharmaceutical applications, the packaging offers a flexible thin film option. The single-dose pouch protects both the substance and the dosage. The most frequent type of bag is aluminium [66].

**Blister Card with multiple units**

There are two parts to the blister container: 1. Bleeding 2. Stock with a lid The product is held in a blister by a chamber made of plastic material that protects it from moisture, and the lid stock is formed of aluminium foil that seals the blister. It is made by softening a thermoplastic resin sheet with heat and then contour moulding the softened plastic sheet under vacuum. After cooling, the sheet is taken from the mould and placed in the packing machine's filling station. As a lid stock, the product is poured into the semi-rigid blister and sealed with a heat-sealable backing material [67].

**Barrier Films**

Because many pharmacological preparations are particularly sensitive to moisture, strong barrier coatings are required. Polychlorotrifluoroethylene (PCTFE) film and Polypropylene are two materials that can be utilised to provide moisture protection. Under any circumstances, polypropylene will not stress crack. It works well as a gas and vapour barrier. The lack of clarity remains a flaw [68].

**Application of Oral Films****Vaccines**

A vaccination can be used as an alternative to buccal films because it dissolves quickly in the mouth and saliva and is stable at room temperature. The rotavirus vaccine, for example, is made in the United States and has several advantages, including increased bioavailability, higher patient compliance, and low storage, handling, and administration costs [69].

**Nicotine Replacement Therapy**

Tobacco contains nicotine, a psychoactive chemical that contributes to smoking's addictive character. The mucosal mode of distribution is the most efficacious in this therapy because it easily penetrates the mucosal barrier. Nicotine is included into a prepared sodium alginate-magnesium aluminium silicate (SA-MAS) buccal film. In comparison to merely SA films, SA-MAS films had a larger nicotine content and a slower penetration across the membrane, according to the study. Drug release was initially quicker, but after 10 hours, controlled drug release was seen [70].



**Controlled and Sustained release**

Long-term release Buccal film can be utilised in hospital preparations, and excipients such as chitin and chitosan derivatives are commonly used. By virtue of their release qualities and adherence, they contribute to the expansion of application, reduction of toxicity, wound dressings, oral mucoadhesive, and water-resisting adhesive [71].

**Antifungal Infections**

Fluconazole is a systemically antifungal medication which is used to treat oral candidiasis, is the drug of choice for mucosal administration. By increasing its oral concentration, its systemic negative effects can be decreased. The contact time between the medicine and pathogenic yeast was increased for a longer period of time using mucoadhesive buccal films with modest dosages of fluconazole, resulting in greater efficacy [72].

**Taste Masking**

For fast dissolving tablets to be commercially successful, taste masking is a must. Fast dissolving buccal films dissolve or disintegrate in the mouth of the patient, releasing the active substances that come into contact with the taste buds, making this attribute crucial for patient compliance. Drugs with an unpleasant bitter taste can be microencapsulated into pH-sensitive acrylic polymers using solvent evaporation and solvent extraction procedures in taste masking. These polymer microspheres demonstrated effective flavour masking and rapid disintegration [73].

**Oral cancer targeted therapy**

The most widely accepted treatment for oral cancer is targeted therapy, which aims to deliver high levels of therapeutic effectiveness with low levels of side effects. A study conducted in Taiwan found that using polymer films to create nano delivery systems increased solubility, stability, and bioavailability even inside tumour cells. A study was carried out to test the cytotoxicity of liposomes loaded in the film in hematopoietic stem cells (HSC-3) [74].

**Orally disintegrating films**

Buccal films that dissolve quickly are made of a water-soluble polymer. The film's capacity to dissolve quickly without the use of water gives an alternative for people with swallowing difficulties and nausea, such as chemotherapy patients [75].

**Asthma**

The buccal patches have been designed to administer sodium cromoglycate, which is used to treat asthma. Because of the drug's short half-life, it had to be formulated in a controlled release method. The use of this medicine in buccal patches resulted in an increase in the time it took for the drug to reach its highest concentration in the blood, as well as a decrease in the maximum plasma concentration in the blood. It also ensured that the medicine was released in a regulated manner [76].

**Cardiovascular Disease**

Hypertension is one of the most common cardiovascular illnesses that requires long-term treatment. Metoprolol is a short-lived antihypertensive with a limited oral bioavailability and poor water solubility. Carvedilol is not water soluble, and propranolol is metabolized by the first-pass system. As a result, the buccal mucoadhesive film system was developed, because through the internal jugular vein, it allows direct access to the systemic circulation, avoiding first pass impacts and permitting high bio-availability. With increased contact duration and by bypassing first-pass metabolism, a lower effective dose of 3.125 mg of carvedilol delivers better efficacy [77,78].

**Hypoglycaemic agents**

A buccal delivery device for hypoglycemic drugs like glipizide and glibenclamide was recently introduced. The biological half-life of glipizide is short when given in two or three dosages of 2.5–10 mg daily. When the water-insoluble medication was added, the film absorbed water. For the preparation of glibenclamide mucoadhesive buccal films, several grades of HPMC with specified ratios were utilised. Finally, at a low concentration of HPMC3000,



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buccal medication delivery can be useful in a regulated manner. *Cucumis callosus*, a member of the Cucurbitaceae family, has been reported to have hypoglycaemic action in its fruit [79,81].

## CONCLUSION

According to the present review, the buccal film produces the best results due to increased patient compliance, a faster method of a drug delivery, by passing hepatic first-pass effects, and a higher bio-availability. Due to their advantages, over traditional dosage forms and their low manufacturing costs, buccal films will replace traditional dosage form and rapid dissolving tablet. Buccal medication administration can accommodate a variety of dose formulations. Buccal films, on the other hand, are a more viable formulation due to their ease of fabrication, drug loading, and characterization. Buccal films would be a more reliable option in the future for optimising the therapeutic efficacy of diverse APIs. Oral mucoadhesive dosage forms, particularly for the new generation of drugs, might continue to be an attractive research focus on enhancing drug absorption.

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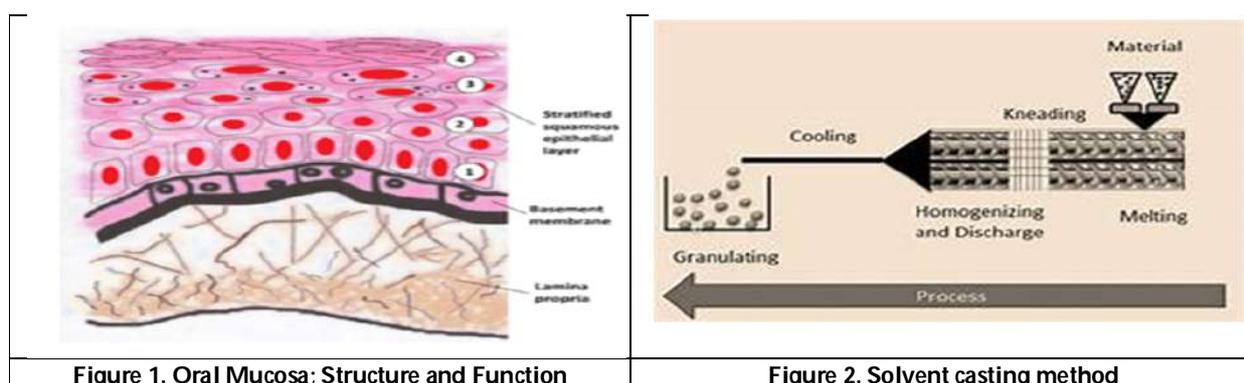
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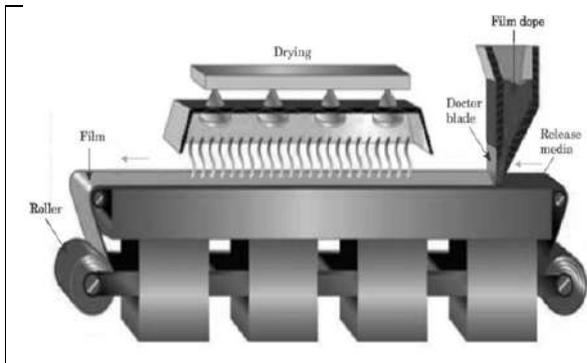


Figure 3. Hot melt extrusion method

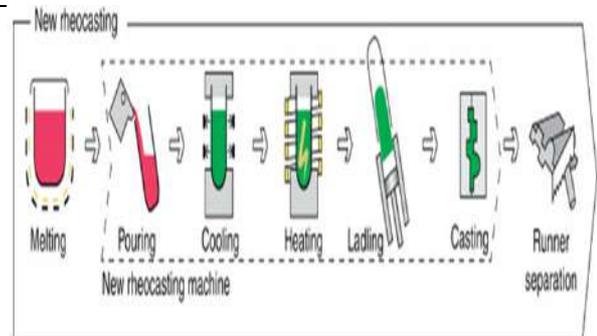


Figure 4. Semi-Solid Casting method

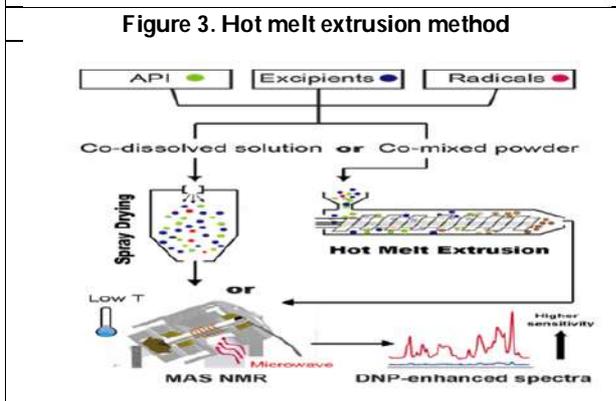


Figure 5. Solid Dispersion Extrusion

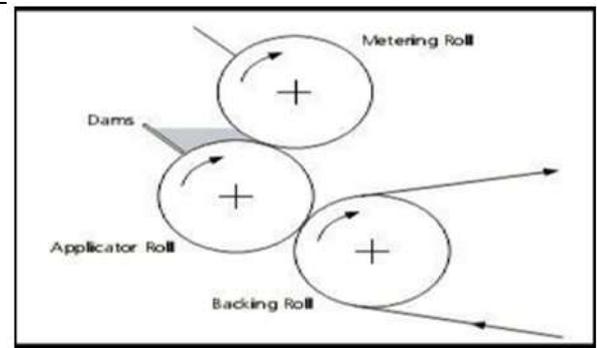


Figure 6. Rolling Method





## A Review Article on Self Micro Emulsifying Drug Delivery System

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### ABSTRACT

The major purpose of this research is to create a SMEDDS, which improves oral bioavailability through self-micro emulsifying drug delivery of antiviral medication, a pharmaceutical that is poorly water-soluble. Antiviral drug solubility was previously determined by the number of vehicles involved. SMEDDS is a combination of Under conditions of modest agitation and digestive motility, oils, surfactants, and cosurfactants are emulsified in an aqueous medium similar to those seen in the GI tract. The creation, characterization, and use of safe self-micro-emulsifying transport devices are the topic of this study (S-SMEDS). Finally, there are minor hurdles to using S-SMEDS as a transportation system. For many bioactive entrepreneurs within reality Physiological and pharmacological benefits are undeniably useful. to do are difficult to furnish because of their limited oral bioavailability, chemical instability, or poor water solubility, as a result, nano- and micro-encapsulation-based sciences are being created to tackle these challenges.

**Keywords:** Drug delivery application, Drug name, Polymer name.

### INTRODUCTION

Lipid-based formulations cowl an extensive spectrum of drug shipping techniques with several benefits for oral administration, which include improved drug obvious solubility, elevated permeability, and decreased pre-systemic metabolism. (1). Because of its simplicity, affected person convenience, compliance, ideal dose, and inexpensive manufacturing cost, the oral route of drug administration has usually been preferred (2). The drug has to be in a solubilized structure before passing over the gastrointestinal (GI) membrane, which is one of the most requirements for oral absorption. The gastrointestinal absorption as well as the bioavailability of medicinal drugs are affected by





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way of a wide variety of pharmacological and physiological variables. (3) Solid-SMEDDS are new formulations that combine the blessings of SMEDDS and strong preparation, reducing the quantity of surfactant required and improving safety. Preconcentrates made with solid micro emulsions have a greater industrial doable and patient acceptance than those made with liquid micro emulsions. (4) One of the drug shipping structures used to tackle the solubility hassle of lipophilic drug treatments was the self-micro emulsifying drug delivery device (SMEDDS). Micro emulsions with particle sizes ranging from 100 to five hundred nm. (5) Antiviral medications are a type of medicine that is particularly used to deal with viral infections. (6) Antiviral medicines, Antiviral medications are one type of antimicrobial that, unlike other antibiotics, do not kill their target infection; instead, they inhibit its development, which additionally consists of antibiotics, antifungal, and ant parasitic drugs. (7) They must be distinguished from vermicides, which are not medications but rather remove viral particles from the environment. (8) Several antiviral on the market today are designed to treat HIV, herpes virus (which causes cold sores and vaginal herpes), and another virus. Hepatitis B and C viruses, which can cause liver cancer, as well as influenza A and B viruses, cause a variety of diseases. (9) SMEDDS are ideal for lipophilic medicinal molecules with dissolution rate-limited absorption and may also improve absorption price and extent, producing more reproducible blood-time profiles. The agitation required for self-emulsification is provided by the stomach and intestine's digestive motility., and SMEDDS is easily dispersed in the GI tract. (10)

### THE EMULSIFICATION PROCESS

In the synthesis of emulsifiable concentrates of herbicides and pesticides, self-emulsification is an industrially valuable phenomenon. (11) Crop spray concentrations have to be diluted by the user, who might be a farmer or a home gardener, to allow for the effective delivery of especially hydrophobic components. (12) SMEDDS, on the other hand, employ excipients that are suitable for oral administration to humans. Because they are no longer commonly employed, there are few records of their physicochemical principles. (13)

#### (a) Self-Emulsification mechanism

$$(b) \Delta G = \sum_i N i^4 \pi r^2 \sigma$$

where N indicates the interfacial energy and signifies the range of droplets of radius 'r'. (14) The equation shows that the Improvement of the contact between the oil and water phases on its own is no longer favorable in terms of energy, the thermodynamic emulsification of the SEDDS system has yet to be shown. (15) The ease with which water enters the oil-water contact is closely connected to the emulsification mechanism, interfacial swelling is caused by the development of liquid crystalline phases. and, as a result, greater emulsification ease. (16) However, in systems along with co-surfactant, it's also possible that broad factor partitioning between the oil and aqueous phases occurs, producing oil is solubilized and migrates into the watery phase, a behavior known as "diffusion and stranding". (17)

#### The stages of dilution

When a component of the SMEDDS system is diluted, the surfactant layer's spontaneous curvature shifts between liquid crystalline phases in a variety of forms. (18) After enough, The droplet form can transition from a reversed spherical droplet to a reversed rod-shaped droplet, hexagonal phase, lamellar phase, a cubic phase, and other structures to a spherical droplet with dilution. (19)

### EXCIPIENTS USED IN SMEDDS

#### SMEDD Compositions

Oil is the system's major incipient. It can dissolve a large number of water-insoluble medicines. (20) Oils used to create SMEEDS include olive oil, corn oil, maize oil, soyabean oil, and hydrolyzed corn oil. The oils were derived from medium-chain and long-chain triglycerides (LCT) and medium-chain triglycerides (MCT) oils. (21) The classification of surfactants depends depending on the molecule's hydrophilic group type. The four most important lessons concerning surfactants are as follows: Anionic surfactants, such as carboxyl (RCOO-), sulphonate (RSO3-), or sulfate, contains a negative charge on the hydrophilic group (ROSO3-). A couple of examples are sodium lauryl



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sulfate and potassium laurate. Cationic surfactants are beneficial to the hydrophilic group. Quaternary ammonium halide is one example. Surfactants that are ampholytic (also known as zwitterionic surfactants) have a positive and negative charge, respectively. (22) Sulfobetaines are one example. Of Nonionic surfactants, in which the hydrophilic group has no charge, however, is water-soluble. (22) In ordinary SMEDDS, hard-sealed gelatin capsules motivate drug precipitation. Other ingredients may encompass pH adjusters, flavors, and antioxidants. The generation of peroxide during the oxidation of lipid products, particularly those containing unsaturated lipids, is a common occurrence. ROO, RO, and OH are examples of free radicals that can harm medicine and cause toxicity. (23) Auto oxidation produces lipid peroxides, which raise the instauration degree of the lipid molecule. Lipid hydrolysis can be hastened by changing Using processing power, such as ultrasonic radiation, or changing the pH of the solution. SMEDDS oily content may therefore require lipophilic antioxidants (example: BHT, ascorbyl palmitate, tocopherol, propyl gallate). (24)

**Oils**

It has the ability to solubilize the required dosage of lipophilic medicine in the SMEDDS components, not simply because it has the ability to dissolve the proper amount of lipophilic in nature medication or promote furthermore, and self-emulsification perhaps most importantly because it has the potential to boost the amount Lipophilic medication is delivered through the lymphatic system of the intestine. (26) As a result of the molecular structure of the triglyceride 28-30, absorption from the GI tract is increasing. To make self-emulsifying compositions, The researchers employed different saturation levels of LCT and MCT oils are long and medium-chain triglyceride oils. (27)

**SURFACTANTS**

Several chemical compounds with surfactant qualities can be used to build self-emulsifying systems, on the other hand, the picks are constrained for the reason that especially few surfactants are morally acceptable. (28) Surfactants that aren't ionic and have a non-ionic charge reasonably excessive hydrophilic-lipophilic stability (HLB) 34 are the most commonly advised. When deciding on a surfactant, one of the most vital issues is safety. (28)

The four major classes of surfactants are as follows: (29)

- A. Anionic surfactants
- B. Cationic surfactant
- C. Surfactants with ampholytic properties
- D. Surfactants that are now not ionic

**Anionic Surfactants**

To make self-emulsifying compositions, Oils having different saturation levels of long and medium-chain triglycerides (LCT and MCT) levels were employed by the researchers. (30)

**Cationic surfactant**

Cationic surfactants are useless as detergents in cleaning systems because they are positively charged. According to Reich, this is due to the negative charge of the pores, skin, and hair surface at "use" pH.[6]. As a result, cationic bonds are excessively strong, particularly to hair fibers, and during the rinsing process, they are no longer efficiently eliminated. Clogged pores, skin irritation, and over-conditioning of the hair can all result as a result of this. In the next part, we'll go through this in detail. (31)

**Surfactants with ampholytic residences**

Amphoteric surfactant is a surfactant that has both anionic and cationic hydrophilic groups and has a structure that carries hermaphroditic ions that can structure cation or anion depending on the environmental situations (such as pH variations). (32)



**Monika D H and Prakash S Goudanavar****Surfactants that are no longer ionic**

Nonionic surfactants include an extensive range of synthetic compounds with varying sorts and architectures. Nonionic surfactants are categorized into three types. Ethoxylates include things like fatty alcohol ethoxylates, alkylphenol ethoxylates, and fatty acid alkoxyates. (33)

**Co-Surfactant**

a co-surfactant having an HLB value in smedds. of 10-14 is usually utilized. Hexanol, pentanol, and octanol are examples of intermediate-chain alcohols. hydrophilic cosurfactants that Lowering the oil/water ratio are proven to be beneficial. contact and facilitate the spontaneous generation of microemulsions. (34)

**Co-Solvents**

Oral administration of organic solvents is possible. Ethanol, propylene glycol, and polyethylene glycol are examples of solvents that can assist in the dissolving of huge quantities of hydrophilic surfactants or drugs in lipid bases. (35) As triacetin is a good example of a co-solvent (an acetylated derivative of glycerols) or other appropriate solvents, such as glyceryl triacetate, are added. 34 Because It can be used to solubilize a hydrophobic substance since it is miscible in the oil/lipid phases. medication, triacetin is a good choice. To make an effective SMEDDS, a rather high surfactant concentration (typically more than 30% w/w) is required. (36)

**MATERIALS AND METHODS****Chemicals and reagents**

Gattefosse, Paramus, NJ, generously provided Plurol Oleique®, Labrafac® CC, Labrasol®, Lauroglycol® FCC, Transcutol®, and Labrafac® CC Capsugel, Morris Plains, NJ, generously provided gelatin capsules, No. 000. Fisher Scientific Co., Pittsburgh, PA, provided the HPLC grade methanol and acetonitrile. New Brunswick, Canada-based Spectrum Quality Products Inc. NJ, provided the phenytoin. Fisher Scientific Co., Pittsburgh, PA, provided analytical quality potassium monobasic phosphate, ethyl alcohol, and hydrochloric acid 6 N All chemicals were utilized exactly as they were given to us. (37)

**Solubility studies**

The solubility of drug in different oils, surfactants, and co surfactants was determined. Each vehicle was given an excess of drug, and the combination was swirled continuously for 72 hours at 30 degrees Celsius. After reaching equilibrium, the mixture was centrifuged for 20 minutes at 2500 g, and the supernatant was filtered through a membrane filter. The results were obtained using high-performance liquid chromatography. the concentration of oridonin (HPLC). (38)

**Phase diagram of a pseudo-ternary system:**

In a drug-free environment, a water titration technique was used to construct the Water, oil, and the ratio of surfactant to co surfactant [S/CoS] are shown in a ternary phase diagram of the mixes. (Dixit et al. 2010). Like the oil, surfactant, and co-surfactant, Tetra glycol, Capmul® MCM, and Cremophor® RH 40 were chosen. respectively, based on solubility measurements. The S/CoS ratios (v/v) were 1:2, 1:1, and 2:1, respectively. for the three groups. Every ratio ranging from 1:9 to 9:1 (v/v) was homogeneously blended with the oil component. At 25°C, while gently spinning, pure water was placed into each oily concoction. Visual inspection of the combinations revealed micro emulsion zones that were clear and/or having a bluish-white look. (39)





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### Method of preparation of SMEDDS.(40)

Oil, Surfactant, Co- surfactant and drug



Drug is dissolved completely at ambient temperature with constant agitation

SMEDDS



Water is added dropwise



Formation of transparent liquid- microemulsion

Flow chart for preparation of smedds

### Methods of preparation

#### The initial technique of preparation

##### Method of phase titration.

The spontaneous emulsification technique (phase titration) was used to make microemulsions, which may be depicted using a phase diagram. The use of section diagrams to explore the complex sequence of interactions that may take place when extraordinary components are blended is a treasured method. Microemulsions are created using several attachment structures, depending on the chemical makeup and care given to each component (micelles, hexagonal, lamellar, emulsions, cubic, and a variety of oily and gel dispersion type). Understanding their segment equilibrium and delineating the section borders are crucial factors of the research. (41) A pseudo ternary phase plan is more understandable and takes less time than quaternary phase arrangements (the four-thing system) is built to discover the extraordinary zones, Each corner of the plan represents 100 percent of the microemulsion zone of the unique component. By simply evaluating the composition region may be divided into o/w and w/o microemulsion. (42)

#### Second method of preparation

##### Method of phase inversion

When an excess of the dispersed phase is added to or if the temperature changes, microemulsion phase inversion occurs inversion of phases results in physical changes, including particle size alterations, which can influence drug release both in vitro and in vivo. These strategies rely on altering the surfactant's spontaneous curvature. This may be accomplished using non-ionic surfactants by increasing the temperature of the solution, transitioning from an o/w point of view To a w/o microemulsion at low temperatures (transitional phase inversion).(43) The system passes through a point of zero spontaneous curvature and low surface tension during cooling. favoring the generation of oil droplets with a fine distribution. The phase inversion temperature (PIT) method is used in this situation. Instead of only considering temperature, other factors may be considered, such as pH value and salt content (43).

Varying the volume proportion of the water can change the radius of curvature. By slowly Water droplets develop in a continuous phase of oil Surfactant's spontaneous curvature transforms Once the water is injected, first stabilizing a w/o microemulsion into an o/w microemulsion at the inversion locus volume percentage is increased. Surfactants with short chains at the o/w, create flexible monolayer contact, near the inversion point, resulting in a discontinuous microemulsion (41)





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### Advantages with references

1. Storage SMEDDS, like emulsions, has the benefit of bettering the solubility of hydrophobic medicines. Macroemulsions cream with time, SMEDDS, on the other hand, are thermodynamically stable, maybe effortlessly preserved (44)
2. Stability: SMEDDS, unlike micro/nano emulsions, are water-free and so have superior physiological as well as chemical stability during storage for a long time. self-nano emulsifying pills proven fine inclusion of carvedilol inner the SNEDDS. When carvedilol was diluted in an aqueous solution if cellulosic polymers are present, this enhanced its stability. (45)
3. Compliance: The majority of SMEDDS formulations come in the form of capsules or tablets, which take up less space, are less difficult to give, and subsequently beautify affected person compliance (46)
4. Drug dose reduction. (46)
5. No influence of lipid digestion method Enhanced encapsulation efficiency. (47)
6. Manufacturability and scale-up. (48)
7. Rapid onset of activity. (49)
8. Inter- and intra-subject variation, as well as the impact of meals Capable of delivering peptides to the GIT for enzymatic hydrolysis. (50)
9. Increase in performance in oral bioavailability. (51)

### Disadvantages of SMEDDS:(52)

1. One of the hurdles to a formulation based on SMEDDS and other lipids development is a scarcity of good in vitro models that can predict outcomes.
2. Because these formulations may be affected by digestion before medication release, traditional dissolution procedures do not work.
3. This in vitro model must be further improved and confirmed before its effectiveness can be determined.
4. Pharmaceutical chemical instability, as well as excessive Surfactant concentrations in formulations that irritate the GIT (about 30-60%).
5. Furthermore, lipophilic drugs have been reported to precipitate Co-solvents in self-micro emulsifying formulations migrate into the shells of soft or hard gelatin capsules when the formulation is self-micro emulsifying.
6. Validating formulas with several components becomes increasingly difficult.

### Characterization of prepared formulations

#### Droplet dimension of emulsion

Emulsion droplet measurement was previously calculated using a Zeta sizer Nano Z Using a Zeta sizer Nano ZS, a dynamicAt a temperature of 25 °C, a moderate particle size analysis was conducted with a 635 nm scattering particle size analyzer and a scattering angle of 90 degrees. In 100 mL of distilled water, the above-mentioned Solid SMEDDS (100 L) and liquid SMEDDS (100 L) (160 mg) were gently stirred. The undissolved fraction was settled for 30 minutes at 25°C in beakers. All of the trials were carried out three times, each time using the z-average diameters. (53)

#### SMEDDS morphological analysis

A scanning electron microscope was used to examine the exterior morphological characteristics of solid SMEDDS including antiviral drug powder, calcium silicate, and drug (SEM). The double-sided sticky tape was used to invulnerable the samples to a brass sampling disc. They were then rendered electrically conductive by sputtering platinum (6 nm/min) on them for 4 minutes at 15 mA under vacuum EMI Teck Ion Sputter (K575K) was used for this experiment (8x10<sup>3</sup> bar). (54)



**Monika D H and Prakash S Goudanavar****Characterization of solid SMEDDS in solid-state**

A DSC Q20 was once used to investigate the thermal houses of drug in solid SMEDDS. Five milligrams of each pattern were sealed in a Tzero pan and lid, and the fuel was heated at a rate of 10 degrees per minute from 60 to 175 degrees, purged with nitrogen gasoline at a rate of 50 milliliters per minute. PXRD was once used to assess the crystallinity of the samples. This was done at ambient temperature with monochromatic Radiation of CuK ( $\lambda=1.54178$ ) at 100 mA at 40 kV with an angular rise of 0.02o/sec at 5° 2 45°. (55)

**Analysis of droplet sizes**

The microemulsion particle size droplets was previously determined utilizing a diffusion strategy and a light-scattering particle size analyzer. Correlation spectroscopy is also used to study it which analyses the variant in mild scattering induced by using Brownian motion. Photon correlation spectroscopy (PCS) and Transmission electron spectroscopy (TEM) had been additionally used to analyze the droplet dimension of a microemulsion. (56)

**Drug content**

UV spectrophotometric and HPLC methods were used to determine the drug content material of the microemulsion. In the instance of UV, one hundred milliliters of Solvent were used to dissolve ten milligrams of the microemulsion containing the medication. (Drug with gold standard solvent solubility). Take 1 mL of this stock solution Add 10 mL of solvent to it and dilute it (In drug-loaded microemulsions, this solvent was not included.). It was previously estimated that the drug content was using the drug molecule's stated Lamda max. (57)

**Zeta Potential**

The cost on the surface of a droplet of microemulsion used to be measured using the zeta potential. In order to analyze the samples with Zetasizer, In double distilled water, 0.1 mL of sample was diluted 100 times. r before analysis. (58)

**Assessment of Self-Emulsion and Precipitation**

As previously reported, visual contrast was used to assess the self-emulsifying capabilities of SMEDDS formulations. 14 In summary, a range of compositions were classified primarily based on the pace of emulsification, clarity, and obvious balance of the resulting emulsion. Visual inspection was formerly done by dropping the preconcentrate (SMEDDS) into 250 mL of distilled water. At room temperature, the contents of a glass beaker were slowly spun magnetically at a hundred rpm. (59)

**In Vitro Dissolution Studies**

The quantitative in vitro launch check was once carried out in 900 mL of pH 1.2 buffer with the usage of a US Pharmacopeia XXIV dissolution machine 2 The paddles have been becoming at one hundred revolutions per minute. The SMEDDS formulations have been placed in association gelatin tablets (0 sizes) and examined for drug release; the findings have been compared to those of normal fenobrate. During the launch trials, a 5-mL sample of the medium was received and subjected to drug detection via HPLC. Each time, the withdrawn quantity used to be replaced with 5 ml of the new medium. The media was once adjusted to buffer pH 1.2 containing Tween 80 to decide the in vitro dissolution of simple fenobrate (equivalent to the amount used in the formulation). Dissolution experiments have been additionally carried out in more than a few mediums (buffer pH 4.5 and 7.2) to look into the effect of pH on drug release. (60)

**Evaluation of liquid SMEDDS****Thermodynamic balance testing**

SMEDDS formulations containing antiviral drug have spun at 3500 rpm for 30 minutes (REMI R-8C laboratory centrifuge, India), and frozen-thawed cycles were performed (21 C and 25 C). At the quilt of each step, the physical appearance used is examined. For additional testing and characterization, It was decided to use formulations that didn't show phase separation, creaming, or cracking. (61)



**Monika D H and Prakash S Goudanavar****Dilution resistance**

A 1 ml sample of each system was diluted with ten, hundred, and thousand distilled water, 0.1 N HCl, and phosphate buffer were used many times (pH 7.8) in this experiment. In order to achieve consistency, a magnetic stirrer was coupled with the diluting machine, which ran at 100 rpm at 37 degrees Celsius. After 24 hours of being at ambient temperature, these constructs were examined visually to determine whether phase separation has occurred. (62)

**Advantages over other dosage formulations****Emulsions**

SMEDDS not only provide the same benefits as emulsions in terms of enhancing the solubility of hydrophobic medications, but they also provide additional benefits. They do, however, solve the problem of emulsion stacking over a lengthy period. (63) SMEDDS is without problems saved since it is a thermodynamically stable device. (63)

**Oral bioavailability is improved**

SMEDDS was developed to present the drug to a GIT-insolubilized structure (globules measuring 1-100 nm) and then increase the special floor area to enable increased absorption of environment-friendly the absorptive brush border membrane and the intestinal aqueous boundary layer carry drugs, resulting in improved bioavailability. (64)

**CONCLUSION**

Despite its poor solubility, SMEDDS is one of the most promising drug transport methods.

Because of its high loading capacity, the medications' bioavailability may also be reached with a modest dosage.

This medicine shipping device is simple to set up and inexpensive.

**Future Prospects****Super saturable SMEDDS (S-SMEDDS)**

The formulation is released into an aqueous solution once it has been discharged from an appropriate dosage form. The S-SMEDDS method produces a prolonged supersaturated solution of the medication. The goal of super saturation is to increase the drug's thermodynamic activity over its solubility limit and as a result, there is a stronger push towards passage through and beyond the biological barrier. The negative effects of surfactants are widely recognized, and using them in high quantities, as in SMEDDS formulations, might result in gastrointestinal side effects. (64) As a result, a novel class of supersaturated formulations known as SMEDDS supersaturated formulations (SSMEDDS) has been conceived and developed to address this issue and reduce GI side effects. HPMC was used as a precipitated inhibitor in traditional SMEDDS formulations to create Paclitaxel's supersaturated self-emulsifying drug delivery system (SSMEDDS). In vitro dilution of the SSMEDDS formulation formed a micro emulsion, which was then slowly crystallized by paclitaxel when left untreated. The systems are supersaturated in crystalline paclitaxel as a result of this outcome and HPMC inside the formulation helped to extend super saturation. The SMEDDS formulation precipitates quickly in the absence of HPMC, resulting in a low concentration of paclitaxel solution. (65)

**SMEDDS that are solid:**

Solid SMEDDS is a lipid-based drug delivery system, liquid excipients are incorporated with powders to make this product. Because it uses liquid SMEDDS, coagulation is a viable drug delivery mechanism for weakly water-soluble molecules. Join (Improved solubility and bioavailability) With stable Dosage structure (high balance with one-of-a-kind dosage forms) Spray-drying an aqueous answer containing liquid SMEDDS and carriers produced the stable SMEDDS formulations. As a hydrophobic and hydrophilic strong carrier, colloidal silica and dextran have been used, respectively. (66) The common droplet dimension of strong SMEDDS formulations was once decided through the strong carriers. The micro emulsion droplet measurement of strong SMEDDS made with colloidal silica used to be comparable to that of liquid SMEDDS (98 two nm vs. one zero one four nm). When in contrast to liquid SMEDDS, the strong SMEDDS fashioned by using Dextran, a hydrophilic carrier, had drastically better emulsion droplet size.



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This stable SMEDDS, like the colloidal silica-prepared stable SMEDDS, generated micro-sized emulsion droplets (about a hundred and fifty nm). (67)

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**Table 1: Illustrates the many forms as well as the benefits and drawbacks of oral lipid formulations. (25)**

| Types of formulations | Excipients   | Characteristics   | Advantages   | Limitations  |
|-----------------------|--|---|--|--|
| Type I                | Surfactant-free a variety of oil (e.g., tri-, di-, and monoglycerides)                           | It is a non-dispersing substance that requires digestion.       | GRAS is easy to use, and compatible with capsules  | Unless the medicine is very lipophilic, it has a low solvent capacity.                               |
| Type II               | Surfactants that are insoluble in water and oils   | SEDDS were created without the use of water-soluble components. | It's unlikely that the solvent capacity would be lost through dispersion.                | Digestion is expected but not essential because of the coarse o/w dispersion.                        |
| Type III              | Excipients that are both water-soluble and insoluble, such as oils, surfactants, and co-solvents | Water-soluble components are used to create SEDDS/SMEDDS.       | Absorption doesn't need digestion because the dispersion is clear or almost transparent. | Dispersion and/or digestion may result in a reduction in solvent capacity.                           |
| Type IV               | Surfactants that are solely water-soluble or those that have co-solvents (no oils)               | Most of the time, it disperses into a micellar solution.        | For many medications, the formulation has a high solvent capacity.                       | When dispersed, there is a chance that the solvent capacity will be lost, although it is digestible. |





## Phytochemical Investigation and Characterization of Leaves Extraction of *Datura metel* (L.)

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### ABSTRACT

Medicinal plants are play a essential role in every day life for treatment of disease and it does not cause any side effects. Various medicinal plants have been used for years since ancient period. *Datura metel* is a plant is belong to the solanaceae family and is used for the study of the phytochemical analysis. The phytochemical constituents are extracted by using Petroleum ether, Chloroform, Ethanol and Aqueous in continuous hot percolation method by using Soxhlet apparatus and cold maceration process. The characterization extraction of *Datura metel* leaves is done by the UV-spectroscopy and IR-spectroscopy. The phytochemical analysis shows the presence of alkaloids, flavonoids, tannins and phenolic compounds. The percentage yield of ethanolic of *datura metal* (L.) leaves is greater than other extract.

**Keywords:** *Datura metel*, Extract, phytochemical and resistance.

### INTRODUCTION

*Datura* leaves are used as anaesthetics, antispasmodics, bronchodilators, and hallucinogens in herbal medicine. *Datura metel* L., The Bengali name "Dhutura" refers to an erect shrub with spreading branches. *Datura metel* Linn, popularly known as Indian Thorn Apple, is a member of the Solanaceae family, which has 85 genera and 2500 species. *Datura metel* Linn is a perennial herbaceous plant that can reach a height of 1.5 metres. Simple alternate leaves are dark green in colour, wide oval in shape, shallowly lobed, and glabrous. Large, solitary, trumpet-shaped flowers with a fragrant smell. Flowers are enormous, solitary, trumpet-shaped, and have a delicious smell that is best experienced in the mornings and nights. They come in a variety of colours, from white to yellow and light to dark purple. Insects pollinate the hermaphrodite blooms, which are hermaphrodite. The fruit is shaped like a capsule with

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small spines on it. *Datura* can grow in regular soil, but it loves rich, moist soil, or even very alkaline soil, and it doesn't do well in the shadow. It prefers a warm environment and can be found in hotter parts of the globe. *Datura* probably is of American origin and widely cultivated in all tropical and subtropical regions for its beautiful flowers. *D. metel* is utilised in traditional Bangladeshi herbal medicine and can be found in East Asia or India. The blossoms of *D. metel* are known as baimantuoluo in Traditional Chinese Medicine and are used to treat skin irritation and Psoriasis. *D. metel* seeds are used to treat skin rashes, ulcers, bronchitis, jaundice, and diabetes in Ayurvedic medicine. Seeds are used to make tea, which is a sedative, and blooms are dried and smoked as cigarettes in Brazil. There are various species of *Datura* which are now cultivated for the production of secondary metabolites.

*Datura* is a fascinating plant that has psychedelic qualities. The whole plant is antiseptic, narcotic, sedative and is useful for asthma. It's also used to heal burns, soothe coughs, and treat laryngitis and tracheitis. Despite its reputation as one of the more dangerous hallucinogens, it has been widely employed by civilization throughout history, in both the old and new worlds, and this practise continues today for individuals interested in ethano botanical uses of this plant all over the world. The demand for alkaloid content in the past necessitated its use as a subject for botanical research. It is a genus of contrasts from smelly weeds to lovely ornamentals.

*Datura metel* has been shown to contain a range of phytochemicals. Alkaloids, flavonoids, phenols, tanins, saponins, and sterols are among the phytoconstituents. *Datura metel* contains the solanaceous alkaloids hyoscyamine and scopolamines. Plant materials are still a valuable resource in the fight against major diseases around the world. Traditional medicinal methods, particularly the use of medicinal plants, continue to play an important role in meeting fundamental health needs in poor countries. Because medicinal plants contain chemical components with therapeutic potential, they have been utilised as treatments for human diseases for ages. More than 80% of the world's population relies on traditional medicine for their basic healthcare requirements, according to the World Health Organization (WHO) in 2008.

**PLANT PROFILE****SYNONYMS**

*Datura* herb.

**BIOLOGICAL SOURCE**

It consist of leaves and flowering tops of *Datura metel*.

**FAMILY**

Solanaceae

**GEOGRAPHICAL SOURCE**

India, England, Other Tropical Region.

**TRADITIONAL USES**

- Treating cold and asthma.
- Recent uses include treatment of epilepsy, acute mania and additional forms of "active insanity"
- Wound and burn healer.
- Aphrodisiac
- It is used to treatment of headache.
- Arthritis.

**PLAN OF WORK**

- Selection of the plant.
- Collection of the plant.



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- Authentication and Extraction of *Datura metel* (L.) leaves by various solvents of increasing order of polarity.
- Preliminary phytochemical screening of different extracts of *Datura metel* (L.) leaves extract.
- Analytical screening by following methods:  
UV - SPECTROSCOPY  
IR - SPECTROSCOPY

## MATERIAL AND METHODS

### Collection and extraction of plant material collection

#### Collection

The fresh leaves of plant *Datura metel* (L.) was collected from Denkani kottai , krishnagiri, Tamilnadu, India.

#### Preparation of crude drug for extraction

Fresh leaves were dried in the shade and utilised to make the extract. These leaves was coarsely powdered with the help of mechanical grinder and passed through sieve no.40. For future use, the powder was kept in an airtight container.

### Preparation of the extracts

#### Method of extraction

Two standard methods were used continuous hot percolation process by using soxhlet apparatus and cold maceration process are used.

#### Materials

- Petroleum ether
- Chloroform
- Ethanol
- Distilled water

### EXTRACTION PROCEDURE

#### Petroleum ether extract

The shade dried coarsely powdered leaves of *Datura metel* (L.) (100g) was extracted with petroleum ether (60-80°C) until the extraction was completed. Distillation was used to eliminate the solvent after the extraction was completed. Dark green colour residue was obtained. After that, the residue was placed in a dessicator.

#### Chloroform extract

The marc left after petroleum ether extraction was dried and then extracted with chloroform (55-56°C), until the extraction was completed. Distillation was used to eliminate the solvent after the extraction was completed. Dark greenish yellow colour residue was obtained. After that, the residue was placed in a dessicator.

#### Ethanol extract

The marc left after extraction was dried and then extracted with ethanol 95% v/v (75-78°C), until the extraction was completed. Distillation was used to eliminate the solvent after the extraction was completed. Dark greenish colour residue was obtained. After that, the residue was placed in a dessicator.

#### Aqueous extract

The marc left extraction was dried and then extracted with distilled water, until the extraction was completed. Distillation was used to eliminate the solvent after the extraction was completed. The brown colour residue was obtained. After that, the residue was placed in a dessicator. The extractive values of various extracts of *Datura metel* (L.) were presented Table no.01





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#### Formula

This formula was used to compute the % yield.

Percentage yield =  $\frac{\text{weight of the dry extract}}{\text{weight of the dry plant}} \times 100$

#### PRELIMINARY PHYTOCHEMICAL SCREENING

The following approach was used to conduct phytochemical tests to determine the presence of bioactive chemical elements such as alkaloids, terpenoids, flavonoids, carbohydrates, tannins, saponins, and steroids-amino acid complexes.

#### Test for alkaloids (mayer's test)

Before being boiled in a boiling water bath with 2 percent Hydrochloric acid, the *Datura metel* extract was drained to dryness. The liquid was filtered and treated with a few drops of Meyer's reagent after cooling (Siddiq and Ali, 1997). The samples were then tested for turbidity and yellow precipitation.

#### Test for Terpenoids

0.5 ml acetic anhydride and 0.5 ml chloroform were used to treat 4 mg of extract. Then a concentrated solution of sulphuric acid was slowly added, resulting in a red violet colour for terpenoid.

#### Test for Flavanoids

1.5ml of 50 percent methanol solution was added to 4mg of extract solution. The solution was warmed before adding metal magnesium. 5-6 drops of strong hydrochloric acid were added to this solution, resulting in a red colour for flavanoids and an orange colour for flavones.

#### Test for Tannins

1 ml of water and 1-2 drops of ferric chloride solution were added to 0.5 ml of extract solution. Gallic tannins were found to be blue, while catecholic tannins were found to be green black.

#### Test for Saponins

In a water bath, 2 g of powdered material was cooked in 20 ml of distilled water and filtered. 10 mL filtrate was combined with 5 mL distilled water and rapidly shaken. Saponins were detected by the presence of persistent foam.

#### Test for Steroids

0.5 mL acetic anhydride and 0.5 mL chloroform were used to treat 4 mg of extract. Then a strong sulphuric acid solution was slowly added, resulting in a red violet colour for terpenoid and a green bluish colour for steroids.

#### Test for Glycosides

One ml of methanol extract were treated with 1ml of ferric chloride (mixture of 1 volume 5% FeCl<sub>3</sub> solution and 99volumes of glacial acetic acid), to this solution a few drops of concentrated H<sub>2</sub>SO<sub>4</sub> was added. The presence of cardiac glycosides is indicated by the appearance of a greenish blue tint after a few minutes.

#### Test for Carbohydrates

Two drops of alcoholic -naphthol solution were added to two ml of methanol extract, the mixture was agitated well, and 1 ml of concentrated sulphuric acid was slowly added along the edges of the test tube and allowed to stand. Carbohydrates had a violet ring around them.

#### Test for phenolic compounds

Fifty milligram of extract was dissolved in five mL of distilled water and then added three mL of 10% lead acetate solution and formed bulky white precipitate, which indicates the presence of phenolic compounds.



**Umamaheswari et al.,****Test for triterpenes**

One mL of chloroform was used to dissolve ten milligrammes of the extract, followed by one mL of acetic anhydride and two millilitres of concentrated H<sub>2</sub>SO<sub>4</sub>. Formation of reddish violet colour indicates the presence of triterpenes.

**UV SPECTROSCOPY****Procedure**

We switch on the spectrophotometer and give it at least 20 minutes to warm up. Then we determine the absorption spectrum using the standard acetate buffer. We select one of the cuvettes for the blank solution ( in this case pet ether, chloroform, ethanol, water) and we do not interchange it with the order cuvettes through which the light passes. We always rinse the cuvettes with several portions of solution by using pet ether, chloroform, ethanol, water buffers before taking a measurement. Then we use tissue paper to clean the exterior of the cuvettes. Then we inserted the cuvette into the cell holder with the index line facing us to avoiding scratching. The different four extract were prepared with the different solvent 100 µg/ml concentration and the maximum absorbance spectrum was taken in the four extracts

**IR SPECTROSCOPY****Procedure**

Warm up the infrared spectrometer before using it. Obtain an unknown sample from the teacher and note the sample's letter and look. To use as a background, gather a spectrum. Place a tiny quantity of sample under the probe using a metal spatula. Twist the probe until it is completely secure. Take a note of the unknown sample's IR spectra. If required, repeat the process to achieve a high-quality spectrum. Keep track of the absorption frequencies associated with the different functional groupings. The probe should be cleaned with acetone. Turn the spectrometer off. Examine the spectrum you've got.

**RESULTS AND DISCUSSION****Extraction of Plant Material**

The dried leaves of *Datura metel* (L.) leaves were extracted with solvents of increasing polarity by using soxhlet apparatus. The percentage yield of ethanolic extract of leaves of *Datura metel* (L.) Leaves was found to be 3.5% which was found to be greater than other extract. The extractive values are represented in Table No.012.

**Preliminary phytochemical studies**

The various extracts of dried leaves of *Datura metel* leaves were subjected for phytochemical screening which showed the presence of following active principles in the extract.

**CONCLUSION**

The leaves of plant *Datura metel* (L.) was belong to the family solanaceae was taken up for the present study to screen and give report on the possible phytochemical and analytical studies. Phytochemical constituents were extracted by successive solvent extraction which has shown good extractive values of 2.1%, 1.8%, 3.5% and 1.5% for petroleum ether, chloroform, ethanol and aqueous extracts respectively. Phytochemical constituents were identified by various phytochemical tests which showed the presence of various phytochemical constituents like alkaloids, flavonoids, tannins. The chloroform extract of leaves of plant *datura metel* (L.) showed the presence of main phytochemical constituents alkaloids, flavonoids, tannins and phenolic compounds. The different four extract were prepared with the different solvent 100 µg/ml concentration and the maximum absorbance spectrum was taken in





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the four extracts. On performing analytical studies of IR- spectroscopy showed that major functional group were present in the ethanol extract of *Datura metel* leaves(L.)

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Table No.01. Data showing the extractive values of *Datura metel* (L.) leaves

| Plant Name                         | Part Used | Method of Extraction   | %percentage yield |            |         |         |
|------------------------------------|-----------|--|-------------------|------------|---------|---------|
|                                    |           |  | Petroleum ether   | chloroform | ethanol | Aqueous |
| <i>Datura metel</i> (L.)<br>Leaves | Leaves    | Continuous<br>Hot Percolation<br>And cold<br>Maceration<br>Process | 2.1               | 1.8        | 3.5     | 1.5     |

Table .02. Data showing the preliminary phytochemical screening of the various extracts of *Datura metel* (L.) leaves.

| SI.NO | CONSTITUENTS      | PET ETHER | CHLOROFORM | ETHANOL | AQOUES |
|-------|-------------------|-----------|------------|---------|--------|
| 01.   | Alkaloids         | +         | +          | +       | +      |
| 02.   | Steroids          | -         | +          | -       | -      |
| 03.   | Flavonoids        | -         | +          | +       | +      |
| 04.   | Terpenoids        | -         | +          | -       | -      |
| 05.   | Tannins           | +         | +          | +       | -      |
| 06.   | Glycosides        | -         | -          | -       | -      |
| 07.   | Sapanoins         | +         | +          | -       | +      |
| 08.   | Triterpenes       | -         | -          | +       | -      |
| 09.   | Carbohydrates     | -         | -          | -       | +      |
| 10.   | Phenolic compound | +         | +          | -       | +      |

'+' presence '-' absence

Table:3 . Pet Ether Extraction of *Datura metel* Leaves

| ABSORPTION | GROUP | COMPOUND CLASS |
|------------|-------|----------------|
| 3430.04    | N-H   | Amines         |
| 3386.24    | N-H   | Amines         |
| 3181.47    | O-H   | Alcohol        |
| 2922.33    | C-H   | Alkane         |
| 2861.37    | C-H   | Alkane         |
| 2729.53    | CHO   | Aldehyde       |





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|---------|-------|------------------|
| 2408.25 | O=C=O | Carbon dioxide   |
| 1741.60 | C=O   | δ-lactone        |
| 1458.25 | C-H   | Alkane           |
| 1376.12 | C-H   | Alkane           |
| 1237.78 | C-O   | Alkyl aryl ether |
| 1163.39 | RCOOR | Ester            |
| 1072.99 | O-H   | Primary alcohol  |
| 976.76  | C-H   | Alkane           |
| 899.19  | C-H   | Alkane           |
| 809.34  | C-Cl  | Halo compound    |
| 723.69  | C=C   | Alkene           |

Table 4. IR- Spectroscopy of Chloroform Extraction of *Datura metel* Leaves

| ADSORPTION | GROUP | COMPOUND CLASS        |
|------------|-------|-----------------------|
| 3739.79    | O-H   | Alcohol               |
| 3670.56    | O-H   | Alcohol               |
| 3393.09    | N-H   | Amine                 |
| 3016.22    | C=C   | Alkene                |
| 2926.18    | C-H   | Alkane                |
| 2856.99    | C-H   | Alkane                |
| 1727.78    | C=O   | Aliphatic ketone      |
| 1622.97    | C=O   | α,β-unsaturated ester |
| 1457.36    | C=O   | Carboxylic acid       |
| 1377.65    | S=O   | Sulfonyl chloride     |
| 1215.02    | C-O   | Alkyl aryl ether      |
| 1176.28    | O-H   | Tertiary alcohol      |
| 1068.55    | O-H   | Primary alcohol       |
| 978.94     | C=C   | Alkene                |
| 925.39     | C=C   | Alkene                |
| 846.35     | C-Br  | Halo compound         |
| 746.06     | C=C   | Alkene                |
| 668.19     | C-Br  | Halo compound         |

Table 5. Ethanolic Extraction of *Datura metel* Leaves

| ABSORPTION | GROUP | COMPOUND CLASS        |
|------------|-------|-----------------------|
| 3741.25    | O-H   | Alcohol               |
| 3347.04    | N-H   | Secondary amine       |
| 2968.65    | N-H   | Amine salt            |
| 2924.23    | N-H   | Amine salt            |
| 2857.51    | N-H   | Amine salt            |
| 2122.78    | N=C=S | Isothiocyanate        |
| 1921.46    | N=C=S | Isothiocyanate        |
| 1730.56    | C=O   | α,β-unsaturated ester |
| 1646.41    | C=C   | Alkene                |
| 1452.55    | C-H   | Alkane                |
| 1379.44    | O-H   | Phenol                |





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|---------|-----|------------------|
| 1269.94 | C-O | Alkyl aryl ether |
| 1081.18 | O-H | Primary alcohol  |
| 1044.03 | O-H | Primary alcohol  |
| 922.87  | C=C | Alkene           |
| 878.71  | C=C | Alkene           |

Table 6. Aqueous Extraction of *Datura metel* Leaves

| ABSORPTION | GROUP | COMPOUND CLASS    |
|------------|-------|-------------------|
| 3320.12    | N-H   | Amine             |
| 2856.22    | N-H   | Amine salt        |
| 2114.31    | C-H   | Alkyne            |
| 1635.34    | C-H   | Aromatic compound |
| 1370.67    | COOH  | Carboxylic acid   |
| 1308.62    | COOH  | Carboxylic acid   |
| 1098.16    | C-O   | Aliphatic ether   |



Fig. 1. Plant

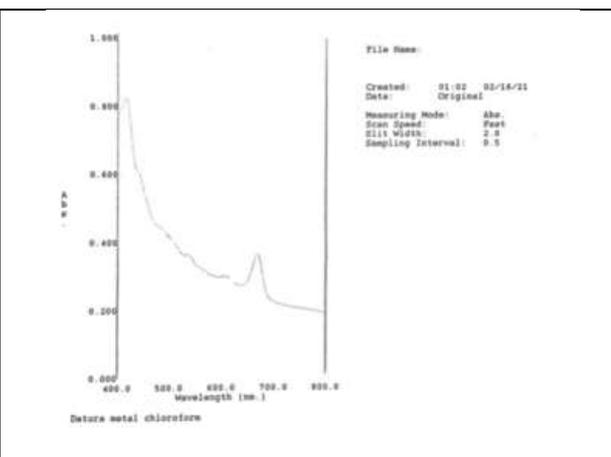


Fig. 2. UV – spectroscopy of chloroform extraction of *Datura metel* leaves:

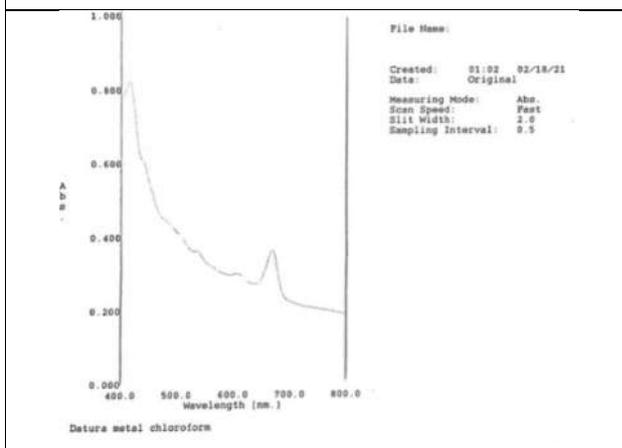


Fig. 3. UV – Spectroscopy of pet ether extraction of *Datura metel* leaves

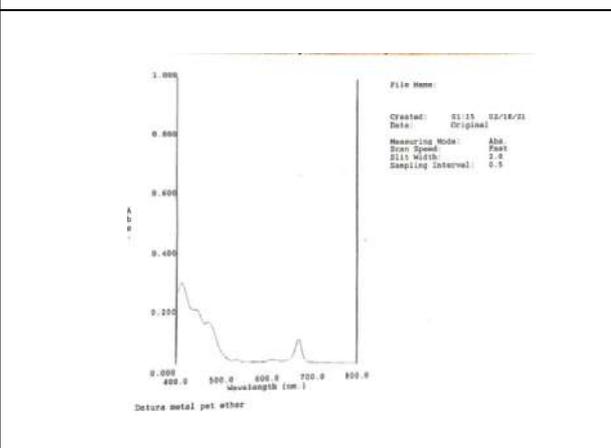


Fig. 4. UV – spectroscopy of ethanolic extraction of *Datura metel* leaves



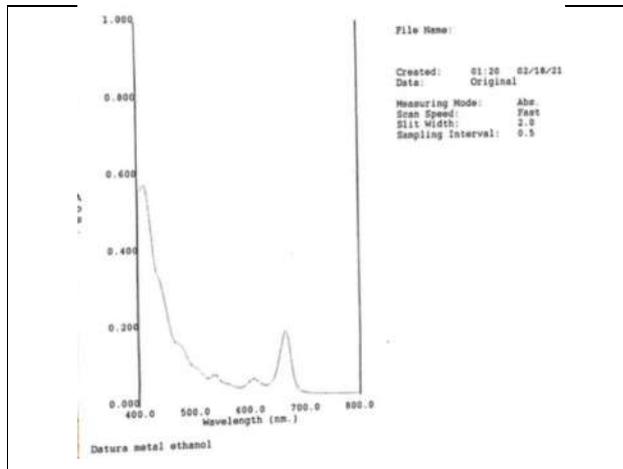


Fig. 5. UV – Spectroscopy of aqueous extraction of *Datura metel* leaves:

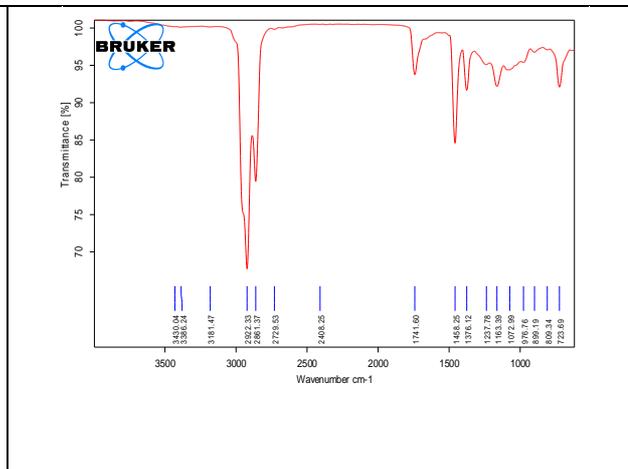


Fig.6. IR- spectroscopy of pet ether extraction of *Datura metel* leaves

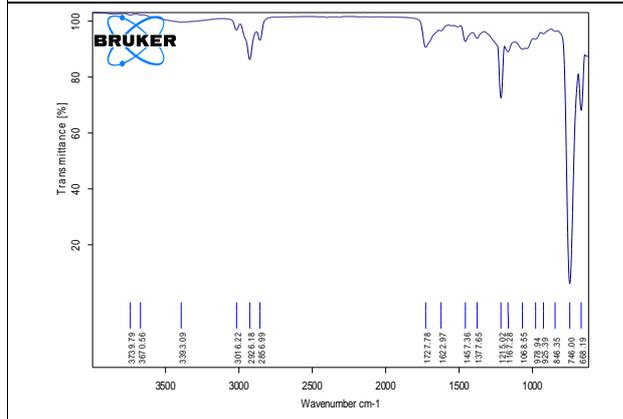


Fig. 7. IR- spectroscopy of chloroform extraction of *Datura metel* leaves:

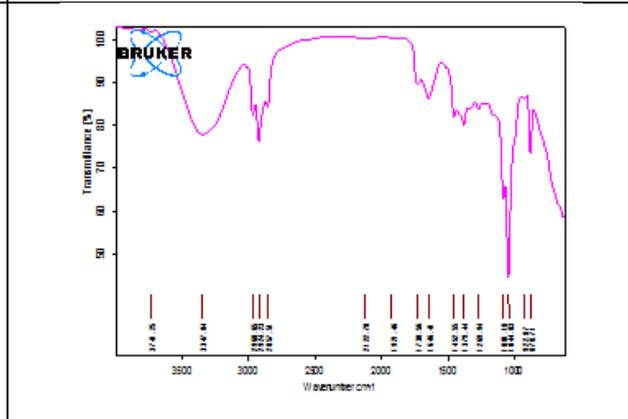


Fig. 8. IR- Spectroscopy of ethanolic extraction of *datura metel* leaves

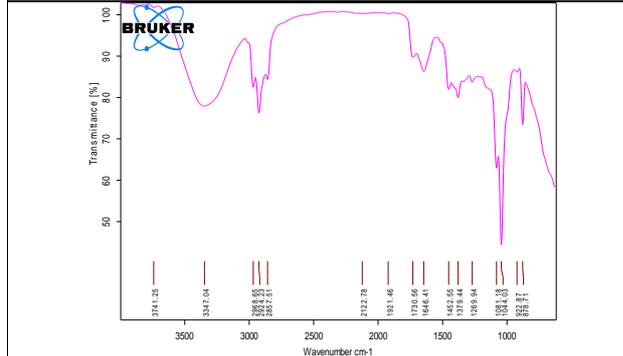


Fig. 9. IR- spectroscopy of aqueous extraction of *Datura metel* leaves.

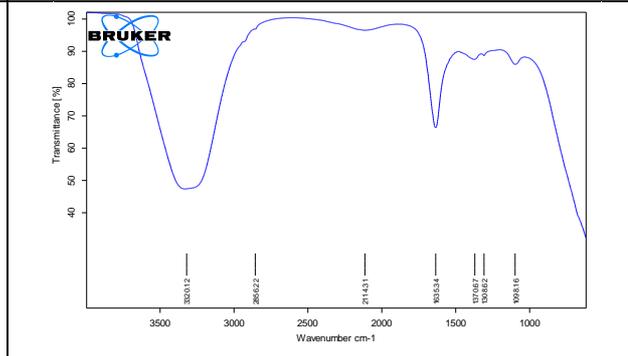


Fig. 10. Aqueous Extraction of *Datura metel* Leaves





## Effectiveness of Educational Intervention on Knowledge Regarding Dietary Management among Parents of Children Suffering with Sickle Cell Anemia

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### ABSTRACT

Sickle cell disease also known as sickle cell anemia is a genetic red blood disorder that causes blood cells to take on a sickle or crescent shape. People with sickle anemia often experience episodes of pain, fatigue and frequent infections. Sickle cell anemia is associated with vitamin D deficiency and poor appetite, leads to growth and developmental delay in children's, results need of higher amount of nutrients including proteins and calories. objective of the study was to assess knowledge regarding dietary management among parents of children suffering from sickle cell anemia. Quasi experimental approach was used with one group pre-test post-test design to assess the effect of educational intervention on Knowledge regarding dietary management of 40 Parents of Children suffering from Sickle Cell Anemia. We had selected East and South Zone where the prevalence rate of sickle cell anaemia found more than other zone. Simple random sample technique used to collect samples. Structured Knowledge Questionnaire used to assess Knowledge of Samples on Dietary Management of Sickle Cell Anemia.. Collected data was analyzed by using descriptive and inferential statistics. Findings revealed that the mean pre-test knowledge score was 11.49 and the mean post-test knowledge score was 21.25. The mean pre-test score of area related to meal planning was 9.04 and the mean post-test score of area related to meal planning was 23.1. Significance of the difference between pre-test and post- test knowledge and meal planning were statistically found significant. Hence, it was statistically proved that the educational intervention on Dietary Management in term of knowledge was effective.

**Keywords:** Sickle cell disease, Educational intervention, knowledge, dietary management.





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## INTRODUCTION

Sickle cell diseases (SCDs) is an emerging public health challenge, not only in India but also globally. It has been estimated that, between 2010 and 2050, about 14.2 million babies will be born with sickle cell anemia. Healthy children's are the Nations greatest resource. Investment in child development is an investment in the future Nation. Healthy children are the greatest asset to the nation and also the pride of the Nation. Promotion of health from the beginning of human life is essential. The child of today is wealth of tomorrow. To maintain the health of a child is great challenge for the community. India is a developing country but due to illiterate public many types of diseases spread in society. Sickle Cell Anemia is one of them.

India has the largest concentration of tribal populations globally. They are believed to be early settlers in the country and are considered to be the original inhabitants. According to censuses of India 2011 the tribal population of India is 8.6 percent of the total population which is about 67.8 million people. The States of Madhya Pradesh, Maharashtra, Odisha, Gujarat, Rajasthan, Jharkhand, Chhattisgarh, Andhra Pradesh, West Bengal and Karnataka account for around 83 per cent of the total scheduled tribe population in the country and majority of these tribal groups live in rural areas. Gujarat with 89.12 lakh tribal populations is expected to have at least 9,00,000 SCT and 70,000 SCD patients. The Dhodia, Dubla, Kukna, Gamit, Chaudhary, Halpati, Varli, Kokni, Kathodi, Kolcha, Kotwadia, etc., are major tribes with documented issues of SCD in Gujarat. To combat SCD, Gujarat Sickle Cell Anemia Control Society was established in the year 2011 with a target of no child birth with SCD by 2020 and prevention of SCD with decrease in morbidity [3,4].

Patients with sickle cell anemia have greater than average requirements for both calories and micronutrients. During sickle cell crises, energy intake can be especially poor. Children frequently hospitalized for sickle cell disease (SCD) commonly show poor linear growth, lean body mass, and reduced fat-free mass. For reasons that are poorly understood, many patients are deficient in essential micronutrients. Tell the Family that Good nutrition can help safeguard healthy growth in children with sickle cell disease and may reduce the risk of complications [7]. After critically review of many literature found that there are many studies on Prevalence of Sickle Cell Anemia but, there are very few studies on Dietary Management. A sound knowledge of well-prepared dietary plan and its implication helps to prevent complication, Hence we felt that there is a need of conducting the study in the selected districts of Gujarat state where the prevalence rate of Sickle Cell Anemia is found more. So the study will be helpful for the Parents of the Sickle Cell Anemia to reduce the complications among their Children. With the knowledge they will be able to put it into practice.

### Statement of the Problem

A cross sectional Study to Assess the Effectiveness of educational intervention on knowledge regarding Dietary Management among Parents of Children Suffering with Sickle Cell Anemia in Selected Districts of Gujarat State.

### Objectives of the Study

1. To Assess the existing Knowledge on Dietary Management among the Parents of Children Suffering with Sickle Cell Anemia in Selected Districts of Gujarat State.
2. To Assess the Knowledge on Dietary Management among the Parents of Children Suffering with Sickle Cell Anemia after administration of educational intervention in Selected Districts of Gujarat State.

### Hypothesis

H-1 The mean post-test knowledge score on dietary management among the Parents of Children Suffering with Sickle Cell Anemia after the administration of educational intervention will be significantly higher than their mean pre-test knowledge score at 0.05 level.





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### Delimitation

1. Only parents of children suffering with Sickle Cell Anemia.
2. Parents those who have the children age between 1 to 12 years.
3. Parents present at the time of study and are willing to participate.

## RESEARCH METHODOLOGY

### Research Design and Approach

Quasi experimental approach was used with one group pre-test post-test design.

### Research Setting

The present study was conducted in the selected areas of Gujarat state. East and South Zone selected because the prevalence rate of sickle cell anemia found more than other zone. Out of 12 district prevalence rate of sickle cell anemia was more in Narmada and Surat District.

### Sample Size and Sampling Technique

Taropa village from Rajpipla, Samar pad village from Dadiapada ,Areth from Mandvi Taluka and kosamba from Mangrol Taluka. Each village 10 parents were selected as samples so total sample size was 40. Simple random sampling methods used to select samples.

### Development and description of tool

The development of tool was a step by step procedure in order to make the tool more practical oriented.

**Section I:** Demographic data of the Samples such as Age, Income, Dietary Pattern, Age of Children and Type of sickle cell anemia in parents.

**Section II-A:** Structured Knowledge Questionnaire using Multiple Choice Items focused on Introduction of Sickle Cell Anemia ,Importance of Diet , Requirement of Nutrients , Dietary Practice, Total Multiple Choice item were 30 and maximum score was 30. Every correct answer was given a score of one and wrong answer was given 0 score.

**Section II-B:** Structured Knowledge Questionnaire using True – False Items focused on Meal Planning, Preventive Measures, Dietary Sources and Preparation of food. Total True and False item were 30 and maximum score was 30. Every correct answer was given a score of one and wrong answer was given 0 score.

### Ethical Consideration

- Obtained formal permission from the commissioner, Department of Health and Family welfare Gandhin agar,
- informed the Chief District health Officers of Narmada and Surat District and Medical officers of Taropa PHC from Rajpipla and Samarpada PHC from Dadiapada Taluka Areth PHC from Mandvi Taluka and Kosamba PHC from Mangrol Taluka
- written consent was taken from parents before conducting study.

## RESULT

### Section: I: Socio demographic data of parents of children with sickle cell anemia

Analysis and interpretation of multiple choice items by structured knowledge questionnaire. Table 1: Area wise Mean, Mean percentage, Standard Deviation (SD), Mean Difference, and 't' value of Pre-test and Post- test Knowledge Scores of Samples. [N=40]





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### Analysis and interpretation of the true - false items by structured knowledge questionnaire

Obtained mean difference in all the areas were found to be statistically significant as evident from 't' value. In all the areas of knowledge the calculated 't' is greater than tabulated 't' (1.68) and so the investigator concluded that there was significant increase in the mean post test knowledge score as compared to the mean pre test knowledge score after the administration of educational intervention on Dietary Management which was statistically proved.

### ANALYSIS AND INTERPRETATION OF DATA BY PRE TEST POST TEST KNOWLEDGE QUESTIONNAIRE

#### RECOMMENDATIONS

1. A similar study can be replicated on a large sample; thereby findings can be generalized for a large population.
2. A study can be conducted by using other teaching strategies like teaching program me, self-instruction modules and audio visual film, by compact disc and teaching guideline and comparison on Dietary Management of Sickle Cell Anemia.
3. Descriptive study may be carried out to find the prevalence of Sickle Cell Anaemia and assess the effectiveness of teaching strategies.
4. A study can be done to find out the effect on health of Parents with Sickle cell Anemia.
5. An exploratory study can be done to find out the difficulties experienced by the Parents of Children suffering from Sickle Cell Anaemia.
6. A study can be performed to find out the attitude of the Parents on Dietary management of Sickle Cell Anemia

#### CONCLUSION

The following conclusions can be drawn from the study findings. The mean knowledge score obtained by the samples in the pretest phase was 20.50 and in the post test phase, it has increased to 44.65. From all the above mentioned findings, it can be concluded that after administration of the educational intervention there was definite increase in Knowledge of Parents of Children suffering from Sickle Cell Anemia. This clearly indicates that the educational intervention on Dietary Management was effective in improving the knowledge of the samples.

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**Table 1. Distribution of subjects as per their Socio-demographic Variables**

(N= 40)

| SN | Personal Data                                    | Frequency | Percentage (%) |
|----|--|-----------|----------------|
| 1  | Age  |           |                |
|    | 21 to 25 year                                    | 10        | 25             |
|    | 26 to 30 years                                   | 20        | 50             |
|    | 31 to 35 years                                   | 2         | 5              |
|    | 36 to 40 years                                   | 8         | 20             |
| 2  | Family income per month in Rupees                |           |                |
|    | Up to 2000                                       | 3         | 7.5            |
|    | 2001 to 4000                                     | 7         | 17.5           |
|    | 4001 to 6000                                     | 30        | 75             |
| 3  | Dietary Pattern                                  |           |                |
|    | Vegetarian                                       | 10        | 25             |
|    | Non vegetarian                                   | 3         | 7.5            |
|    | Mixed  | 27        | 67.5           |
| 4  | Age of child is between                          |           |                |
|    | Up to 3 Years                                    | 13        | 32.5           |
|    | 4 to 6 Years                                     | 7         | 17.5           |
|    | 7 to 9 Years                                     | 3         | 7.5            |
|    | 10 to 12 Years                                   | 17        | 42.5           |
| 5  | Type of Sickle cell Anemia in Mother of Children |           |                |
|    | Sickle Cell Trait                                | 25        | 62.5           |
|    | Sickle Cell Disease                              | 15        | 37.5           |
| 6  | Type of Sickle cell Anemia in Father of Children |           |                |
|    | Sickle Cell Trait                                | 27        | 67.5           |
|    | Sickle Cell Disease                              | 13        | 32.5           |

**Table 2: Area wise Mean, Mean percentage, Standard Deviation (SD), Mean Difference, and 't' value of Pre-test and Post- test Knowledge Scores of Samples. [N=40]**

| Area                               | Max. Score | Pre Test   |                     |      | PostTest   |                     |     | Mean Difference | Calculated 't' value |
|------------------------------------|------------|------------|---------------------|------|------------|---------------------|-----|-----------------|----------------------|
|                                    |            | Mean Score | Mean Percentage (%) | SD   | Mean Score | Mean Percentage (%) | SD  |                 |                      |
| Introduction of Sickle Cell Anemia | 5          | 2.08       | 41.60               | 0.94 | 3.95       | 79.00               | 0.6 | 1.87            | 12.63                |
| Importance of Diet                 | 3          | 1.10       | 36.67               | 0.71 | 2.05       | 68.33               | 0.6 | 0.95            | 8.41                 |
| Requirement of Nutrients           | 11         | 4.28       | 38.91               | 0.88 | 7.50       | 68.18               | 1.7 | 3.22            | 9.85                 |





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|                  |           |              |       |      |              |       |     |             |       |
|------------------|-----------|--------------|-------|------|--------------|-------|-----|-------------|-------|
| Dietary Practice | 11        | 4.03         | 36.63 | 1.33 | 7.75         | 70.45 | 1.1 | 3.72        | 16.45 |
| <b>Total</b>     | <b>30</b> | <b>11.49</b> |       |      | <b>21.25</b> |       |     | <b>9.76</b> |       |

**Table 3 Mean, Mean Difference, Standard Deviation (SD) and ‘t’ value of all over Pre Test and Post Test Knowledge Scores of Sample [N=40]**

| Knowledge Test | Mean  | Mean D | SD   | Calculate ‘t’value | Tabulated ‘t’value | Level of Significance |
|----------------|-------|--------|------|--------------------|--------------------|-----------------------|
| PreTest        | 20.50 | 24.15  | 3.67 | 34.71              | 1.68               | 0.05                  |
| PostTest       | 44.65 |        | 2.87 |                    |                    |                       |





## NH-16 Drainage Management from Bhadrak to Chandikhol; Odisha; India

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### ABSTRACT

The work is the design of roadside drainage problems of NH-16 from Bhadrak to Chandikhol segment in Odisha. The present work envisages the design of proficient, safe, and financially viable drainage scheme based on geomorphology, topography, hydrology, and hydraulics of about 75km stretch housed anatomized drainage network of the Mahanadi tri-delta. The length of road under study suffers from inadequate numbers of cross drainage work and the roadside depressions are waterlogged for four to five months affecting the structures and subsoil of the pavement. The entire work is focused to address the causes and provide the solution to the problems related to the drainage system to outfall and cross drainage structures through several design parameters, tables, and contents used to design stipulated by the hydraulics of the area, hydrology studies and hydraulic parameters of the drainage system min that area. With the 21<sup>st</sup> century climatic anomalies, rainfall intensity of 13.69mm/hr, where the catchment areas are 0.375, 0.75, 0.820, 0.95, and 1.30 km<sup>2</sup> considered for the sub-catchments of the various open channels and conduits. The runoff coefficient (k) of 0.45 is also taken into consideration while designing and analyzing the respective area. Therefore, the resulting design discharge is 0.642, 1.28, 1.40, 1.62, and 2.22 m<sup>3</sup> for conduits. The design of the drainage system is developed by using the latest software AutoCAD, Q-GIS to solve the drainage problem across the NH-16 from the area of Bhadrak to Chandikhol and ameliorate the smooth discharge from the present roadside waterlogged areas.

**Keywords:** Drainage, Hydrology; IRC, NH-16, Rainfall intensity, Runoff coefficient,

### INTRODUCTION

Drainages called the back one of the roads as it helps in the removal and interception of storm/ drained water from the surrounding area of the road surfaces. Road frames are the key players in the country's development of commerce, tourism, agriculture, industry, and health care sector in the process of production and distribution of skill,

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commodities, and their fast distribution among the beneficiaries. Drainage can be surface (the flow of water is done through conduits/ drainage structures of the pavement) or draining/ conveyance water from the surface of the road. The structural integrity, life, and safety of the users are critically affected by the surface and the subsurface drainage of roads, and thus it is very important during the design and construction of highways. Therefore, efficient means for the removal of this water should be provided in the road designs, which creates the urgency for the design of drainage of the storm water flow. The drainage provision can protect the longevity of the roads against any damage from the surface or subsurface flow. Dangerous conditions can be seen as a result of poor drainage systems as it is important for traffic safety purposes. Various anthropogenic and natural structures can be allied with the drainage systems like the provision of pipes, ditches, culverts, and curbs to convey this roadside water safely. For successful construction of a drainage network, one has to select and collect apposite road construction materials as per discharge requirements and convey them to the drainage system protected. Attending to adequate capacity and durability of each drainage material is very important for the engineers/ managers. Adherence to quality control, application of good construction techniques, and performing routine periodic maintenance, improve the functioning of the drainage efficiency without any clogging or choking. A major necessity for maintaining a road, its structural soundness, and functional effectiveness is required for a adequate drainage. Water must be kept out of the pavement structure, especially in the sub grade; otherwise, it will degrade the sub grade over time by saturating it and damaging the pavement structure. As a result, the rapid dispersal of water from the sub grade and pavement becomes a major concern in the design of pavement. In addition, appropriate drainage quickly removes water from the pavement surface, reducing the risk of skidding vehicles, Chow et al., 1998, Mukherjee 2014, Kims et al 2021). IRC:37"Guidelines for the Design of Flexible Pavements" emphasizes the importance of efficient drainage in ensuring pavement life. Maintaining excellent slope cross-sections to sensible cross-fall to promote rapid drainage of surface waters and provision of adequate surface and subsurface drainage, where appropriate, are among the steps established therein to defend against poor drainage conditions. Other steps such as extending the granular sub base across the full width of the formation, providing a drainage layer, and ensuring the formation level are sufficiently above ground/HFL are also listed. Water infiltration under the pavement through the adjacent dirt shoulders (or shoulders) and median is another major cause of pavement deterioration. Therefore, the reason for this work is to design an efficient drainage system along this road.

**Scope and objective**

It is constructed within 40 to 50years span but the working of the roads has become detrimental due to moisture damage, loss of strength, and modulus decline ( $\leq 30\%$ ) to the asphalt surface to a tune of 30% or more. The excess moisture contenting the aggregate and soil may lose stiffness ( $\geq 50\%$ ) as per IRC: SP: 42-2014. One of the oldest inland communications, the NH 16 (Old NH 5) is running from Calcutta to Chennai serving four states i.e. West Bengal, Odisha, Andhra Pradesh, and Tamil Nadu. The Odisha stretch was old and was one lane 40years back with inadequate culverts, bridges, siphons, aqueducts, or another cross drainage (CD) structure. After renovations or up gradation, and construction of ring roads while negotiating a city/urban, the number of CD structures and roadside drainages provided were inadequate to discharge smoothly the run of these roadside drains (IS 37-2018).

Design of an efficient and effective drainage system along the highway and cross drainage structures is warranted from Bhadrak to Chandikhol, during its upgradation to 6-lane or 8-lane. The main objective of this study is to construct an efficient drainage system along the side of NH-16 i.e. Bhadrak to Chandikhol to:

1. Hydrological survey for climate change, rainfall anomaly, and runoff estimation
2. Flood information of the region
3. Hydraulic Design, and Geotechnical investigation
4. Determine the expected flow and the catchment area.
5. To determine the runoff into the drainage.
6. To plan, design, and proposals for an efficient drainage system.





## LITERATURE REVIEW

The Bhaskaracharya National Institute for Space Applications and Geo-informatics (BISAG-N), Gandhinagar, Gujarat has ~131Th Km of national highways (NH) exist in India for which 2021: GIS Mapping of ~131Th km (gazette notifications issued & Google maps updated) for initiation of validation exercise; (MoRTH circular 2022) Highway drainage is constructed for the interference and elimination of water from under, over, and also in the surrounding area of the road, (Panda et al., 2020). Permeable concrete for roads can address the drawbacks of roadside accumulation of storm, flood, or runoff and can be ponded for reuse during the non-monsoon period without affecting the pavement and structures on the roads, (Ajamu et al, 2012, Gupta et al, 2020, Under climate change, extreme rainfall events, sudden release of upstream dammed water, carry away sewage, and unwanted waters, accumulate on roadside causing embankment failure, Liu et al, 2022. Drains can be of different types, they can be a pipe, trench, or channel; unlined or lined, V-shaped, rectangular, trapezoidal, half pipe, flume chute, or may be covered or opened. Various drains used in the NH are depressed median, and lined saucer drains, gully traps, cement concrete curbs or horizontal steel grating, etc. (Magdi MEZ 2014, IRC SP 042, 2014, Magadi 2016.) The cross drainage structures are provided across the national high ways not to interfere with the drainage flow are culverts of type pipe or box type depending upon the discharge quantity, joining drains to canals as per suitability, aqueducts, siphons, bridges depending upon the topography of the road and the drainage network, CHOW 1959, Aranda et al, 2021, Highway side drainage is considered one of the most important factors in highway design and construction. If the surface drainage system is not properly designed and constructed, then instead of performing all other aspects of road design and construction effectively, the road will quickly become reused due to the influx of water in the pavement and its base Agbonkheshe et al., 2013, Mukherjee 2014, Amit et al., 2016, It is possible to control the damages due to the flow of water on the pavement by keeping the water out of places where it can cause damage or by removing it quickly and safely through the drainage system Jitendra et al, 2013.

### NH-16 (Old NH-5)

National Highway-5 (NH-5) is one of the major economic corridors running parallel east coast of the Bay of Bengal of length 1711km and joining Chennai (Madras) and Kolkata (Calcutta) and running through the four coastal states adjacent to the Bay of Bengal are West Bengal (WB), Odisha, Andhra Pradesh (AP), and Tamil Nadu (TN). NH-16 (NH-5) disconnecting the highly developed districts of Guntur and Visakhapatnam in AP. The corridor has a stretch of poor drainage stretch from Bhadrak toll gate to Chandikholtoll gate of length 74.5km connecting three economic hot spots Bhadrak, Panikoili, and Chandikhol. This stretch of road crosses three major rivers the Salandi, Baitarani, Brahmani, and Biluakhai of the Mahanadi branch which remains flooded and its anatomized of drains keep the NH side drains carrying water causing deterioration of the embankments of the pavement and joining NH 20 at Bhadrak and NH 53 at Chandikhol (Fig 2).

### Drainage and traffic status study area

The study area comprising the northern fringe of the Mahanadi tri-delta faces floods with the frequency of two to three years, Mishra et al, 2019, Satisfactory drains with adequate subgrade to allow water through the road section is a prime prerequisite for enhancing the functional efficiency, stability, durability and the soundness of structures of a road. Otherwise, in long run, the pavement may be undermined or deteriorated and cause distress to the structures and connectivity infrastructure. Immediate dispersal of accumulated water on the roadside saves the road embankment from piping, vehicular skidding, overtopping, and finally leading to failure of the road system. Stagnation due to water logging in the road's vicinity may weaken the structures, infiltration triggered in subgrade resulting erosion of embankments, shoulders, verges, and rain cuts. It is pertinent to know that the NH-16 from Bhadrak passes through the tri-delta of the Mahanadi system i.e., mostly the rivers the Salandi, the Baitarani, the Brahmani, and the Mahanadi in plain and rolling areas of Odisha. The NH-16 passes through the townships like Bhadrak, Panikoili, Jaraka, and Chndikhol which is thickly populated and connect heavy traffic zone (Sethi et al, 2020).





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#### Types of drainage

Mainly three types of drainage are possible on the highway roads according to ORR (2003) and these are Surface drainage, subsurface drainage, and Cross drainage.

#### Surface Drainage

Comprises transverse drainage. It's utilized to keep natural water lines from being in erupted by the road. It is intended to keep the platform and adjacent regions from flooding. The pertinent structures are Aqueducts, culverts, and cross drainage structures. *Drainage along a long axis is used* to collect and channel precipitated water from the road surface, side slopes, and nearby land, preventing it from reaching the road surface and addressed through unlined and lined drains, Kerb's channel drains, and so on.

#### Sub-surface Drainage

It is indispensable to remove trapped water within the sub grade and pavement layers. This is because as soil moisture content increases, its compressive strength also increases. Increasing the moisture content within the pavement beyond a certain point (e.g., the liquid limit) reduces the bearing capacity of the road and causes premature pavement breakdown and deterioration, reducing the design life of the pavement. Groundwater ingress, water table change, water ingress from above through fractures, leaky joints, and other factors create changes in moisture content in the pavement and sub grade layers. To discharge trapped water within the sub grade and pavement layers, two types of underground drains are constructed. They are longitudinal interception drains and longitudinal drains for lowering the water table.

## METHODOLOGY

#### Site Visit

To have better comprehension of the problems and also to have knowledge about the gadgets, use modern and competent survey instruments such as LIDAR, Total stations, and GPR are to be in use for carrying out the reconnaissance survey.

#### Determination of runoff

It involves the process of determining the catchment area, topography, soil characteristics, and limnology of the stretch to be studied, runoff estimation needs to be done along with the nature of the surface, rainfall pattern, and the critical intensity of the storm. Longitudinal drain's slope  $S$  of known or assumed cross-section and depth of flow, may be determined with the help of Manning's formula for the design value of velocity flow  $V$ , roughness coefficient  $n$ , and hydraulic radius  $R$  (Andrews 1976, Chow 1978, Abiola 2002). Manning's formula is given as  $V_0 = \frac{1}{n} P^{2/3} S^{1/2}$  eqn.1

Where  $V_0$  = Velocity of flow;  $n$  = Rugosity coefficient;  $P$  = Hydraulic perimeter;  $R$  = Hydraulic radius;  $S$  = Longitudinal slope of the channel. This equation is used for the calculation of drainage volume (Table 1)

#### Drainage Hydrology

The distribution, accumulation, and flow/drive of the amount of water in the surface and subsurface drainage system are to be estimated. Finally, the hydrological drainage design, based on the rational formula, is recommended as per the "Highway Manual Part 1: Design, Volume 1, Geometric Design, 2013

#### Estimating runoff coefficient C

The surface drainage system is designed to handle the maximum rainfall rate of surface runoff that can occur in urban areas. The slope, the area, the vegetation, and the type of soil must be considered. The runoff coefficient is commonly assumed to be a percentage of rainfall for land drainage system design. The following rainfall percentages are assumed for the various surfaces below to estimate the runoff coefficient  $C$ . The coefficient in the percentage of





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various landforms is provided as per guidelines are single houses (60%), asphalt concrete pavement (20%), garden apartments (15%); parks, pastures, farmland(5%);

**Runoff Calculation**

The rational formula is applied for the estimation of runoff of water for drainage,

$$Q = 0.027CIA \dots\dots\dots I$$

$$Q = A * V \dots\dots\dots II$$

Where: Q = maximum runoff in Cum/ sec, C = constant (depend upon the surface nature), I = critical intensity of storm in mm/ hour. A = catchment area (km <sup>2</sup>). Time of concentration (Tc): It is assumed to be 5mnts, otherwise 20mnts for inlets (From "Practical Hydraulics" by Andrews L. S).

**Rainfall intensity (I)**

It helps to measure the amount of rainfall per unit of time. Parameters such as time of concentration t<sub>c</sub>, average frequency occurrence n, and rainfall station constants a, and b, are used to obtain the rainfall intensity I.

General Talbots equation for Rainfall intensity (I)

$$I = \frac{A}{B + P_n} \dots\dots\dots Eqn\ ii$$

Where I= Rainfall intensity and t = rainfall duration. and

$$P_n = (C + D) \log n \dots\dots\dots Eqn\ iii$$

And a and b are the values for rainfall station constants

As per Highway Manual Part 1; Applying the station constant obtained from the table for Panikoili

$$K n = (2.94 + 1.90) \log 10 20 = 6.29$$

$$T c = 0.07hr$$

From (ii), Rainfall intensity (I) = = 13.69mm/hr ..... IV

**Calculation for catchment area**

1. The GIS/RS data from satellite images of the area (Q-GIS an app Google earth software).
2. Then we marked out the catchment area.
3. I plotted the outline on the Auto CAD software.
4. The latter areaways measured from the AutoCAD area measuring tool.
  1. Area 1 was found to be 0.375km<sup>2</sup>
  2. Area 2 was found to be 0.75km<sup>2</sup>
  3. Area 3 was found to be 0.820km<sup>2</sup>
  4. Area 4 was found to be 0.95km<sup>2</sup>
  5. Area 5 was found to be 1.30km<sup>2</sup>
  6. Area 6 was found to be 0.375km<sup>2</sup>
  7. Area 7 was found to be 0.75km<sup>2</sup>
  8. Area 8 was found to be 0.820km<sup>2</sup>
  9. Area 9 was found to be 0.95km<sup>2</sup>
  10. Area 10 was found to be 1.30K<sup>2</sup>





## RESULTS

The task involves, the design of the side drainage channels by the side of roads and the Calculation of top width for conduits I, II, and III,....VIII, IX, and X using the software.

### AutoCAD screen showing the map of the area

4.3 Design of rectangular section Design using CAD software

The following dimensions were derived using a rectangular section, as in Table 5 below

## DISCUSSIONS

Determination of cross-sectional area and dimensions: involves the process of determining the amount of surface water that needs to be removed through drainage. The allowable velocity of flow of the surface water and effective drainage of subsurface water is based on knowledge of hydraulics, geology, topography, and hydrology of the area where the roads pass through. Both software and manual methods are used to create trapezoidal and rectangular sections. The results are summarized in the tables that follow.

### Trapezoidal section

The depths acquired by the software are greater in ducts I,II, and III,....VIII, while those obtained by manual design are greater in ducts IV, V, IX, and X. This can be seen in the summary previous. of data. To achieve a safer hydraulic design, the software results (depths) should be used for conduits I, II, III, VI, and VIII, while the depths acquired by manual design should be used for conduits IV, V, IX, and X. Except for conduits III, and VIII, the bottom widths obtained from the program are higher in all conduits. As result, for all conduits except III, and VIII, this oft ware results should be used, while the bottom width derived from the manual design should be used. Because the width of the top of the conduit is determined by the software is higher in all conduits, the software's results should be adopted.

### Rectangular section

The depths attained by using the software are comparatively greater in the ducts I,II, and III,....VIII, while those got from the manual design are larger in ducts IV, V, IV, and X (Table 9). To accomplish a safer hydraulic design, software results (depths) are to be used for ducts I, II, and III,....VIII, while depths attained by manual design should be used for ducts IV,V, IX, and X. Table 10: The results acquired from the software are superior in all canals except canals III and VIII. As can be seen from the results summary above, the results received from the software are higher for all channels except for channels III and VIII. Consequently, except in ducts III and VIII, where the results of the design manual must be applied, the findings of the software will be used. The dimensions are slightly different by comparison, with larger figures obtained from the software for both trapezoidal and rectangular cross-sections. Because the software is built to provides a fehydraulic design, this is the case. As a result, the software's results will be used to create this design. In addition, the trapezoidal cross-section will contain more water than the rectangular cross-section, according to both computerized and manual methods. As a result of the high discharge in the area, the software-generated trapezoidal section should be employed for this design.

## CONCLUSION

Flooding, water logging, inundations, pothole formations, overflows, undulations, water accumulation, ruts, and roadside erosion were some of the problems observed. However, roadside drainage was designed as a result of the data collected for the road and the analysis carried out by inspection, practical verification of the whole road and all the areas surrounding the road, so the above-mentioned problems are would avoid when this design is applied. As a





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result, to maintain the useful life and purpose of the road, by creating a Roadside Drainage of suitable size and capacity, the discharge and all dimensions produced can be used for construction as specified.

#### Planning / Management

Because the road is in poor condition, this issue must be addressed using the knowledge obtained in this thesis. As a result, the design presented in this thesis will benefit road users. To avoid drain obstruction, routine maintenance will be required for the designed drainage. There should also be follow-up projects on the examination and evaluation of the drainage system designed in this thesis. However, the design will only be of optimum and long-term advantage if it is combined with a suitable and long-lasting drainage structural design. As a result, drainage structural design is strongly suggested.

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**Table 1: Various drainage channels, the values of  $\eta$  ('s rugosity coefficient), and maximum Velocity**

| Channel material paved                    | Manning's $\eta$ (good to poor) | Maximum Velocity (m/s) |
|---|---------------------------------|------------------------|
| <i>Concrete surfaces</i>                  |                                 |                        |
| i. Trowelfinish                           | 0.011 – 0.013                   | 6.1                    |
| ii. Floatfinish                           | 0.012 – 0.014                   | 6.1                    |
| iii. Formed, no finish                    | 0.013 – 0.014                   | 6.1                    |
| Concrete bottom, sides finished with:     |                                 |                        |
| a) Dressed stone inmortal                 | 0.014 – 0.016                   | 5.5 – 6.1              |
| b) Random stone inmortal                  | 0.016 – 0.019                   | 5.2 – 5.8              |
| c) Dressed stone or smooth concreterubble | 0.02 – 0.025                    | 4.6                    |
| d) The rubble or random stone             | 0.034 – 0.029                   | 4.6                    |
| Gravel bottom, side of:                   |                                 |                        |
| i. Form                                   | 0.017 – 0.020;                  | 3.0                    |
| ii. Random stone in mortar                | 0.020 – 0.023;                  | 2.4 – 3.0              |
| iii. Random stone or rubble<br>(rip-rap)  | 0.023 – 0.033;                  | 2.4 – 3.0              |
| d. Brick                                  | 0.013 – 0.016                   | 3.0                    |
| e. Asphalt                                | 0.012 – 0.016                   | 5.5 – 6.1              |

**Table 2: Runoff coefficient (C) considered for various surfaces in the terrain around the study area:**

| Surfaces in the terrain considered                    | Value in °C   |
|---|---------------|
| Urban residential: single house, garden, apartments   | 0.3°C         |
| commercial and industrial                             | 0.5°C         |
| Forested and dense vegetation areas depending on soil | 0.8°C         |
| Parks, farmland, pasture                              | 0.03 – 0.19°C |
| Asphalt, or concreted areas/pavement                  | 0.84 – 0.99°C |





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**Table 3: The ground parameters for calculation of rainfall in the Panikoili area**

| Constants        |       |       |      |      |
|------------------|-------|-------|------|------|
| Stations         | A     | B     | C    | D    |
| Bhandari Pokhori | 0.329 | 0.860 | 2.17 | 1.43 |
| Panikoili        | 0.499 | 1.031 | 2.94 | 1.90 |
| Kuakhia          | 0.599 | 0.951 | 3.28 | 2.33 |

**Table 4. Drainage dimension acquired from the software used (Microsoft)**

| Conduit        | Depth in (m) | Bottom width in (m) | Top width in (m)         |
|----------------|--------------|---------------------|--------------------------|
| Conduit-I      | One meter    | 0.5m                | $0.5 + 0.5 + 0.5 = 1.5m$ |
| Conduit- II    | One meter    | 0.5m                | $0.5 + 0.5 + 0.5 = 1.5m$ |
| Conduit - III  | One meter    | 0.5m                | $0.5 + 0.5 + 0.5 = 1.5m$ |
| Conduit - IV   | One meter    | 1m                  | $0.5 + 0.5 + 1.0 = 2.0m$ |
| Conduit -V     | One meter    | 1m                  | $0.5 + 0.5 + 1.0 = 2.0m$ |
| Conduit -VI    | One meter    | 0.5m                | $0.5 + 0.5 + 0.5 = 1.5m$ |
| Conduit - VII  | One meter    | 0.5m                | $0.5 + 0.5 + 0.5 = 1.5m$ |
| Conduit - VIII | One meter    | 0.5m                | $0.5 + 0.5 + 0.5 = 1.5m$ |
| Conduit - IX   | One meter    | 1m                  | $0.5 + 0.5 + 1.0 = 2.0m$ |
| Conduit - X    | One meter    | 1m                  | $0.5 + 0.5 + 1.0 = 2.0m$ |

**Table 5: showing: Dimensions obtained from the software**

| Conduit        | Depth (m) | Width (m) |
|----------------|-----------|-----------|
| Conduit-I      | One meter | 1.0m      |
| Conduit- II    | One meter | 1.1m      |
| Conduit - III  | One meter | 1.2m      |
| Conduit - IV   | One meter | 1.0m      |
| Conduit -V     | One meter | 1.3m      |
| Conduit -VI    | One meter | 1.5m      |
| Conduit - VII  | One meter | 1.2m      |
| Conduit - VIII | One meter | 1.1m      |
| Conduit - IX   | One meter | 1.5m      |
| Conduit - X    | One meter | 1.0m      |

**Table 6: Comparison of depths obtained by software and manual design**

| Conduit        | Software depth (m) | Manual depth (m) |
|----------------|--------------------|------------------|
| Conduit-I      | One meter          | 0.99m            |
| Conduit- II    | One meter          | 0.90m            |
| Conduit - III  | One meter          | 0.90m            |
| Conduit - IV   | One meter          | 0.15m            |
| Conduit -V     | One meter          | 0.15m            |
| Conduit -VI    | One meter          | 0.85m            |
| Conduit - VII  | One meter          | 0.90m            |
| Conduit - VIII | One meter          | 0.90m            |
| Conduit - IX   | One meter          | 1.15m            |
| Conduit - X    | One meter          | 1.15m            |




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**Table 7: Comparison of bottom widths obtained by software and manual design**

| Conduit        | Software bottom width (m) | Manual Bottom width (m) |
|----------------|---------------------------|-------------------------|
| Conduit-I      | 0.5m                      | 0.15m                   |
| Conduit- II    | 0.5m                      | 0.5m                    |
| Conduit - III  | 0.5m                      | 0.6m                    |
| Conduit - IV   | 1.0m                      | 0.4m                    |
| Conduit -V     | 1.0m                      | 0.7m                    |
| Conduit -VI    | 1.0m                      | 0.5m                    |
| Conduit - VII  | 0.5m                      | 0.6m                    |
| Conduit - VIII | 0.5m                      | 0.4m                    |
| Conduit - IX   | 1.0m                      | 0.7m                    |
| Conduit - X    | 1.0m                      | 0.15m                   |

**Table 8: Comparison of top widths obtained by software and manual design**

| Conduit        | Software bottom width (m) | Manual Bottom width (m) |
|----------------|---------------------------|-------------------------|
| Conduit-I      | 1.50m                     | 0.85m                   |
| Conduit- II    | 1.50m                     | 1.25m                   |
| Conduit - III  | 1.50m                     | 1.30m                   |
| Conduit - IV   | 2.0m                      | 1.50m                   |
| Conduit -V     | 2.0m                      | 1.70m                   |
| Conduit -VI    | 1.50m                     | 0.85m                   |
| Conduit - VII  | 1.50m                     | 1.25m                   |
| Conduit - VIII | 1.50m                     | 1.30m                   |
| Conduit - IX   | 2.0m                      | 1.50m                   |
| Conduit - X    | 2.0m                      | 1.70m                   |

**Table 9: Depth comparison obtained by the software, and the manual design**

| Conduit        | Software depth (m) | Manual depth (m) |
|----------------|--------------------|------------------|
| Conduit-I      | One meter          | 0.99m            |
| Conduit- II    | One meter          | 0.90m            |
| Conduit - III  | One meter          | 0.90m            |
| Conduit - IV   | One meter          | 0.15m            |
| Conduit -V     | One meter          | 0.15m            |
| Conduit -VI    | One meter          | 0.85m            |
| Conduit - VII  | One meter          | 0.90m            |
| Conduit - VIII | One meter          | 0.90m            |
| Conduit - IX   | One meter          | 1.15m            |
| Conduit - X    | One meter          | 1.15m            |





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**Table 10: Comparison of the widths attained by the software and the manual design**

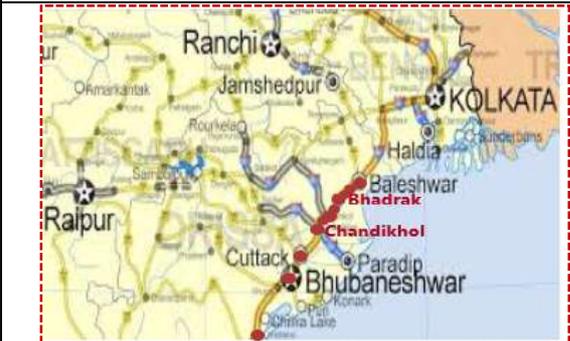
| Conduit        | Software depth (m) | Manual depth (m) |
|----------------|--------------------|------------------|
| Conduit-I      | 1.0m               | 0.50m            |
| Conduit- II    | 1.2m               | 0.95m            |
| Conduit - III  | 1.2m               | 1.40m            |
| Conduit - IV   | 1.3m               | 0.90m            |
| Conduit -V     | 1.5m               | 1.20m            |
| Conduit -VI    | 1.0m               | 0.50m            |
| Conduit - VII  | 1.0m               | 0.95m            |
| Conduit - VIII | 1.2m               | 1.50m            |
| Conduit - IX   | 1.3m               | 0.90m            |
| Conduit - X    | 1.5m               | 1.20m            |



**Fig. 1 (a) A closed drain**



**Fig. 1(b) An open drain**



**Fig 2: The index map from Bhadrak to Chandikhol (Study area)**

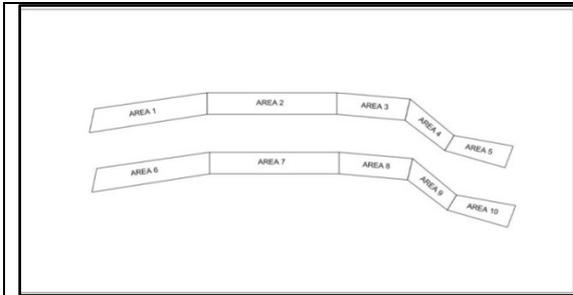


**Fig 3: Satellite view of the area obtained from the Google earth.**





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**Fig. 4. Plot of the area on AutoCAD**



**Fig.5. Design of rectangular section Design using CAD software**





## The Present Day Physico-Chemical Assessment of Potable Water from Hnahthial Town in Mizoram, India

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### ABSTRACT

Water is one of the world's most vital and abundant substances. Water is required for the life and growth of all living species on the planet. Only the planet Earth currently has around 70% of its surface covered in water. However, it has been extremely polluted with various dangerous chemicals as a result of rising human population, industrialization, agricultural fertiliser use, and man-made activity. As a result, the quality of drinking water must be assessed and examined on a regular basis, because contaminated drinking water exposes people to a variety of water-borne diseases. The poor quality of discharged water by restaurants, hotels, construction activities and other food-selling business sites contains varied amounts of pollutants in the current condition around the world. The low quality of discharged water is the outcome of improper food waste water management. These pollutants are released into the environment, either intentionally or accidentally, and are released directly or indirectly into public sewer lines, dumping yards, and reservoirs. As a result, the potable water quality of different water sources in Hnahthial town in Mizoram needs to be assessed. Physico-chemical assessment of the different water sources within Hnahthial town were assessed. The geology of the area is mostly defined by sandstones and shales and the potable water sources were assessed and the results show that all the water sources were within BIS standards for human consumption.

**Keywords:** Water, geology, Hnahthial, Mizoram.





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## INTRODUCTION

Water is an essential component for the survival of life on Earth because it contains minerals that are crucial for humans, the environment, and aquatic life. The world's most important freshwater resources are lakes and surface water reservoirs, which provide numerous benefits. They are utilised for domestic and irrigation reasons, as well as providing ecosystems for aquatic life, particularly fish and thus serve as a source of necessary protein as well as important components of the world's biological variety. As a result of tourism and recreation, they provide significant social and economic benefits, as well as cultural and aesthetic value to people all over the world. Hnahthial town is located in the south eastern corner of Mizoram bordering Myanmar to its east in North east India (Fig.1). The town is a modern bustling town and is the administrative capital for Hnahthial district. The study area falls in 84B/13 in the Survey of India toposheet and the geology of the area consist of mainly sandstones and shales with weathered siltstones dominating in many places. We can characterise better water quality using physical, chemical, and biological factors. However, there may be some link between these variables, and the most significant one might be used to determine water quality.

With the growing population and modernization, the importance and need for quality potable water has increased tremendously in hilly areas of North east India. Hnahthial, like any other hilly area has seen development in many facets which could hamper and degrade the quality of the potable water. In many areas across the world, potable water has been assessed using different physico-chemical methods and these reveal the true quality of potable water from those source areas. In Iran, the physico-chemical studies of potable water do not fall with the permissible limits [1]. Also, in Turkey, a study was carried out to assess the potable water in Camligoze Dam located in the central Anatolian region [2]. Surface and groundwater samples were assessed using the physico-chemical method to analyse potential threats of pollution [3]. Also, to address the longevity of health, physico-chemical water assessments were also carried [4]. To prepare a better overall index for water quality, exploration of the behaviour and the limitations of the conventional methods for quality evaluation were used [5]. To better understand the physico-chemical characteristics of streams, spatial and temporal surveys were conducted [6]. Also, in mainland India and the North east, water assessment using the physico-chemical methods have been extensively used for better understanding of the potable water from different water sources [7-12]. In these studies, APHA, AWWA, WEF and BIS 2012 standards were used [13-14].

**Materials and Methods:** For detailed hydrological and hydrogeological assessments, water samples were collected from 12 sources within Hnahthial town (Fig.2). These samples were collected during the pre-monsoon month of February in 2022. The pH, temperature, TDS, EC, Alkalinity, Chloride, Hardness, Iron, Potassium, Magnesium, Nitrate, Manganese and Phosphate were analysed at Public Health Engineering Laboratory (NABL Accredited laboratory) at Lunglei, Mizoram on the same day. The samples were collected using prewashed polythene *Tarson* bottles for each water source of 1 litre each. To prevent any leakage and spillage, the bottle caps were all sealed right after sampling. Perennial springs (tuikhur), public water supply and hand pumps were the water sources from which the samples were collected. Strict measures and methods of the APHA, AWWA and WEF were used.

## RESULTS AND DISCUSSION

The physico-chemical parameters result obtained from Hnahthial town are presented in Table 1. The pH of water ranges from 5.80-7.88. According to the BIS 2012 standards, the permissible limit for drinking water is between 6.5-8.5. Thus, three water samples of water having pH of 6.31, 6.49 and 5.80 were outside the permissible limits for drinking water. The Total Dissolved Solids (TDS) are measured in ppm and the permissible limits under BIS 2012 is 500 ppm. All the water sources fall within the permissible limits for drinking water. The alkalinity is a measure of CaCO<sub>3</sub> in water, the permissible limits for which ranges up to 200 ppm. It was found that all the water samples collected from the different water sources fall within the desired levels of BIS 2012 standards. Chloride is often present in water, and the amount that is permissible in drinking water is up to 250 mg/l. It was found that all the

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water samples collected were within the permissible limits. The potable water from different sources were assessed for the total hardness, it was found that all the water samples were having values below 250 mg/l which suggest that the water sources are suitable for drinking purposes. The water samples were assessed for the content of Iron in them, all the water sources were below 0.3 mg/l which is the maximum permissible limit for Iron content in potable water. Potassium and Magnesium presence in the water were also assessed which show that all the water sources were within the permissible limits. Also, presence of Nitrate, Manganese and Phosphate were all within the permissible limits for drinking water quality. Conclusion: After thorough assessment of water sources of Hnahthial town, it has been found that all the water samples collected from different sources were suitable for domestic consumption. Conflict of interest: No conflict of interest took place

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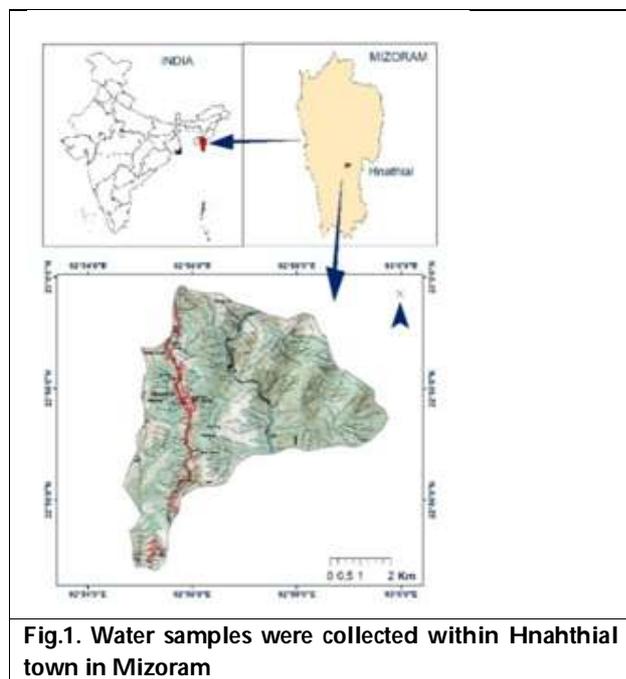




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Table 1: Physico-Chemical analysis of water samples within Hnahthial town

| S.No | pH   | Temperature (°c) | TDS   | EC mS/cm | Alkalinity | Chloride | T. Hardness | T. Iron | Potassium | Magnesium | Nitrate | Manganese | Phosphate |
|------|------|------------------|-------|----------|------------|----------|-------------|---------|-----------|-----------|---------|-----------|-----------|
| 1    | 6.98 | 18.5             | 251.0 | 502.0    | 48.0       | 70.86    | 140.0       | Nil     | 1.21      | 4.35      | 8.21    | 0.029     | 0.093     |
| 2    | 7.34 | 18.3             | 80.2  | 160.4    | 46.0       | 18.95    | 52.0        | Nil     | 0.85      | 5.14      | 0.30    | 0.024     | 0.040     |
| 3    | 6.31 | 18.7             | 128.0 | 258.0    | 16.0       | 41.92    | 56.0        | Nil     | 0.073     | 2.68      | 6.12    | 0.037     | 0.071     |
| 4    | 6.74 | 18.8             | 122.0 | 243.0    | 48.0       | 38.42    | 660         | Nil     | 1.38      | 5.19      | 0.32    | 0.019     | 0.054     |
| 5    | 6.49 | 19.0             | 129.0 | 257.0    | 74.0       | 35.43    | 78.0        | 0.06    | 2.18      | 9.84      | 0.29    | 0.064     | 0.1       |
| 6    | 5.78 | 19.3             | 23.9  | 47.7     | 320        | 6.49     | 20.0        | 0.05    | 0.059     | 2.36      | 0.31    | 0.031     | 0.042     |
| 7    | 6.47 | 19.2             | 72.5  | 145.3    | 34.0       | 27.93    | 50.0        | Nil     | 1.032     | 4.88      | 0.26    | 0.022     | 0.082     |
| 8    | 5.80 | 19.4             | 23.3  | 46.3     | 32.0       | 7.97     | 14.0        | 0.06    | 1.05      | 5.03      | 0.32    | 0.030     | 0.045     |
| 9    | 6.52 | 19.2             | 94.1  | 188.3    | 58.0       | 12.48    | 50.0        | 0.03    | 1.58      | 2.61      | 0.34    | Nil       | 0.142     |
| 10   | 7.68 | 19.3             | 66.9  | 133.7    | 86.0       | 11.48    | 56.0        | Nil     | 3.21      | 3.04      | 0.31    | 0.035     | 0.039     |
| 11   | 7.62 | 19.6             | 37.6  | 75.2     | 46.0       | 5.99     | 28.0        | 0.06    | 0.91      | 1.32      | 0.34    | 0.064     | 0.057     |
| 12   | 7.88 | 19.6             | 107.0 | 213.0    | 126.0      | 10.48    | 92.0        | 0.05    | 0.41      | 1.08      | 0.32    | 0.038     | 0.060     |





## 3D Printing –A Much Needed Change in Dentistry

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### ABSTRACT

Modern technology has and steadily paved its way into dentistry. With the introduction of Digital OPG (Orthopantomogram), RVG (Radiovisiography), CBCT (cone beam computed tomography), digital impression machines, Intra-oral scanners (IOS) and in office CAD-CAM milling machines, proper treatment planning and completing other procedures have become much simpler than it was before the use of technology. The latest invention in dentistry is Three- Dimensional printing. Three-dimensional (3D) printing technologies are advanced manufacturing technologies based on computer-aided design digital models to create personalized 3D objects automatically. Three – dimensional printing has been widely used in dentistry, design, engineering, and manufacturing fields for approximately 30 years. It has many advantages in process engineering, with applications in dentistry ranging from the field of period ontology, prosthodontics, oral and maxillofacial surgery, and oral implant logy to orthodontics and endodontics. This paper will provide a practical and scientific overview of 3D printing technologies, materials used in 3D printing and the application of 3D printing technology in various fields of dentistry.

**Keywords:** 3D printing; additive manufacturing; CAD/CAM technology; implants; Dentistry; Treatment Planing.

## INTRODUCTION

Three-Dimensional printing, the latest invention in dentistry has been proclaimed as a revolutionizing technology which will considerably evolve dentistry. Chuck Hull in 1987 first commercialized the 3D printer, which used the Stereo Lithography(.STL) File Format.[1] The process of 3D printing also known as digital fabrication technology or additive manufacturing has originated from the layer-by-layer fabrication technology of three-dimensional (3D)

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structures directly from a CAD model [2]. Successive layers of the materials are laid to create the object in the additive process. Whereas, the subtractive manufacturing is mainly the opposite of the additive process which consists of knocking off or cutting down a piece of metal or plastic with, for example a milling machine. 3D printing innovation is really inventive and has arisen as an adaptable technology. It has a great potential to revolutionize various industries and manipulate the industrial production. It offers a great advantage of time reduction with increasing production speed and highly customizable models with high value-added products that can be manufactured quickly [3].

As this innovation lessens how much material wastage utilized this cycle is intrinsically harmless to the ecosystem. In any case, the ecological advantages are expanded when you consider factors like better eco-friendliness from utilizing lightweight 3D printed parts.[4] Simultaneously, there are a few disadvantages in the reception of 3D printing technology in the manufacturing industry. For example, the impact of the utilization of 3D printing innovation is will decrease the utilization of assembling labour work so naturally will extraordinarily influence the economy of nations that depend on an enormous number of low expertise occupations.[5] Also, the high cost of processing the material and time-consuming post-processing procedure. One more possible issue with 3D printing is mainly connected with the kind of machine or interaction utilized, for certain printers having lower resiliences, implying that last parts might vary from the original design. This can be fixed in post-handling; however, it should be viewed as that this will additionally expand the time and cost of creation.

Recent advancements in digital technology and their application to dentistry, particularly in the fields of prosthodontics, orthodontics, oral and maxillofacial surgery, and endodontics, have resulted in the development of techniques that can be used to improve clinical practice and patient outcomes. To summarize, 3D printing innovation has arisen during late years as an adaptable and strong strategy in advance assembling industry. This innovation has been broad utilized in numerous nations, particularly in the fabricating industry. Therefore, this paper sets to present the overview of the types of 3D printing technologies, materials used in 3D printing and the application of 3D printing technology in various fields of dentistry.

### Basics of 3D Printing

There are various steps involved in 3-D printing technologies. Firstly, CAD based model is made and afterwards changed over completely to a Stereo-lithographic file (.STL). This file separates the surface into consistent series of triangles which addresses a piece of the outer layer of a 3D model that is then utilized for the slicing algorithm. The STL document cuts the model into slight cross-sectional layers that permitted the expected model to be 3D printed [6].

### Types of 3-D Printing Technologies

The International Organization for Standardization (ISO)/ American Society for Testing and Materials (ASTM) 52900:2015 standard classify standard, AM processes into seven categories:[7]

- (1) Binder Jetting (BJ);
- (2) Directed Energy Deposition (DED);
- (3) Material Extrusion (ME);
- (4) Material Jetting (MJ);
- (5) Powder Bed Fusion (PBF);
- (6) Sheet Lamination (SL); and
- (7) VAT Photo polymerization (VP).

Binder Jetting (BJ) Two materials are used in this process, a powder-based material and a binder. Generally, the binder is in liquid and it acts as an adhesive between the powder layers. The object is then built up by sticking the particles together.[8] Directed Energy Deposition (DED) According to Gibson et al., 2010, it is a more complex printing process commonly used to repair or add additional material to existing components. Focused thermal



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energy is used in DED to melt materials during deposition. Also known as Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), Electron Beam Additive Manufacturing (EBAM), Directed Light Fabrication, and 3D Laser Cladding [8]. Material Extrusion (ME) In, Fused Deposition Modelling (FDM) or Fused Layer Modelling (FLM) Material is drawn through a nozzle, where it is heated and is then deposited layer by layer. This technique is most commonly used and is quite inexpensive [8]. Material Jetting (MJ) A similar method like two-dimensional ink jet printer is used to make objects in Material Jetting. Material is flown onto a form stage utilizing either a persistent or Drop on Demand (DOD) approach. It has an advantage of high accuracy of droplet deposition [9].

**Powder Bed Fusion (PBF)** The Powder Bed Fusion process includes the following commonly used printing techniques: Direct metal laser sintering (DMLS), Electron beam melting (EBM), Selective heat sintering (SHS), Selective laser melting (SLM) and Selective laser sintering (SLS). Powder Bed Fusion(PBF) techniques utilizes either a laser or electron beam to soften and intertwine material powder. It is comparatively inexpensive and the powder bed acts as an unified support structure [8,9]. Sheet Lamination (SL) Ultrasonic Additive Manufacturing (UAM) and Laminated Object Manufacturing (LOM) are included in sheet lamination. The UAM process utilizes sheets or strips of metal, which are bound together utilizing ultrasonic welding. The interaction requires extra cnc machining and evacuation of the unbound metal, frequently during the welding system. LOM utilizes a comparative layer by layer approach yet involves paper as material and cement as opposed to welding. It has an added advantage of high speed, low cost and Simplicity of material handling [8,9].

**VAT Photopolymerization (VP):** A vat of fluid photopolymer resin is utilized in VAT polymerisation, out of which the model is built layer by layer. An ultraviolet (UV) light is utilized to fix or solidify the resin where required, while a stage moves the article being made downwards after each new layer is cured. It includes Stereo Lithography (SLA) and Digital Light Processing (DLP) technology. it offers excellent accuracy with perfect surface finish.[8,9]

**3-D printing in Dentistry**

Three-dimensional (3D) printing is an industrial technology that has rapidly evolved over its forty-year history. This additive manufacturing (AM) approach differs from classical subtractive manufacturing principles and is currently utilized in a plethora of disciplines ranging from aerospace industries to personalized medicine and dentistry. This manufacturing scheme enables rapid creation of custom-based complex parts, made it an applicable solution in developing self-growing robots[10]. Integration of 3D printing into different facets of contemporary dentistry has enabled the production of complex prosthodontic, orthodontic and surgical devices that demand flexibility and abrasion resistance from the molding materials [11].

**Clinical Applications of 3D Printing in dentistry**

Equipped for delivering a wide scope of oral appliances, models, guides, 3D printing is dignified to boom dentistry. 3D Printing objects have been successfully used in prosthodontics, periodontics, oral and maxillofacial and orthodontic procedures. The advantages of 3D printed objects for instructing and the executives of treatment techniques in these disciplines have been broadly announced.

**Applications in Prosthodontics**

**Custom trays:** Custom plate can be produced from computerized scans of impressions/models and printed or can be made using readily available materials (Figure 2).Manufacturing of custom trays can be done using two methods. The first method includes scanning the impression and then transferring it to the program. The second method includes recording the impression using stock trays and then pouring the model in stone. Then, scanning the model prototype or using it directly during the manufacturing process [12].

**Laser Sintering of Crowns and Bridges** Laser sintering has now turned into a standard cycle for the development of Co Cr crowns and bridges [13]. By advancing post-handling after the real structure process, it is presently conceivable to fabricate totally tranquil and precisely fitting non-precious alloy frameworks. The huge number of





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units that can be situated on a solitary stage has diminished the creation time per unit to a couple of moments (Figure 3). This process is extremely cost-effective and well established.[14]

### Complete Dentures

The 3D printing innovations can directly get CAD information and immediately make a new advanced model, which can be applied to the creation of a total dental replacement resin base without the requirement for molds, cutting apparatuses, or on the other hand tooling apparatuses (Figure 4) [15]. The 3D printing innovation has the advantages of quicker creation of dentures, and there are less stages in the work interaction, which can lessen the chance of blunders [16]. Image from Digital Denture Evolution: CAD-CAM and 3D Printed Dentures by Piero Venezia, 2019.

### Removable Partial Denture

The interaction of developing a partial prosthesis outline utilizing CAD/CAM is as per the following. To begin with, either an intraoral or extra oral scanner is used to examine impressions or regular projects to secure a computerized work record, for example, a standard tessellation file (STL). Second, STL documents are moved to CAD programming for planning lastly to 3D printers to create customized structures [17]. Mainly utilized material to fabricate RPDs with SLM is cobalt-chromium amalgam (Co-Cr). The Co-Cr is regularly utilized because of its actual properties satisfying the prerequisites of RPDs including exact fit, astounding mechanical properties, simple to clean, and doesn't barge in with tongue space.[18]

### Applications in Orthodontics

Digitization has made it really easy for the orthodontist to create smiles. After the three-dimensional intra oral scan, it is moved to the computer to get three dimensional pictures of patient's teeth. Various removable appliances (like Hawleys retainer, splints), functional appliances, arch expansion appliances, clear aligners, retainers, arch wires, brackets, auxiliaries, trays for indirect bonding set up models which will make lingual orthodontics and mock medical procedures quick and simple, additionally study models.[19]

### Applications in Oral and Maxillofacial Surgery

**Maxillofacial prosthesis** The absence of parts of the outside ear can be brought about by congenital problems or can be obtained. While attempting to reestablish these missing parts with prosthetic materials, the prosthesis ought to be redone for a superior comprehending of its part in the complex. At the point when defects are one-sided, it is ideal to check the contrary side and reestablish the affected side by duplication.[20]

### Occlusal Splints

It is an intraoral gadget with reversible helpful properties. It predominantly treats temporomandibular joint problems by changing the occlusal connection between the upper and lower dental arches [21].

### OMF implants

The capacity to print maxillofacial implants in titanium or implantable polymers (particularly Poly ethyl ether ketone [PEEK] has received a lot of attention. [22]Although 3D printing can create complex geometries, most OMF implants are fairly simple in design. 3D printing can be used to directly print the implanted structure or as a tool for indirect manufacturing utilising a pressing process. (Figure 5).

### Applications in Oral Implantology

#### Surgical Guides

Surgical guidance can increase clinical treatment accuracy and efficiency, reduce treatment errors, and improve its outcome. Also, allows patients to better understand the implant treatment. Surgical guides speed up the procedure and assure consistent results. Although their creation necessitates interdisciplinary collaboration, current advances in digital modelling and 3D printing can be used to produce customized surgical guides and anatomical models in the office [23.]





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### 3-D Printed Custom Trays

The first stage in complete denture repair is to take a correct edentulous impression, which is crucial to guaranteeing that the complete dentures will have appropriate support, retention, and stabilising functions [24]. Yuchun Sun et al in 2017 did a study on Clinical evaluation of final impressions from three-dimensional printed custom trays and they observed the impressions made with the digitally designed and 3D-printed customized trays showed better thickness distribution than those made with traditionally made trays, indicating that they were more adaptable[25]

### 3-D Printed Implant

3D printing/additive manufacturing (3DP/AM) technologies have grown in importance in the industrial sector over the last few decades: they allow for the creation of actual products directly from virtual 3D data projects, saving time and money. In a 3-year follow-up prospective clinical study, by SamyTunchel et al. on single 3DPrinted implants have shown 94.5% of survival rate and 94.3% of implant-crown success rate. Considering these results, dental implants produced with 3DP/AM technologies seem to represent a successful clinical option for the rehabilitation of single-tooth gaps in both jaws, at least after a 3-year follow-up [26].

### Applications in Periodontology

#### 3-D-Printed Ti-Mesh

In implantology, adequate bone volume in both horizontal and vertical dimensions is critical for long-term cosmetic and functional benefits. However, many patients in our everyday practise have horizontal or vertical bone deficit, particularly in situations of long-term edentulous ridges or trauma-induced bone deficiencies. During a prosthetic surgery, resorbed alveolar bone is usually insufficient to insert dental implants, jeopardizing the successful outcome of an optimum implant placement. In order to properly achieve bone augmentation, GBR is one of the most utilized methods. However, maintaining a suitable bone shape and volume during the entire healing period for GBR, particularly for large bone abnormalities, is difficult. Therefore, stiff Ti-mesh can maintain space better than other membranes and specifically, custom-made titanium mesh has more advantages than commercial meshes in terms of reducing surgery time and avoiding the danger of infection after surgery [26]. Paula Korn et al [28] in an original research in 2020 on 3D Printing of Bone Grafts for Cleft Alveolar Osteoplasty – *In vivo* Evaluation in a Preclinical Model developed a novel therapy concept based on 3D printing of biodegradable calcium phosphate-based materials and integration of osteogenic cells allowing fabrication of patient-specific, tissue-engineered bone grafts.

### Bioprinting

Using 3D printing to create the bone replacement helps to create a scaffold in the shape of the bone, and the printer can coat it with adult human stem cells, that are capable of developing into many different tissue types. The ink of the 3D printer has a polymer called polylactic acid and a gel-like substance called alginate. The polylactic acid provides the hard, mechanical strength of bone, while the alginate acts as a cushioning material for the cells. Thus, the printed product can be implanted in the body, where the scaffold will degrade and be replaced by new bone in about three months [29].

## CONCLUSION

3D printing technology is already gaining traction in the industrial industry, and it has numerous advantages for individuals, businesses, and governments. As a result, more data is needed to work on approaches to improve 3D printing acceptance. More knowledge about 3D printing technology will assist businesses and governments in upgrading. As a result, this paper will provide an overview of the many methods of 3D printing technologies, materials utilized in 3D printing, and finally, 3D printing applications.





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| <p><b>Figure 1: 3D Printed custom trays</b></p>   | <p><b>Figure 2: Laser sintered CoCr Crowns</b></p>  |
|    |   |
| <p><b>Figure 3: 3D Printed complete denture.</b><br/>Image from <i>Digital Denture Evolution: CAD-CAM and 3D Printed Dentures</i> by Piero Venezia, 2019.</p> | <p><b>Figure 4: Cranioplasty and orbital rim implants in titanium or PEEK fitted to a 3D printed SLS model</b><br/>(Courtesy of <a href="http://www.cavendishimplants.com">www.cavendishimplants.com</a>)</p> |





## Foot Arch in Subjects with Osteoarthritis of Knee: A Review

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### ABSTRACT

Knee malalignment causes excessive loading of the knee resulting in greater compressive forces on the knee joint. As a result of the changes in mechanical alignment caused by chronic knee osteoarthritis, abnormal ankle and foot characteristics are more likely to emerge. Hence the assessment of the foot posture becomes important in patients with OA knee. Out of the 38 studies selected, 8 were reviewed. Comparisons were made between the groups for the analysis of the association of foot posture with osteoarthritis of the knee. Studies having subjects with other concurrent hip pathologies, congenital foot or knee deformities or previous surgeries were excluded. With the help of search strategies 38 studies were identified, and a total of 15 potentially relevant studies remained. After these studies were reviewed with the inclusion criteria to determine if they should be reviewed, 8 studies remained, and the other 30 studies were excluded from the review. This review concludes that significant positive correlations were emphasized between osteoarthritis of the knee and foot posture changes. Subjects with medial compartment OA demonstrated pronated feet, and those with lateral compartment OA demonstrated more supinated feet.

**Keywords:** malalignment, mechanical, alignment, compartment OA



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## INTRODUCTION

Knee osteoarthritis (OA) affects about 10% of persons over the age of 55 and is a leading source of pain and physical disability in the elderly [1]. At least half of the 55 percent of men and women who have knee pain have radiographic knee osteoarthritis (OA), and many more have evidence of cartilage destruction that may be seen on magnetic resonance imaging (MRI) scans [2]. The medial compartment of the knee transmits more forces across the knee joint than the lateral compartment while walking, and higher medial compartment loading has been reported in individuals with knee OA. Gait mechanics, specifically knee adduction moments, have been linked to the advancement of medial compartment knee OA. [3] Because of the changes in mechanical alignment caused by chronic knee osteoarthritis, abnormal ankle and foot characteristics are more likely to emerge. [4] Treatment options for knee OA have been recommended, such as foot orthoses, knee braces, and footwear, to decrease the knee adduction moment and, as a result, the stress on the medial compartment [3,5,6].

Knee malalignment causes excessive loading of the knee resulting in greater compressive forces on the knee joint. The foot is considerably more important in absorbing mechanical forces from the ground during contact and in aligning posture and joint mobility at the knee, hip, and ankle joints [7]. The posture, as well as the mobility of the foot, knee, and hip, are coupled within a closed kinematic chain during most of the weight-bearing activities [2,8]. A position of flexion is assumed by the knee in the sagittal plane, abduction in the frontal plane, and rotation in the transverse plane. Subjects with genu varum, during walking, demonstrate increased pronation at the subtalar joint, suggesting that any deformities of the knee in the frontal plane can alter kinetic and kinematics of the foot during gait [9]. Thus, the assessment of the foot posture in patients with osteoarthritis becomes imperative in determining patients eligible for non-operative treatment [10]. Foot orthoses and footwear modifications hence receive special attention being the frequently suggested non-operative treatment of knee osteoarthritis [11,12].

There are various methods available to assess the foot posture and or foot arch including the navicular drop test, foot posture index, Staheli's arch index, navicular height, and normalized truncated navicular height [4,10,13]. there still exists controversy as to which method is reliable and more accurate than others in assessing the foot posture. Overall, various research have looked at the relationship between foot position and the probability of knee OA, as well as factors such knee pain and cartilage destruction. However, research on the impact of foot posture in knee osteoarthritis is limited [10]. Overall, it appears that a complete examination of the relationship between foot posture and objective clinical indicators of knee OA, as well as radiologic indications of knee alignment, is required. In light of the foregoing information, the purpose of this study was to determine the relationship between foot arch/foot posture and osteoarthritic knees.

## MATERIALS AND METHODOLOGY

The keywords that were used were: osteoarthritis, OA knee, foot arch, medial arch, and foot posture. After finalizing keywords, internet search was conducted on Pub Med and Google Scholar; the University library and research center were also approached for e-copy and possible hand search of articles. The criteria for inclusion of articles were all research designs like Systematic review, Meta-analysis, Randomized Control trials, Cross sectional studies, Narrative Reviews and editor's notes published in the English language, and full articles providing data on foot arches or foot posture in subjects with osteoarthritis of the knee.

### Inclusion Criteria

- Studies with exercises / rehabilitation programs described and initiated for OA knee along with treatment of foot muscles
- Studies with prescribed arch support





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#### Exclusion Criteria

- Previous surgeries on hip and or knee
- Patients with congenital/ acquired foot deformities prior to the development of OA knee

The articles included in the study were then appraised and reviewed

| SR. | Year/<br>Author   | Study  | Methodology   | Outcome<br>measures   | Results  | Conclusion  |
|-----|---|--|---|---|--|---|
| 1.  | Mazlum<br>Serdar<br>Akaltun et al<br>2021 <sup>14</sup> | Assessment of<br>foot posture<br>and related<br>factors in<br>patients with<br>knee<br>osteoarthritis  | This case-control<br>study included a<br>total of 115<br>patients with OA<br>and 77 healthy<br>controls.<br>Participants were<br>evaluated using<br>the WOMAC scale,<br>Visual Analog<br>Scale (VAS), and<br>the Beighton<br>criteria.<br>Radiological<br>assessments were<br>performed using<br>the Kellgren-<br>Lawrence grading,<br>condylar plateau<br>angle, and medial<br>tibiofemoral joint<br>width. The Foot<br>Posture analysis<br>was done to<br>classify foot as<br>supinated, neutral,<br>and pronated | 1.WOMAC<br>2.VAS<br>3.Beighton<br>criteria<br>4. Foot Posture<br>Index  | Foot posture<br>was<br>significantly<br>different<br>between the<br>patient and<br>control groups.<br>The WOMAC<br>total scores<br>were<br>significantly<br>associated with<br>foot posture<br>abnormality | Joint<br>hypermobilit<br>y and foot<br>posture are<br>the factors<br>that may<br>influence the<br>clinical<br>characteristic<br>s of knee<br>OA.                                  |
| 2.  | Gunawardan<br>a et al<br>2020 <sup>4</sup>              | The<br>relationship<br>between static<br>foot posture<br>and chronic<br>bilateral knee<br>osteoarthritis<br>among the<br>patients<br>attending<br>Department of<br>Rheumatology<br>and<br>Rehabilitation<br>(General), | A descriptive<br>cross-sectional<br>study was<br>conducted under<br>consecutive<br>sampling method<br>including 155<br>patients within the<br>age group of 40–<br>80, who were<br>clinically<br>diagnosed with<br>bilateral knee<br>osteoarthritis. The<br>foot posture of  | Foot posture was<br>evaluated using<br>two-foot<br>measures, Foot<br>Posture Index<br>(FPI) and Staheli<br>Arch Index<br>(SAI). | There was a<br>significant<br>difference<br>(P<0.05) for foot<br>posture changes<br>which were<br>evaluated using<br>SAI   | Altered foot<br>postures<br>were<br>common<br>among<br>chronic<br>bilateral<br>knee<br>osteoarthritis<br>patients in<br>Sri Lanka.<br>Therefore, it<br>is<br>recommende<br>d that |





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|    |                                      | National hospital, Sri Lanka   | these patients was evaluated   |  |   | assessment of foot posture in knee osteoarthritis patients.  |
| 3. | Jade M. Tan et al 2020 <sup>15</sup> | Associations of foot and ankle characteristics with knee symptoms and function in individuals with patellofemoral osteoarthritis | In this cross-sectional study, weight bearing ankle dorsiflexion range of motion, foot posture and midfoot mobility and obtained patient-reported outcomes for knee symptoms and function were measured. | 1. Foot Posture Index<br>2. Midfoot mobility (via the Foot Measurement Platform)<br>3. 100mm visual analogue scales<br>4. Anterior Knee Pain Scale [AKPS], 5. Knee injury and Osteoarthritis Outcome Score<br>6. Repeated single step-ups<br>7. double-leg sit-to-stand to knee pain onset | 188 participants with symptomatic PFOA were included in this study. Lower weight bearing ankle dorsiflexion range of motion had a small significant association with higher average knee pain and maximum knee pain during stair ambulation and lower scores on the AKPS. Higher FPI scores and greater midfoot mobility were significantly associated with fewer repeated single step-ups and double-leg sit-to-stands, to knee pain onset, although the magnitude of these relationships was small. | Lower weight bearing ankle dorsiflexion range of motion, a more pronated foot posture, and greater midfoot mobility demonstrated small associations with worse knee pain and greater disability in individuals with Patello femoral osteoarthritis |
| 4. | Jade M. Tan et al 2020 <sup>15</sup> | Associations of foot and ankle characteristics with knee symptoms and function in  | In this cross-sectional study, weight bearing ankle dorsiflexion range of motion, foot posture and midfoot mobility  | 1. Foot Posture Index<br>2. Midfoot mobility (via the Foot Measurement Platform)<br>3. 100mm visual  | 188 participants with symptomatic PFOA were included in this study. Lower weight bearing  | Lower weight bearing ankle dorsiflexion range of motion, a   |





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|    |   | individuals with patellofemoral osteoarthritis   | and obtained patient-reported outcomes for knee symptoms and function were measured.  | analogue scales<br>4. Anterior Knee Pain Scale [AKPS], 5. Knee injury and Osteoarthritis Outcome Score<br>6. Repeated single step-ups<br>7. double-leg sit-to-stand to knee pain onset | ankle dorsiflexion range of motion had a small significant association with higher average knee pain and maximum knee pain during stair ambulation and lower scores on the AKPS. Higher FPI scores and greater midfoot mobility were significantly associated with fewer repeated single step-ups and double-leg sit-to-stands, to knee pain onset, although the magnitude of these relationships was small. | more pronated foot posture, and greater midfoot mobility demonstrated small associations with worse knee pain and greater disability in individuals with Patello femoral osteoarthritis             |
| 5. | Sayali Tribhuvan et al 2019 <sup>17</sup> | Correlation between foot posture index (FPI) and knee osteoarthritis (OA) in elderly individuals | The participants were first assessed by the principal investigator and radiological findings were used to determine the grades of OA according to the Kellgren and Lawrence system for classification of knee osteoarthritis. They were then evaluated for foot posture with the help of Foot Posture Index scale that rates weight bearing | 1. Foot Posture Index  | In total 65% participants had pronated foot, 7% participants had highly pronated foot, 7% participants had supinated foot, 5% participants had highly supinated foot whereas 16% participants had normal foot posture. The Karl Pearson correlation coefficient (r) for the above study  | The study concluded that, there is positive correlation between knee osteoarthritis (OA) and foot posture index. The abnormal foot posture was commonly seen in patients with OA Knee grade 3 and 4 |





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|    |  |   | foot posture (in bilateral stance) according to series of clinical observational criteria   |  | is 0.43, R squared value is 0.18 and the two tailed p value was <0.0001 and thus the result shows extreme significance.   |   |
| 6. | Shalmali et al 2017 <sup>18</sup>        | Prevalence of altered foot posture in osteoarthritis of knee  | A cross sectional study done on 100 Osteoarthritis patients diagnosed with ACR clinically diagnostic criteria. Patients were evaluated using NDT and AI.  | Navicular Drop Test (NDT) Arch Index (AI). | Patients showed equal amount of pronation and supination i.e. 36%, while 28% had no alteration in foot posture. Medial compartment had 19.20% pronated foot due to knee adduction moment arm. 28.12% had supinated foot in order to decrease load on lateral compartment and to delay further degenerative process. | The study concluded that medial compartment OA and lateral compartment OA showed more pronated and supinated foot type respectively |
| 7. | F.E. Abourazzak et al 2014 <sup>10</sup> | A Positive Association Between Foot Posture Index and Medial Compartment Knee Osteoarthritis in Moroccan People | Two groups participated in the study: a knee OA group and an age-matched and gender-matched healthy control group. The OA group included one hundred patients whose X-ray was positive for the medial compartment OA. The control group | 1.Foot posture index<br>2.Navicular height | Patients group have more pronated foot for FPI, more flat foot, and less pes cavus than the control group. However, there was no significant difference between the groups in the navicular   | They concluded that Pronated foot posture and flat foot are significantly associated with medial compartment knee osteoarthritis    |





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|    |  |  | included eighty participants. The foot posture, medial arch was measured in both the groups.   |  | height. In multivariate statistical analysis, pronated foot in FPI, and pes cavus had a significant correlation with the knee osteoarthritis.   |  |
| 8. | Pazit Levinger et al. 2010 <sup>13</sup> | Foot posture in people with medial compartment knee osteoarthritis | Foot posture of 32 patients with clinically and radiographically-confirmed OA predominantly in the medial compartment of the knee and 28 asymptomatic age-matched healthy controls was investigated. | 1.Foot posture index<br>2.Vertical navicular height and drop<br>3.Arch index | Significant differences were found between the control and the knee OA groups in relation to the FPI, navicular drop and the arch index . No significant difference was found for vertical navicular height | People with medial compartment knee OA exhibit a more pronated foot type compared to controls. |

**RESULT**

With the help of search strategies 38 studies were identified; following the removal of duplicates from multiple databases and the screening of titles and abstracts, a total of 15 potentially relevant studies remained. After these studies were reviewed with the inclusion criteria to determine if they should be reviewed, 8 studies remained, other 30 studies were excluded from the review.

**DISCUSSION**

Musculoskeletal disorders such as knee osteoarthritis have an impact on the mechanical alignment and kinetics of the adjacent structures of the lower limb.[4]Hence the assessment of foot postures in subjects with Osteoarthritis of knee becomes imperative. In this review, a total of 38 studies were identified using different search strategies. Out of these, a total of 15 potential studies were reviewed with the inclusion criteria to determine if they should be reviewed. 8of these studies remained, whilst the other 30 studies were excluded from the review.

The Foot Posture Index is a reliable clinical tool with high inter-item consistency. It quantifies the degree to which a foot can be regarded to be pronated, supinated, or neutral. Out of the 8 reviewed studies, 7 studies mentioned above, used Foot Posture Index as an outcome to measure the foot posture. [10]Apart from foot posture index, the other methods that were used in some studies to assess the foot arch/ posture were navicular drop, navicular height, and Arch index. Most of the studies showed significant correlation of the foot arch with foot posture index.[4,10,13,14,15,17]



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A case-control study compared the foot postures of healthy controls with those of subjects with knee osteoarthritis using the foot posture index. The three groups formed after the foot posture assessment i.e.; pronated, neutral, and supinated feet. The results demonstrated that the increased rate of neutral foot posture was lower, while the rate of supinated and pronated foot postures was higher in the patients with knee OA. Abnormal foot posture was found to be associated with joint hyper mobility and WOMAC-total scores.[14] Whereas, a study by Shalmali et al concluded that subjects with medial compartment OA showed more pronated feet, and those with lateral compartment OA showed more supinated feet. [18]The reasons for the same might be that due to cartilage wear and tear, medial compartmental osteoarthritis increases the knee adduction moment arm, further stressing the medial compartment. Thus, as compensation, to reduce the adduction moment, there occurs pronation at the subtalar joint, thus shifting the pressure to the lateral side and decreasing pressure on the medial compartment. Whereas, due to degenerative changes, the line of gravity passes through the lateral compartment producing an adduction moment at the knee causing lateral tibial torsion. For compensation, there occurs supination at the subtalar joint, reducing load over the lateral compartment [2,10,13,18,19,20].

A study conducted by DadiaSadbhawal and Singh Sonia concluded that grade 3 and 4 of knee osteoarthritis exhibit a pronated or highly pronated foot, while near-normal foot arch was observed in grades 1 and 2 of knee OA.[9]In patients with osteoarthritis of knee, the most common postural malalignment seen is Genu Varum. This may further lead to compensatory foot pronation enabling the foot to planti grade during weight bearing.[21]The results of a study by Gunawardana et al demonstrated that 49.7% of patients with knee osteoarthritis exhibited flat feet at least in one foot. [4]In contrast to this, a study by K Douglas et al concluded that the association of planus foot with cartilage damage in the medial tibiofemoral compartment is not dependent on the presence of varus knee malalignment. The study suggested that association of planus foot morphology with frequently occurring knee pain may be similarly independent of the presence of either varus or valgus knee malalignment. [2] Out of the discussed 8 studies, 3 studies used the method of navicular height for measurement of foot arch. In all the studies, the navicular height correlated with the results of the foot posture index. Although, clinically it is more appropriate to normalize the height of the navicular to the length of the foot for each subject which permits comparison with other individuals with different foot size. [22] Utilization of this method for the assessment of foot arch of the subjects may prove to yield better results than those of navicular height alone.

Therefore, assessment of the foot postural changes of patients with knee Osteoarthritis may facilitate the health care professionals' knowledge of the possible role of the footwear modifications and foot orthoses on proper alignment and function of the lower limb. [4] For the prevention of further pronation and supination at the ankle joint, emphasis must be laid on the use of wedges in the foot over a particular side to offload that compartment of some weight-bearing forces. In medial knee OA, there is a rise in adduction moment. The use of lateral wedged insoles has probable benefits in correcting the adduction moment, thus correcting the biomechanical alignment of the lower limb, whereas in lateral knee OA, frontal loading of knee can be decreased by medial wedges inserted into shoes or amalgamated with ankle orthoses. [23,24,25]. Hence, Foot Posture Index is a clinical tool that evaluates the foot posture in a quick, cost effective and reliable manner

**CONCLUSION**

This review concludes that significant positive correlations were emphasized between osteoarthritis of the knee and foot posture changes. Subjects with medial compartment OA showed more pronated feet, and those with lateral compartment OA showed more supinated feet. It is recommended that assessment of the foot posture in patients with knee osteoarthritis is an essential component in clinical practice in order to minimize further complications and introduce corrective orthotic and footwear modifications as an added management strategy.





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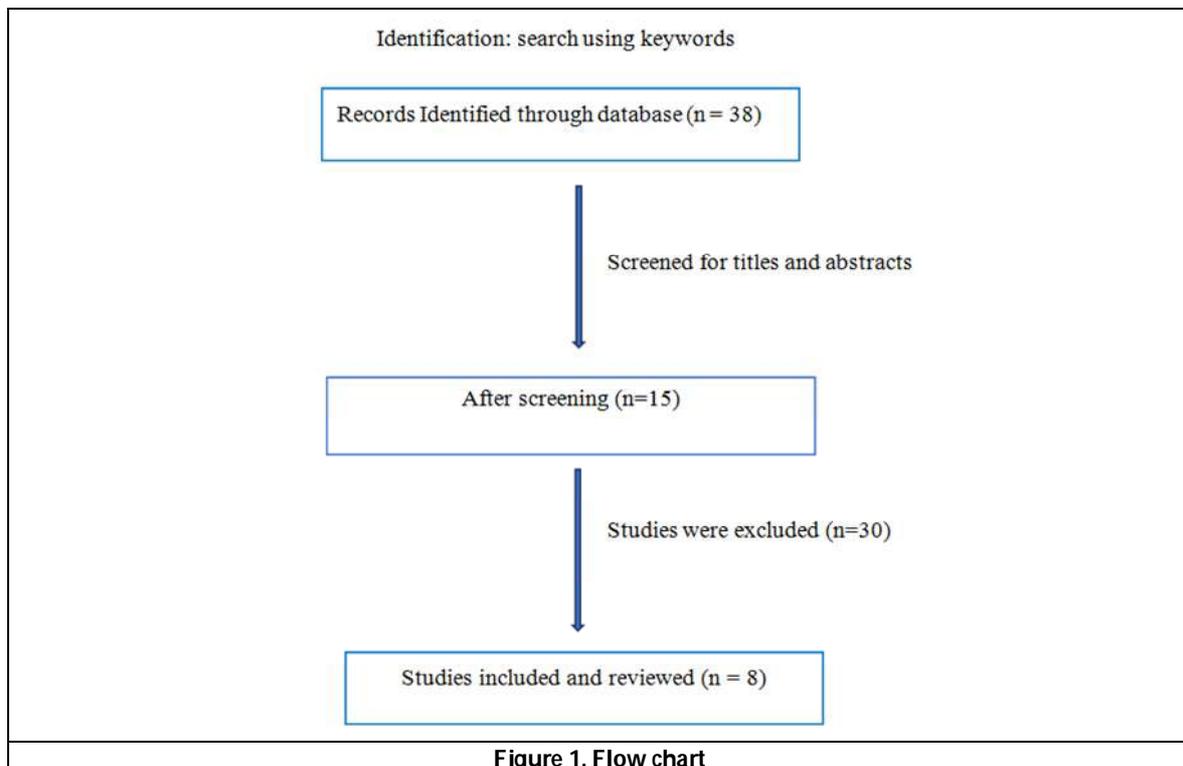
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## Formulation and Evaluation of Herbal Fairness Cream

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### ABSTRACT

The aim of the study was to formulate and evaluate a herbal fairness cream using *Aloe vera* and *Carica papaya* extracts. Different varieties of oil in water (O/W) namely F1 to F5, were formulated using ethanol extracts of *Aloe vera* (leaves) and papaya (fruits) as well as in various percentages. All five formulations (F1 to F5) were evaluated for several parameters such as pH, viscosity, spreadability, and stability as well as irritancy test. Spreadability, consistency, homogeneity, appearance, pH, ease of removal, and signs of phase separation were all good in formulation F3. During irritancy tests, the formulation F3 displays no redness, edema, inflammation, or irritation. These products are safe to use on the skin.

**Keywords:** *Aloe vera*, *Carica papaya* and Herbal fairness cream

## INTRODUCTION

### Herbal fairness cream

Cosmetics are in high demand. This growth is driven by the availability of novel components, the financial incentives for generating successful products, and the requirement to maintain a high level of quality in consumer formulations. In terms of performance, a formulation's quality should meet the needs of consumers. A greater understanding of skin physiology is required for the plant parts employed in cosmetic preparation. Cosmetics are products designed to be applied to the body for the purposes of cleaning, beautifying, or changing one's look, as well as improving one's beauty. Cosmetics are created to combat wrinkles, acne, and oil secretion. Skin protection, sunscreen, antiacne, antiwrinkle, and antiaging compositions are created with a variety of natural and synthetic components. Cosmetic development includes qualities such as antioxidant, anti-inflammatory, antiseptic, emollient,





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and antibacterial. According to market data, the herbal trade is on the rise, with the herbal cosmetics business playing a crucial part in fueling this global need for herbals [1].

- Herbal products are safe because they are made from natural ingredients.
- The component with medicinal qualities that shows good topical effects and provides protection against degenerative skin disorders.
- The substance with therapeutic qualities that has excellent topical effects and protects against degenerative skin disorders.
- Cosmeceuticals improve the appearance of the skin by giving essential nutrients.

Herbal cosmetics account for about Rs 2000 crores of the country's entire cosmetics market, which is estimated to be worth Rs 2000 crores. The cosmetics market as a whole is rising at a rate of 20-25 percent every year. Herbal cosmetics accounted for nearly 60% of this growth. As a result of the foregoing, the study's ultimate goal is to develop a herbal cosmetic formulation in the form of a face cream. The practise of employing chemicals to lighten skin tone or offer an even skin tone or create an even skin complexion by decreasing the concentration of melanin is referred to as herbal fairness products.<sup>2</sup> "Cosmetics" comes from the Greek word "Cosmetics," which meaning "to decorate." Cosmetics are materials that are used to enhance a person's appearance. From ancient times, measures are being used to increase beauty. Cosmetics are products that retain contact with the body's external portions while inflicting no harm. Maintains the skin's structure and look while also protecting it from UV radiation. Cosmetics are used to remove filth and preserve a healthy appearance without interfering with our bodies' natural functioning. Cosmetic items include skin creams, lotions, and shampoos.

### **HERBAL COSMETICS**

The shell is named "Herbal Cosmetics" because more herbal substances are employed to provide certain cosmetic benefits. Herbal medicines are in high demand due to their absence of negative effects. Herbal cosmetics are manufactured entirely from herbs and bushes. Natural herbs have no negative effects on human skin. Cosmetics are now commonly utilized to improve their appearance. Cosmetics are used to prepare and enhance their appearance [3].

#### **What does the fairness cream do?**

- Reduces pigmentation by inhibiting the synthesis of melanin.
- Melanocytes are being destroyed.
- Tyrosinase activity is inhibited, and so melanin synthesis is inhibited.

#### **What should be the desired qualities of fairness cream?**

- Pleasant odour and colour
- Must be aesthetically appealing
- Easy to spread, and apply
- Easy penetration
- Should be non-oily /non-greasy after application
- Impart skin lightening
- Improve complexion
- Render moisturization
- Impart hydration
- Render nourishment
- Well tolerance
- Non-allergenic

### **TYPES OF HERBAL CREAM**





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- Cold cream
- Cleansing cream
- Night cream
- Nourishing cream
- Vanishing cream
- Fairness cream
- Moisturizing cream
- Sun burn cream
- Anti-acne cream

#### **Cold cream**

Cold cream is an emulsion in which the proportion of fatty and oily material predominated, although when it is applied to the skin a cooling effect is produced due to slow evaporation of the water contained in the emulsion.

#### **Cleansing cream**

These are cosmetic preparations used to be applied on skin for removing the facial makeup. They are also used to improve the healthy and good appearance to the skin. They contains other ingredients which helps to soften, lubricate or protect the skin.

#### **Fairness cream**

Fairness creams to improve the complexion of person. Irrespective of whether they have dark or fair complexion.

#### **Moisturizing cream**

Moisturizer is a cosmetic preparation used for protecting, moisturizing and lubricating the skin. Water contained in the cream is lost by evaporation when the cream is applied to the body. This medication is used as a moisturizer to treat or prevent dry, rough, scaly, itchy skin and minor skin irritations (such as skin burns from radiation therapy)

#### **Vanishing cream**

Vanishing creams are oil in the type of emulsions. When applied on the surface of the skin, they spread thin oil-less film which is not visible to the naked eye. Hence, they are called vanishing creams[4].

#### **Ideal properties of herbal based cream**

- It must be inert and compatible with other ingredients.
- There should be no microbiological contamination.
- It must be non-toxic.
- It must be cost-effective.
- All of the creams rheological qualities should be preserved, and it should be cleaned with water and stain free.
- It should be simple to use and handle.
- The storage condition should be stable.

#### **Advantage of herbal fairness cream:**

- Lightens spots
- Provides additional sunprotection
- Prevents oxidative damage
- Slows the ageing process





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#### Disadvantages of herbal fairnesscream

- The majority of herbal drugs are difficult to come by, and the manufacturing procedure is time-consuming and complicated.
- No pharmacopoeia specifies any particular process or substance for use in herbal cosmetics.

#### TOPICAL DRUG DELIVERY SYSTEM

Topical dermal delivery is described as the application of a system to the skin directly at the affected area in order to transfer a medicine into the dermis and underlying tissue at the application site. Topical drugs are exclusively meant for external use. Whereas topical dermatology products are designed to have a localized effect on one or more layers of skin. Anti-inflammatory, antifungal, karyolytic agent, local anaesthetic etc., but some medication for this topical product may enter the systemic circulation inadvertently[5].

#### Factors affecting topical absorption of the drug

##### Physiological factors

- The thickness of the skin
- The pH of the skin.
- The amount of lipids in the skin
- The blood flow
- Skin hydration
- Hair follicle density
- Skin inflammation
- Illness
- Sweat gland density

##### Physiochemical factors

- Effect of vehicle
- Partition coefficient
- Molecular weight
- Degree of ionization[6].

#### THE SKIN

The skin is made up of several layers. The layer above the epidermis is called the epidermis, and the layer beneath the epidermis is called the dermis. The dermis is made up of blood vessels, hair follicles, sweat glands, and sebaceous glands. Subcutaneous fatty tissues exist beneath the dermis. Hair bulbs protrude into these fatty tissues.

#### Epidermis

It is the outermost layer of the skin, which is approximately 150 micrometers thick. Cells from the lower layer of the skin travel upward during their life cycle and become flat dead cells of the corneum. The source of energy for the lower portions of the epidermis is also glucose, and the end product of metabolism, lactic acid, accumulates in the skin.

The layers of the epidermis are:

- Stratum Germinativum (Growing Layer)
- Malpighian Layer (Pigment Layer)
- Stratum Spinosum (Prickly Cell Layer)
- Stratum Granulosum (Granular Layer)
- Stratum Lucidum
- Stratum corneum (Horny Layer)





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### **Stratum Germinativum**

Basal cells are nucleated, columnar. Cells of this layer have high mitotic index and constantly renew the epidermis and this proliferation in healthy skin balances the loss of dead horny cells from the skin surface.

### **Malpighion Layer**

Melanocytes, which manufacture and transfer melanin granules to keratinocytes for pigmentation and radiation protection, are also found in the basal cell.

### **Stratum Spinosum**

The cells in this layer are formed by morphological and histochemical changes in the bottom layers of the cells as they progress upward. The nuclei of the cells contract and flatten. Fine prickles join them and form the desmosomes, which serve as an intercellular bridge. The epidermis is kept in good shape by these linkages.

### **Stratum Granulosum**

Above the keratinocytes is this layer. The keratinohylline granules are a basic staining particle that they produce. This keratogenous or transitional zone is a hotbed of metabolic activity and morphological transformation.

### **Lucidum Stratum**

A thin, transparent layer grows immediately above the granule layer in the palm of the hand and the sole of the foot. Non-nuclear cells are present.

### **Stratum Corneum**

Epidermal cells form the most superficial layer of the epidermis, stratum corneum, at the end of differentiation. The body friction surface, such as the palms and soles, adapt for weight bearing. While the rest of the body's membranous stratum corneum is flexible but impermeable. The membranous horny layer is at least 40 times thicker than the horny pads (sole and palm)

### **Dermis**

Between the epidermis and the subcutaneous fatty region is a nondescriptive region. It consists mostly of a dense network of structural protein fibres, such as collagen, reticulum, and elastin, contained in a mucopolysaccharidic 'ground material' semigelmatrix. Fibrous tissue under the dermis opens up and unites with fat-containing subcutaneous tissue. In dermal metabolism, protein synthesis is crucial.

### **Subcutaneous tissue**

Tissue beneath the skin, this layer is made up of a sheet of fat- rich areolar tissue called superficial fascia, which connects the dermis to the underlying structure. Only the superficial region has large arteries and veins.

### **Skin Appendages**

The skin contains hair follicles and sebaceous gland-like regions, as well as two types of sweat glands: eccrine and apocrine. These are referred to collectively as skin [7].

## **MATERIALS ANDMETHODS**

### **List of excipients**

## **METHODOLOGY**

### **Organoleptic properties:**

A natural substance's organoleptic quality refers to its appearance, odour, colour, and taste. The initial stage of the study is to characterise the attributes, which aids in the primary identification of the natural substance as well as determining the probability of patient acceptability of the raw materials' odour, taste, and colour, as well as their

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likely inclusion in the final dose form. Changes in the colour and odour of the raw material used in the formulation might sometimes indicate that the formulation's stability has deteriorated.

**IR spectra analysis**

The spectrum was recorded between the wavelengths of 4000 and 400cm<sup>-1</sup>. An IR spectrum was obtained using an ATR-FTIR spectrophotometer after a sample of the drug was immediately put into the cavity of the sample holder.

**Compatibility studies****Physical compatibility studies**

The physical mixture of drug and excipient was kept in a petri dish and stored at normal and high temperatures in a stability chamber at 45°C/75 % RH for a week, and the samples were checked for any physical changes such as discoloration, odour, etc.

**Chemical compatibility studies**

The spectra was recorded in the wave number range of 4000 to 400cm<sup>-1</sup> for these compatibility investigations, which were conducted using an ATR-FTIR spectrophotometer. The natural and excipients were completely mixed in the mortar until the mixture was complete. The sample was then taken from the mortar and placed in the sample holder's cavity, where the spectrum was recorded.

**FORMULATION DEVELOPMENT OF HERBAL FAIRNESS CREAM**

The herbal fairness cream formulation using papaya, aloe vera.

**PREPARATION OF ALCOHOLIC EXTRACT OF CRUDE DRUG**

In a conical flask, 2 g of crude drug papaya fruit dried powder was added, then by 100 ml of ethanol, and the flask was covered with aluminium foil. After that, the mixture was macerated for 5 days.

**Preparation of Herbal Fairness Cream**

- A cream based on an oil in water (O/W) emulsion (semisolid formulation) was developed.
- The emulsifier stearic acid, as well as other oil-soluble components such as cetyl alcohol, olive oil, and bees wax, were dissolved in the oil phase (part A) and heated to 75°C.
- The sodium benzoate, zinc oxide, triethanolamine, 2gm papaya, and 2gm *Aloe vera* preservatives and other water soluble components were dissolved in the aqueous phase (part B) and heated to 75°C.
- After heating, the aqueous phase was gradually added to the oil phase, stirring constantly until the emulsifier cooled.
- Finally, in a particular cream formulation, a flavouring agent was added.

**EVALUATION OF FORMULATED CREAM****Appearance**

The colour, look, and transparency of the formulated herbal fairness cream were assessed visually. Rubbing the cream between the fingers to check for smoothness, clumping, roughness, and uniformity stimulated the smoothness of the cream.

**pH of the cream**

The pH of the cream was measured using a digital pH metre by completely immersing the glass electrode in the cream system. The test was done three times and the average of the three results was recorded.





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### Determination of Viscosity

The viscosity was determined using a Brookfield viscometer with spindle no. 4 spinning at 50 rpm at 25°C. The tests were conducted in triplicate, with the average of three readings recorded.

### Dyetest

The cream and the scarlet crimson dye are combined. Using a microscope, place a drop of cream on a microscopic slide, cover it with a cover slip, and observe it. The ground is colorless if the dispersed globules are red. It's an o/w variety of cream. When using a cream without type, the dispersed globules appear white but turn scarlet.

### Homogeneity

Visual appearance and touch were used to check the uniformity of the formulation. The colour, pearlescence, and roughness of the cream were rated.

### Type of smear

It was determined by applying the cream on the skin surface of volunteer. After application of cream, the type of film or smear formed on the skin were checked.

### Removal

The ease with which the cream applied could be removed was tested by rinsing the applied region with tap water.

### Determination of emolliency

After applying a predetermined amount of cream, the emolliency, slipperiness, and amount of residue left were assessed.

### Determination of spreadability

Place around 3gm of sample between two glass slides and press them together to generate a film of uniform thickness by inserting 1000gm. After 5 minutes, a weight (10gm) was placed to the pan, and the top plate was pulled with the help of a line tied to the hook. The time it takes for the top glass slide to move over the moving plate by 10cm is recorded. The formula was used to calculate the spreadability(s).

$$S = M \times L / T$$

Where,

S-Spreadability

M- weight tied to upper glass slide-length moved on a glass slide

T- Time taken

The determination were carried out in triplicate and the average of three readings was recorded.

### Determination of microbial content

1g of cream was dissolved in nutritional agar culture, and the volume was adjusted to 100 ml using the same medium. About 10mL of material was placed in 100mL of nutritional agar culture broth and incubated at 43-45°C for 18-24 hours. On a plate with nutrient agar culture, a subculture was established and incubated for 18-24 hours at 43-45°C. The presence of E.coli is indicated by the formation of red, generally non-mucoid colonies of gram negative rods showing as reddish zones, whereas the absence of E.coli is shown by the absence of red, generally non-mucoid colonies of gram negative rods appearing as reddish zones.

### Irritancy Test

On the left hand dorsal, draw a 1-sq.-cm area. The cream was applied to the designated area, and the amount of time it took to do so was recorded. It was evaluated for irritability, erythema, and reported at regular intervals upto 24 hours.



**Uma Maheswari et al.,****STABILITY STUDIES****Introduction**

The time from the date of manufacture and packaging of the formulation until its chemical or biological activity is not less than a set level of labelled potency and its physical properties have not changed considerably or deleteriously can be characterised as the drug's stability. The stability of the active component must be a primary consideration in evaluating whether or not a dosage form should be accepted or rejected in any design or review of medication dosage forms.

**The objective of the study**

Stability testing enables recommended storage settings, re-test intervals, and shelf- lives by predicting how the quality of a drug ingredient or drug product changes over time under the effect of various environmental elements such as temperature, humidity, and light. Observing the rate at which a product degrades under typical room temperature takes a lengthy period in most cases. The notion of expedited stability investigations is used to avoid this unfavourable delay. The international conference on harmonization (ICH) guidelines titled "stability testing of new drug substance and products" (Q1A) describe the stability test requirements. The present work stability study was carried out for the optimized formulation at  $40^{\circ}\text{C}\pm 2^{\circ}\text{C}/75\% \text{RH}\pm 5\% \text{RH}$  for one month.

**RESULT AND DISCUSSION****Pre-formulation studies****Organoleptic properties**

The present study was carried out to develop herbal fairness cream by using herbal ingredients. The physical description/organoleptic quality of the drug is the first step in recognising the drug substance. It aids in determining the drug's suitability for formulation into the desired dosage form. This also aids in the evaluation of patient acceptability variables such as colour, nature, odour, and taste, which leads to improved patient compliance.

**Papaya powder**

- Colour -paleorange
- Odour- pungent odour
- Taste -sweet

**Aloe vera gel**

- Colour-white
- Odour- rotten onion or garlic
- Taste -bitter

The API was examined for colour, odour, nature, and taste, and it was observed in accordance with the monograph. Based on the findings, it was determined that the cream formulation was satisfactory, and that patient compliance would not be affected.

**IR spectrum Analysis**

IR spectrum of papaya

**Physical compatibility studies**

It can be proven that no colour changes occur in the physical mixture as a result of the physical compatibility research, and it can be inferred that all excipients were compatible with natural powder. Excipients had no interaction with herbal powder, according to the compatibility testing, which was conducted at  $40^{\circ}\text{C}/75$  percent RH.





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### **Chemical compatibility studies**

The ATR-FTIR spectrum of the pure drug and manufactured cream was compared to the spectrum of the drug with excipients, and the spectrum was recorded in the wave number range of 4000 to 400cm<sup>-1</sup>. These excipients were combined in herbal components based on their functional category. This implies that the medicine is compatible with the formulation's components, as evidenced by the results in figure.

### **IR spectrum Analysis**

#### **IR spectrum of herbal fairness cream**

#### **Discussion**

ATR-FTIR spectroscopy was fixed at a range of 4000-400<sup>-1</sup>. There is no interaction between the drugs and excipients.

### **Evaluation of cream formulation**

#### **Appearance**

The appearance, colour, and texture of the made cream were all checked visually. All of the formulations were white in colour, had a smooth viscous texture, and were consistent without lumps.

#### **pH of the cream**

pH measurements of the produced cream were taken using a digital pH metre by immersing the glass electrode completely in the cream system and covering it. The outcomes of the study are summarised in the table below (Table no:7.1)

#### **Discussion**

pH is one of the major evaluation factors in the cream preparation purpose of avoiding the irritation of the skin upon the application.

#### **Determination of viscosity**

The viscosity of the cream was in the range of 27021-27053 cps, indicating that it was spreadable. F2, F3, and F4 were easily spreadable on skin with a small degree of shear in our investigation, however F1 and F5 were not. However, F3 has a better spreadability than the other formulations.

#### **Discussion**

The above results shows the viscosities of all the formulations ranging from (25021) to (27042) cps.

#### **Dye test**

All of the formulations were o/w type emulsion creams, according to this colour. In an o/w type emulsion, however, formulation (F3) appears to be more stable. As a result, we've chosen F3 cream base for further investigation.

#### **Homogeneity**

All base formulations generate a homogeneous cream dispersion. This was confirmed by sight and touch.

#### **Type of smear**

The type of smear that formed on the skin after applying the cream base was non- greasy.

#### **Removal**

The cream that had been put to the skin was simply removed by rinsing it off with tap water.

#### **Determination of spreadability**

The formula was used to determine the





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### Spreadability of the cream preparation

The spreadability of the cream was determined by its viscosity, which ranged from 6 to 13 cm in all formulations. Because the formulations are more consistent, the cream spreads readily with a tiny quantity of smear.

### Irritancy test

During irritancy tests, the formulation F3 displays no redness, edema, inflammation, or irritation. These products are safe to use on the skin.

### STABILITY STUDIES

The optimised formulation was subjected to a one-month stability testing at 40°C and 75 percent relative humidity, as per ICH recommendations. The physical and chemical properties of the cream did not alter much, according to the findings. As a result, it was discovered that the formulation (F3) is stable.

## CONCLUSION AND SUMMARY

- In the present study, an attempt was made to develop herbal fairness cream to provide safe and non-toxic to humans using natural ingredients.
- The physicochemical properties of the drug such as ATR-FTIR Spectroscopy, organoleptic properties, drug compatibility studies were investigated and confirmed.
- Natural ingredients such as papaya and *Aloe vera* were used to make herbal based cream formulations, which were then tested for appearance, pH, viscosity, spreadability, dye, homogeneity, smear, removal, irritancy and stability according to ICH requirements.
- The herbal fairness cream was evaluated.
- The cream formulation may be an effective, inexpensive.

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**Table 1. Skin [7] Materials**

| S. No | Materials            | Manufactures / Suppliers |
|-------|----------------------|--------------------------|
| 1.    | Papaya fruit powder  | Madura Herbals, salem    |
| 2.    | <i>Aloe vera</i> gel | VMCP, Salem              |
| 3.    | Olive oil            | VMCP, Salem              |
| 4.    | Rose oil             | VMCP, Salem              |
| 5.    | Triethanolamine      | VMCP, Salem              |
| 6.    | Cetyl alcohol        | VMCP, Salem              |
| 7.    | Bees wax             | VMCP, Salem              |
| 8.    | Zinc oxide           | VMCP, Salem              |
| 9.    | Stearic acid         | VMCP, Salem              |
| 10.   | Sodium Benzoate      | VMCP, Salem              |
| 11.   | Glycerol             | VMCP, Salem              |
| 12.   | Purified water       | VMCP, Salem              |

**Table 2. List of Equipments**

| Equipments               | Supplier/ Manufacturer                 |
|--------------------------|--|
| Brook field viscometer   | Brook field engineering laboratory USA |
| Digital pH meter         | Elco Pvt. Ltd.                         |
| Digital weighing balance | Scal tac, Mumbai                       |
| Mortar & Pestle          | Neutronic Pvt. Ltd.                    |
| Weighing balance         | Mettler Toedo                          |





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Table 3: Composition of herbal fairness cream

| SL. NO | INGREDIENTS           | F1  | F2  | F3  | F4  | F5  |
|--------|-----------------------|-----|-----|-----|-----|-----|
| 1.     | Papaya powder(mg)     | 2   | 2   | 2   | 2   | 2   |
| 2.     | <i>Aloe vera</i> (mg) | 2   | 2   | 2   | 2   | 2   |
| 3.     | Olive oil(mg)         | 5   | 4   | 3   | 2   | 1   |
| 4.     | Cetyl alcohol(mg)     | 1   | 1   | 1   | 1   | 1   |
| 5.     | Stearic acid(mg)      | 2   | 2   | 2   | 2   | 2   |
| 6.     | Bees wax(mg)          | 10  | 8   | 6   | 4   | 2   |
| 7.     | Zinc oxide(mg)        | 3   | 3   | 3   | 3   | 3   |
| 8.     | Sodium benzoate(mg)   | 2   | 2   | 2   | 2   | 2   |
| 9.     | Ethanol (ml)          | 5   | 5   | 5   | 5   | 5   |
| 9.     | Rose oil(ml)          | 2   | 2   | 2   | 2   | 2   |
| 10.    | Glycerin (ml)         | 6   | 5   | 4   | 3   | 2   |
| 11.    | Triethanolamine (ml)  | Q.s | Q.s | Q.s | Q.s | Q.s |
| 12.    | Purified water        | Q.s | Q.s | Q.s | Q.s | Q.s |

Table 4. ICH guidelines for stability study requirements

| Study        | Storage condition                               | Time period |
|--------------|---|-------------|
| Long term    | 25°C±2°C/60%RH±5RH<br>OR<br>30°C±2°C/65%RH±5%RH | 12 month    |
| Intermediate | 30°C±2°C/65%RH±5%RH                             | 6 month     |
| Accelerated  | 40°C±2°C/75%RH±5%RH                             | 1 month     |

Table 5. pH of herbal fairness cream

| Formulation | pH         |
|-------------|------------|
| F1          | 6.4        |
| F2          | 6.3        |
| <b>F3</b>   | <b>6.4</b> |
| F4          | 6.5        |
| F5          | 6.3        |

Table 6. Viscosities of cream preparations

| Formulation | Viscosity (cps) |
|-------------|-----------------|
| F1          | 25021           |
| F2          | 27031           |
| <b>F3</b>   | <b>27035</b>    |
| F4          | 27042           |
| F5          | 26032           |





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**Table 7. Determination of spreadability**

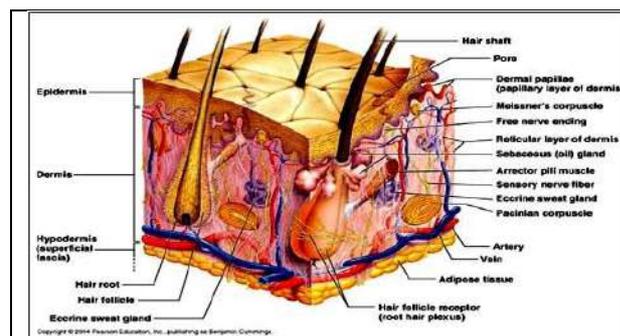
| Formulation | Spreadability (g.cm/sec) |
|-------------|--------------------------|
| F1          | 6.5                      |
| F2          | 6.3                      |
| <b>F3</b>   | <b>7.8</b>               |
| F4          | 7.1                      |
| F5          | 7.2                      |

**Table 8. Adverse effect of cream base**

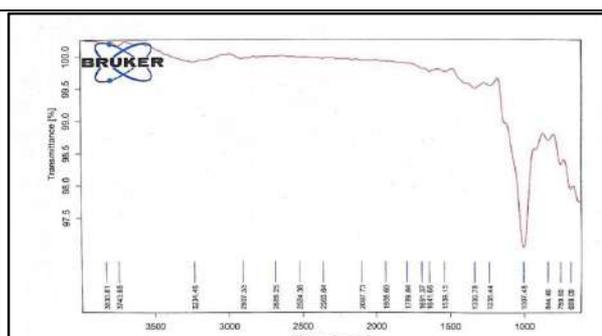
| Formulation | Irritant | Erythema | Edema |
|-------------|----------|----------|-------|
| F1          | NIL      | NIL      | NIL   |
| F2          | NIL      | NIL      | NIL   |
| F3          | NIL      | NIL      | NIL   |
| F4          | NIL      | NIL      | NIL   |
| F5          | NIL      | NIL      | NIL   |

**Table 9. Stability Parameter of selected formulation**

| Parameters          | Initial                 | After one month<br>40/75(°C/ RH) |
|---------------------|-------------------------|----------------------------------|
| Appearance          | Yellowish white colored | Yellowish white colored          |
| Feel on Application | Smooth                  | Smooth                           |
| Irritancy           | No irritancy            | No irritancy                     |
| Ph                  | 6.4                     | 6.3                              |
| Viscosity           | 27035                   | 27011                            |
| Spreadability       | 7.8                     | 7.5                              |



**Fig.1 Cross section of human skin**



**Fig. 2: IR spectrum of papaya**





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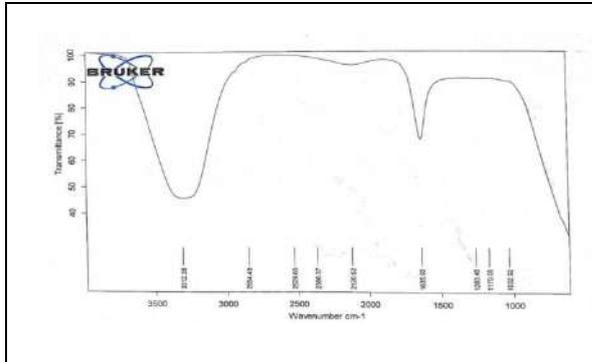


Fig. 3. IR spectrum of *Aloe vera* Compatibility studies

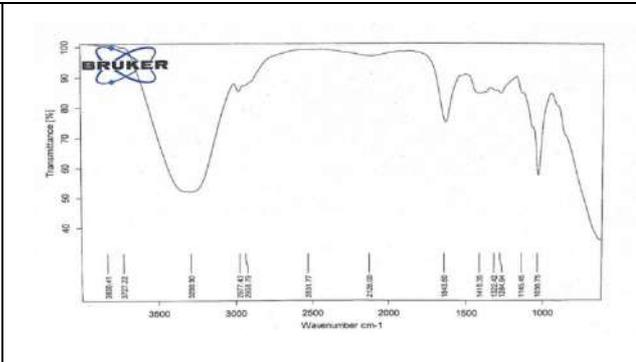


Fig. 4. IR Spectrum Analysis





## Proposal for construction of VUP at Benapur Junction, Jajpur Road, Jajpur, Odisha

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### ABSTRACT

In transportation engineering, a black spot is a 500-meter stretch of NH where either 5 or 10 fatalities occurred in the previous three calendar years. Present study is the apocalyptic black spot observed since extension of the National Highway (NH-16) at Benapur intersection at Panikoili Junction, which connects Keonjhar district Head quarter to Panikoili via Jajpur Road Junction and Ghatgon a tourist location (NH-20). A conflicting at-grade is existing, but not sufficient to level the risk and creating delay in travel time during accidents. The study of black spot warrants uninterrupted traffic data, geotechnical studies with soil data and decision of an alternate traffic routes. Moderation to accidents in Panikoili Chhak the engineering action plans under taken are physically visual survey of the area, collection of traffic census data, traffic study. For structural safety, the geotechnical survey such as grainsize analysis, Liquid limit, plastic limit, Proctor density test, and CBR test conducted. As a solution to the problem, the design and drawing of a *Vehicle under Pass* (VUP) has been under acceptance from a numerous alternatives. The design of a VUP, drawing and the respective cost estimate has been prepared and presented as the structural solution to the risks, accidents, identified.

**Keywords:** Black Spot, VUP, Accident, Transportation Engineering, Grade separated intersection

## INTRODUCTION

At Panikoili intersection, the Keonjhar-Ghatagaon-Panikoili Rd (NH 20) joins the Balasore-Bhadrak-Cuttack Rd (NH 16). If we start the survey at 0.000km chainage at Panikoili junction, the Benapur intersection, which has now become an accident black spot, is located at 6.853km chainage on NH 20 on the Keonjhar-Ghatagaon-Panikoili Rd. Now,



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there is an at-grade intersection, which creates more conflict and increases the likelihood of an accident at the intersection. It also lowers the vehicle's average highway speed. The Jajpur Rd-Vyasanagar- Duburi- Kalinganagar corridor is considered the state's primary industrial centre. The NH 20 runs right through these communities. Benapur junction is a junction that connects NH 20 and Jajpur Road, which has become a traffic hotspot. Vehicles entering from Jajpur road collide with passing vehicles on National Highway 20, which has become a major concern that has to be addressed promptly for better traffic flow. It's worth noting that vehicles travelling on NH 20 maintain an average speed of 80 kilometres per hour, with vehicles ranging from two-wheelers to large, heavily loaded lorries. As a result, collisions with these big vehicles inflict significant damage to the colliding cars, resulting in an increased risk of casualties as well as extended hours of waiting and traffic congestion for other passengers. Increased travel volume has resulted in traffic congestion, particularly in densely populated areas in shallow under pass [Belinda et al, 2019[1].

## LITERATURE REVIEW

NHAI of India/Odisha has identified 506/12 black spots in NH's in India out of which 261/4 are put right 261, 198 numbers under pipe line projects, 33 numbers are in tender stage and 14/8 in S/I stage (NHA Report 2020[2]). The risks related to voyage goal, time, place of tour, purpose and time of the trip, Convenience and comfort and personal safety are all factors of importance that helps the Underpass/Overpass work effectively (Bandara et al, 2020[3]). For design of RCC Box VUP structure, various loads, forces, earthquake force, and other parameters but not use bearings, observed from structural examination using STAAD Pro software (Malakondaiah et al., 2018[4]). The VUP, PUP and CUP's get flooded during rainy season in under passes which is determinant for vehicular traffic and the drivers, Maharani et al., 2019[5] , Jin et al., 2021[6]. Construction of underpasses considered cost-effective, and suitable for topographic uneven situations, that significantly reduce accidents, traffic congestions, traffic management, and systematic traffic circulation, Arun et al., 2018[7]. An underpass is a model that enables traffic to pass beneath a highway or railway track (KGM 1997). As a driver inside the car and as a pedestrian outside the vehicle, the "human" factor is a major factor affecting traffic Aksu 2014[8], Yumrutaş et al., 2021 [9]. Every year, it is estimated that about 30,000 people die and 10 to 15 million others are injured in traffic accidents around the world. According to accident data, 48 percent of accidents occur during the day and 52 percent of accidents occur at night. • THE THREE E'S FOR ACCIDENT PREVENTION 1. Engineering 2. Enforcement 3. Education or public education Cartenia et al., 2018[10], Deepdarshan, et al., 2020[11]. A bridge or an under pass is a structure that spans a physical impediment such as a body of water, a valley, or a road in order to provide passage over it, Tiwari, et al., 2016 [12] At-grade traffic management strategies are ineffective at some urban crossings because they are extremely crowded in spite of potential benefits, grade separation (underpasses or flyovers) at crossings is frequently overlooked as a congestion relief measure Dehnert et al., 2004[13]. Improper road planning that considers future capacity is one of the reasons of traffic congestion. As a result, traffic research is critical for improving existing facilities and anticipating future road needs Dey, et al, 2021[14].

## METHODOLOGY ADOPTED AND RESULTS

A drone investigation is being used to survey and identify traffic at the Benapur junction. Visual and physical parameter surveys are also conducted to determine the causes of hazardous accidents. Land features are investigated in the laboratory, and soil parameters are analyzed and evaluated for soil samples collected. Accident data is also collected in order to improve the VUP's analysis and design. For design of a VUP, the various codes, and reports to be followed are from IRC: 6-2017[15] (Standard specifications and code of practice for road bridges, updated amendment of 1957-58, 2006, 2014), IRC: 78-2014[16] and for the design, IRC: 112-2011[17]. The analysis and design of the various structural components of RCC Box type of Vehicular Underpass has done in the STAAD. However Pro-software is used for the traffic study (Table 1).



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Soil properties are test after collecting the soil samples and standard procedures are followed for various tests, Table 2, Table 3, Fig 1, Table 4, Table 5, Table 6 and Fig 2, Table 7 Demane et al., 2013[19], Ravindra et al., 2020 [20].

**CONCLUSIONS**

Traffic wardens are required to monitor traffic prior to the building of the underpasses, particularly during peak hours in the morning and evening. During construction, the emp This grade separated intersection, or VUP, will reduce the number of accidents as well as noise and air pollution. The VUP proposed shall maintain a smooth flow with safety of traffic with minimal disruption.

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**Table 1: Traffic Census Data (Tahmasseby et al., 2021[18])**

| sl no.           | date       | car, jeep, van & auto rickshaw | buses |         |       | trucks |         |       | tractor trailer |         | heavy triler | bullock | cycle | cycle rickshaw | motor cycle | remarks |
|------------------|------------|--------------------------------|-------|---------|-------|--------|---------|-------|-----------------|---------|--------------|---------|-------|----------------|-------------|---------|
|                  |            |                                | mini  |         | heavy | mini   |         | heavy | laden           | unladen |              |         |       |                |             |         |
|                  |            |                                | laden | unladen |       | laden  | unladen |       |                 |         |              |         |       |                |             |         |
| 1                | 2          | 3                              | 4     | 5       | 6     | 7      | 8       | 9     | 10              | 11      | 12           | 13      | 14    | 15             | 16          |         |
| 1                | 25-01-2022 | 2496                           | 30    | 30      | 45    | 230    | 227     | 301   | 755             | 772     | 205          | 0       | 567   | 0              | 1021        |         |
| 2                | 26-01-2022 | 2495                           | 30    | 30      | 47    | 254    | 247     | 312   | 772             | 775     | 218          | 0       | 572   | 0              | 1055        |         |
| 3                | 27-01-2022 | 2498                           | 30    | 30      | 43    | 247    | 238     | 307   | 761             | 765     | 219          | 0       | 570   | 0              | 1026        |         |
| 4                | 28-01-2022 | 2494                           | 30    | 30      | 42    | 255    | 251     | 315   | 768             | 751     | 221          | 0       | 566   | 0              | 1065        |         |
| 5                | 29-01-2022 | 2498                           | 30    | 30      | 48    | 257    | 252     | 270   | 771             | 768     | 213          | 0       | 568   | 0              | 1045        |         |
| 6                | 30-01-2022 | 2497                           | 30    | 30      | 46    | 241    | 245     | 256   | 764             | 754     | 226          | 0       | 573   | 0              | 1091        |         |
| 7                | 31-01-2022 | 2499                           | 30    | 30      | 45    | 237    | 242     | 298   | 762             | 761     | 234          | 0       | 574   | 0              | 1067        |         |
| total            |            | 17477                          | 210   | 210     | 316   | 1721   | 1702    | 2059  | 5353            | 5346    | 1536         | 0       | 3990  | 0              | 7370        |         |
| vehicles per day |            | 2497                           | 30    | 30      | 45    | 246    | 243     | 294   | 765             | 764     | 219          | 0       | 570   | 0              | 1053        |         |
| p.c.u per day    |            | 6756                           |       |         |       |        |         |       |                 |         |              |         |       |                |             |         |
| p.c.u per day    |            |                                |       |         |       |        |         |       |                 |         |              |         |       |                |             |         |

**Table 2: Grain Size Analysis**

| Sieve size in mm                        |       | Amount Retained | % by wt. retained | Cumulative %by wt. Retained | % Finer |
|---|-------|-----------------|-------------------|-----------------------------|---------|
| Grain size Analysis (% by Wt. retained) | 20.00 | 0.00            | 0.00              | 0.00                        | 100.00  |
|   | 10.00 | 0.00            | 0.00              | 0.00                        | 100.00  |
|   | 4.75  | 0.85            | 0.43              | 0.43                        | 99.58   |
|   | 2.36  | 2.42            | 1.21              | 1.64                        | 98.37   |
|   | 1.18  | 18.07           | 9.04              | 10.67                       | 89.33   |
|   | 0.6   | 21.87           | 10.94             | 21.61                       | 78.40   |
|   | 0.425 | 28.75           | 14.38             | 35.98                       | 64.02   |
|   | 0.075 | 34.96           | 17.48             | 53.46                       | 46.54   |





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**Table 3: Liquid Limit Test of Soil (LL)**

| Test No. | Container Number | Weight of Container +Wet Soil | Weight of Container +Dry Soil | Loss of Moisture | Weight of Container | Weight of Dry Soil | Moisture content Percentage | Number of Blows | Liquid limit Percentage |
|----------|------------------|-------------------------------|-------------------------------|------------------|---------------------|--------------------|-----------------------------|-----------------|-------------------------|
| 1        | 12               | 135.26                        | 110.02                        | 25.24            | 60.25               | 49.77              | 50.71                       | 20              | 36.16                   |
| 2        | 13               | 128.65                        | 109.35                        | 19.30            | 61.85               | 47.50              | 40.63                       | 24              |                         |
| 3        | 14               | 119.36                        | 103.73                        | 15.63            | 63.21               | 40.52              | 38.56                       | 27              |                         |
| 4        | 15               | 122.65                        | 108.62                        | 14.03            | 58.64               | 49.98              | 28.07                       | 31              |                         |
| 5        | 16               | 116.35                        | 105.74                        | 10.61            | 59.23               | 46.51              | 22.81                       | 36              |                         |

**Table 4: Plastic Limit Test of Soil (PL)**

| Test No. | Container Number | Weight of Container +Wet Soil | Weight of Container +Dry Soil | Loss of Moisture | Weight of Container | Weight of Dry Soil | Moisture content Percentage | Plastic limit Percentage | Plastic Index |
|----------|------------------|-------------------------------|-------------------------------|------------------|---------------------|--------------------|-----------------------------|--------------------------|---------------|
| 1        | 32               | 42.63                         | 41.67                         | 0.96             | 36.00               | 5.67               | 16.93                       | 18.86                    | 17.30         |
| 2        | 33               | 43.74                         | 42.71                         | 1.03             | 36.95               | 5.76               | 17.88                       |                          |               |
| 3        | 34               | 48.86                         | 47.75                         | 1.11             | 42.65               | 5.10               | 21.76                       |                          |               |

**Table 5: Proctor Density Test of Soil**

| Test No. | Weight of mould W1(gm) | Volume of mould Vm(cc) | Weight of mould+ Compacted Soil (gm)W2 | Weight of wet Soil (gms)W2- W1 | Wet Density (gms/cc) | Container No. | Weight of Container (gms) | Weight of Container +Wet Soil (gms) | Weight of Container +Dry Soil (gms) | Moisture in (gms) | Weight of Dry Soil Ws (gms) | Moisture Content in % (W) | Dry Density (gm/cc) | Optimum Moisture Content in % | Max. dry density |
|----------|------------------------|------------------------|--|--------------------------------|----------------------|---------------|---------------------------|-------------------------------------|-------------------------------------|-------------------|-----------------------------|---------------------------|---------------------|-------------------------------|------------------|
| 1        | 2107                   | 1021.42                | 3852                                   | 1745                           | 1.708                | 1.00          | 25.12                     | 72.05                               | 70.45                               | 1.60              | 45.33                       | 3.53                      | 1.650               | 12.20                         | 1.819            |
| 2        | 2107                   | 1021.42                | 4002                                   | 1895                           | 1.855                | 2.00          | 26.23                     | 75.23                               | 72.23                               | 3.00              | 46.00                       | 6.52                      | 1.742               |                               |                  |
| 3        | 2107                   | 1021.42                | 4115                                   | 2008                           | 1.966                | 3.00          | 28.54                     | 74.04                               | 70.12                               | 3.92              | 41.58                       | 9.43                      | 1.797               |                               |                  |
| 4        | 2107                   | 1021.42                | 4192                                   | 2085                           | 2.041                | 4.00          | 26.05                     | 81.23                               | 75.23                               | 6.00              | 49.18                       | 12.20                     | 1.819               |                               |                  |
| 5        | 2107                   | 1021.42                | 4170                                   | 2063                           | 2.020                | 5.00          | 25.34                     | 78.36                               | 71.85                               | 6.51              | 46.51                       | 14.00                     | 1.772               |                               |                  |

**Table 6: CBR Test of Soil (For Sub Grade Soil only) IS: 2720 (Part-16)**

| Time of Penetration 1.25 mm/ml n | Penetration | Proving Ring Reading |      |       | Load intensity (kg/cm <sup>2</sup> ) (A)x one division value area of Plunger |      |       | Corrected Load Intensity(kg/cm <sup>2</sup> ) |      |       | Standard Load Intensity(kg/cm <sup>2</sup> ) | Unsoaked/soaked CBR% (C X 100/D) |      |      | Average CBR(%) |
|----------------------------------|-------------|----------------------|------|-------|--|------|-------|---|------|-------|--|----------------------------------|------|------|----------------|
|                                  |             | (i)                  | (ii) | (iii) | (i)  | (ii) | (iii) | (i)   | (ii) | (iii) |  | Std.                             | (i)  | (ii) |                |
| 0-0                              | 0           | 0                    | 0    | 0     | 0  | 0    | 0     | 0   | 0    | 0     |  |                                  |      |      |                |
| 0-24                             | 0.5         | 5                    | 5    | 4     | 1.58   | 1.58 | 1.26  | 1.58  | 1.58 | 1.26  |  |                                  |      |      |                |
| 0-48                             | 1           | 7                    | 6    | 6     | 2.21   | 1.89 | 1.89  | 2.21  | 1.89 | 1.89  |  |                                  |      |      |                |
| ,1-12                            | 1.5         | 8                    | 6    | 7     | 2.53   | 1.89 | 2.21  | 2.53  | 1.89 | 2.21  |  |                                  |      |      |                |
| ,1-36                            | 2           | 10                   | 8    | 9     | 3.16   | 2.53 | 2.84  | 3.16  | 2.53 | 2.84  |  |                                  |      |      |                |
| 2-0                              | 2.5         | 12                   | 13   | 11    | 3.79   | 4.10 | 3.47  | 3.79  | 4.10 | 3.47  | 70   | 5.41                             | 5.86 | 4.96 | 5.41           |
| ,2-24                            | 3           | 13                   | 14   | 13    | 4.10   | 4.42 | 4.10  | 4.10  | 4.42 | 4.10  |  |                                  |      |      |                |
| ,3-12                            | 4           | 14                   | 15   | 14    | 4.42   | 4.74 | 4.42  | 4.42  | 4.74 | 4.42  |  |                                  |      |      |                |
| 4-0                              | 5           | 16                   | 17   | 19    | 5.05   | 5.37 | 6.00  | 5.05  | 5.37 | 6.00  | 105  | 4.81                             | 5.11 | 5.71 | 5.21           |
| 6-0                              | 7.5         | 18                   | 18   | 20    | 5.68   | 5.68 | 6.31  | 5.68  | 5.68 | 6.31  | 134  |                                  |      |      |                |
| 8-0                              | 10          | 19                   | 20   | 21    | 6.00   | 6.31 | 6.63  | 6.00  | 6.31 | 6.63  | 162  |                                  |      |      |                |
| 10-0                             | 12.5        | 20                   | 21   | 22    | 6.31   | 6.63 | 6.95  | 6.31  | 6.63 | 6.95  | 183  |                                  |      |      |                |

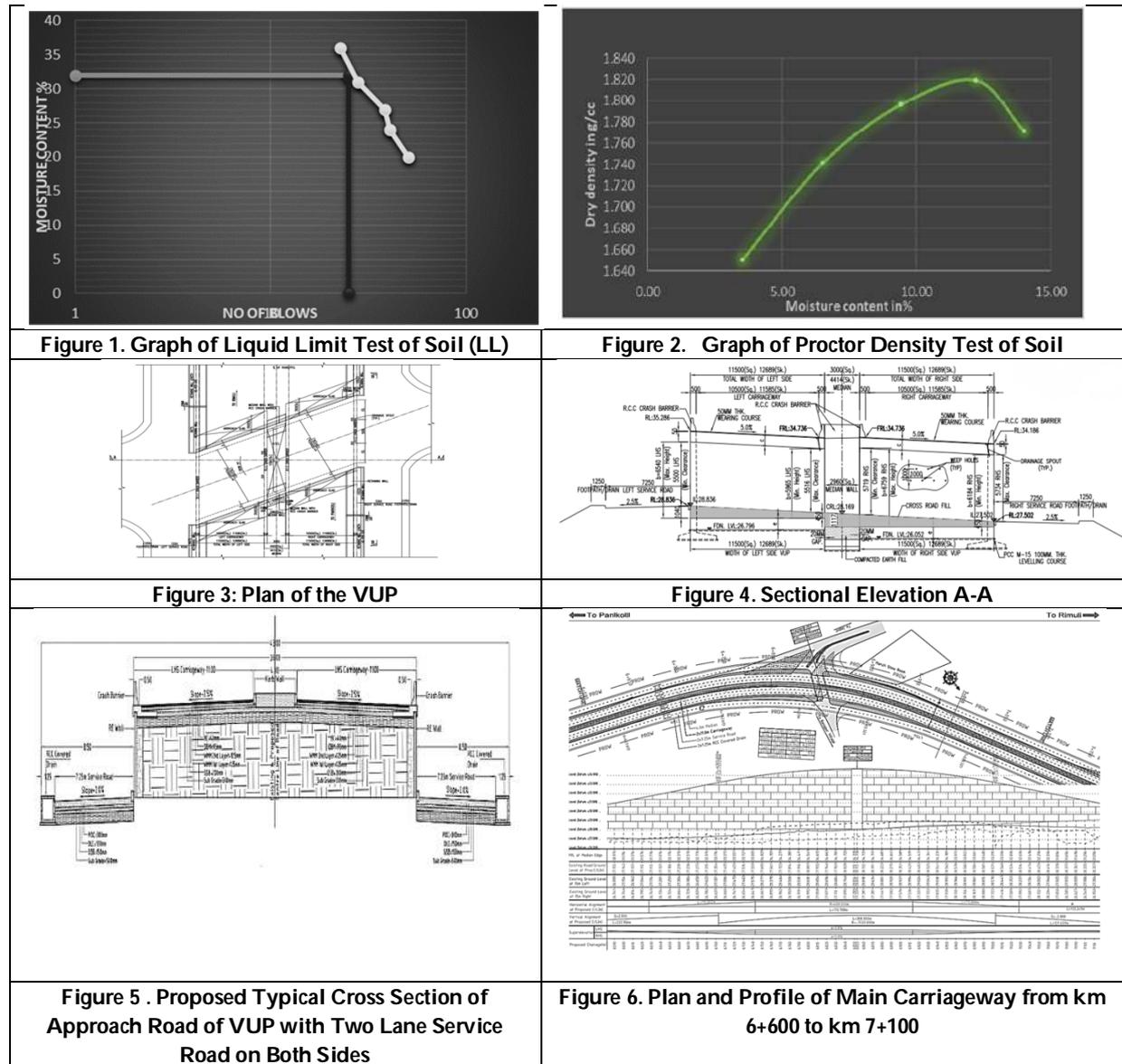
**Table 7: Test Result of CBR Soil Test of Sub Grade**

|                                    |      |
|------------------------------------|------|
| Av CBR at 2.5mm penetration (%)    | 5.41 |
| Av CBR at 5.0mm penetration (%)    | 5.21 |
| Av Saturation Moisture Content (%) | 11.5 |
| Av Swelling (%)                    | 1.25 |





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## Investigation on Medicinal Plants as Feed Additives for *Cirrhinus mrigala*, and Its Potency as Antimicrobial Compounds against Various Pathogenic Strains

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### ABSTRACT

The bacterial disease in freshwater aquaculture implies huge financial loss for the industries. Commercial antibiotics have unfavorable side effects when used to treat diseases. Many medicinal plants have a powerful impact on aquatic organism survival and growth, hormonal balancing, physiological support and also antimicrobial properties. The aim of the present study is to use three medicinal plants, *Azadirachta indica*, *Ocimum sanctum*, and *Abutilon indicum*, were fed to Indian carp *Cirrhinus mrigala* to test their antimicrobial activity against pathogens that cause diseases, such as *Aeromonas hydrophila*, *Esherichia coli*, *Staphylococcus* species, and *Pseudomonas aeruginosa*. The anti microbial activity was done by extracting flesh and liver extract from the treated fish and it is observed that 400 µl of flesh extract of *Cirrhinus mrigala* of Treatment four (T4) ( $0.95 \pm 0.23$ ) shows higher Zone of Inhibition against *Aeromonas hydrophila* when compared with other treatments. By this study, we can state that using consortium of these medicinal plants has adverse effect than using individual medicinal plant. These results also indicated that the use of medicinal plant as a feed might elevate the function of nonspecific immunity and enhance disease resistance against various microbial diseases and also for better fish production.

**Keywords:** *Cirrhinus mrigala*, Medicinal plants, Feed Additives, Antimicrobial activity

### INTRODUCTION

In fish culture, disease outbreaks are a limiting factor. On many fish farms and hatcheries, antibiotics, vaccines, and chemotherapeutic drugs, as well as immunostimulants, have been utilized to prevent viral, bacterial, parasite, and fungal diseases. To defend themselves against invading diseases, fish, like humans, employ both particular and non-

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specific methods. The skin and mucus are the primary lines of non-specific defense in fish [1]. Pathogens within water are directly in contact with fish. High population, as well as poor hydrodynamic conditions and feeding, result in higher susceptibility to infections. Numerous medications are used for infection treatment and prevention in order to prevent major economic losses caused by diseases. Antimicrobial drug use in aquaculture may result in the evolution of resistance in pathogenic microorganisms [2]. Disease outbreaks rise in direct proportion to the expansion of intensive aquaculture. Natural compounds, which include traditional medicines, were used to treat various human diseases for centuries. Numerous active compounds are known to be responsible for potential bioactivities. As a result, there has been a lot of studies in the use of medicinal plants in aquaculture in order to ensure safe and environmentally friendly compounds to substitute antibiotics and chemical compounds, and to also improve immune status and control fish disease [3]. Nowadays, a large portion of the world population, especially in developing countries depends on the traditional system of medicine for a variety of diseases. Medicinal plants can be used not just to treat diseases, but also as growth promoters, stress resistance boosters, and infectious disease preventatives. Furthermore, phytomedicines are less expensive and more effective than chemotherapeutic agents without causing toxic effect. Phytoconstituents derived from medicinal plants, such as tannins, alkaloids, and flavonoids, may have antibacterial activities. These ingredients can also act as immune modulators, enhancing fish non-specific defence system and raising specific immune response [4]. Herbs are currently used in commercial aquaculture as growth promoters, antimicrobial compounds, nutrients, and for a variety of other purposes. The mrigal (*C. mrigala*) is among India's major carps, which is an essential part of the country's long-term food security. These fish are infected with a wide range of diseases [5]. Azadirachtin, camphor, and Abutilon are the active ingredients in *Azadirachta indica*, *Ocimum sanctum*, and *Abutilon indicum*, respectively. These natural immunostimulants are biocompatible, biodegradable, cost efficient, and environmentally friendly, as well as having potent antifungal and antibacterial properties [6]. The present study was conducted to evaluate the effect of three medicinal plants, *Azadirachta indica*, *Ocimum sanctum*, and *Abutilon indicum*, as a feed to Indian carp *cirrhinus mrigala* to check its antimicrobial activity against diseases causing pathogens such as *Aeromonas hydrophila*, *Escherichia coli*, *Staphylococcus* species, *Pseudomonas aeruginosa*.

## MATERIALS AND METHODS

### Fish Collection and Maintenance

Growing live specimen of the *Cirrhinus mrigala* were obtained from the fish farms situated in and around the Chidambaram, Tamil Nadu. Collected samples were transferred to the Department of Zoology laboratory, Annamalai University, Chidambaram. These fishes were maintained in FRP (fiberglass reinforced plastic) tanks (capacity 40 L). Portion of the water in the tank was replaced on alternate days to maintain hygiene and water management. The health of the fish was checked on a daily basis, and any dead fish or fish with diseases were removed from the tank.

### Feed Additives of Fish

During the adaptation period, all the fish were provided with different formulated feeds (see table 1 for different treatment) (pellets made from rice bran, groundnut oil cakes, wheat flour, and mineral mixture) at 2% of their body weight on a daily basis.

### Harvesting of *Cirrhinus mrigala*

After 60 days, the fish samples were harvested and cleaned with a 4 percent potassium permanganate (kmno4) solution, washed with water, drained, and transferred to individually labeled (Control, T1, T2, T3, T4) polythene bags, which were promptly transported to the laboratory in ice boxes. The fish were not given any chemicals or anaesthetic before being collected. The meat sample and liver were collected using a sterile blade, and no blood residues were found in the flesh or liver. The samples were then placed in a sterile container and kept at 0°C to prevent bacterial growth.



**Thangadurai and Puvaneswari****Test Microorganisms**

All microbial strains studied human pathogen including Gram-negative bacterial strains *Escherichia coli*, *Pseudomonas aeruginosa*, and one Gram-positive bacterial strains *Staphylococcus sp* and one fish pathogenic Gram-negative bacterial strain *Aeromonas hydrophila* were procured from Indian Biotrack Research Institute Thanjavur, Tamilnadu, India. All the bacterial strains were cultured as per the microbiological safety protocols and conditions [7]. Each microbial strain was grown at 37°C in nutrient broth (0.5% peptone, 0.5% NaCl, 0.3% beef extract, distilled water, pH 6.8 at 28 C). Then, colony forming units (CFU) of each bacterial strain were calculated by CFU method [8].

**Preparation of Flesh and Liver Sample**

The frozen fish Flesh and liver samples were processed to obtain their extracts in Methanol. In brief, the fish Flesh and Liver were cut into small pieces with a sterile blade, thawed with distilled water and blotted with adsorbent paper. Then, 1g Flesh and liver of a fish was homogenized in 4 ml ice-cold Methanol with the help of a homogenizer. The homogenate was centrifuged at 4,900 rpm for 45 min at 5 °C in a refrigerated centrifuge and the supernatant was separated.

**Anti-Microbial Activity by Agar well diffusion assay**

The antibacterial effect of *Cirrhinus mrigala* flesh and liver extract of four different treatments on the selected bacterial strains were assayed by Agar well diffusion method [9]. Petri plates containing 80 ml nutrient agar medium were seeded with 24-h cultures of approximately  $10^7$  CFU ml<sup>-1</sup> bacterial strains. Then, wells with a diameter of 6–7 mm were punched aseptically with a sterile cork borer or a tip and the treated samples (T1,T2,T3,T4) and along with the control in different concentration (100 µl, 200 µl, 300 µl, 400 µl) of each extract per well were added. The plates were then incubated at 37°C for 24 h. Evaluation of bactericidal effect was done by measuring the diameter of the zone of inhibition (ZOI) formed around the well [10]. The diameter of ZOI was measured in term of millimeter (mm). Antibacterial activity results were compared between the control and different treatment.

**RESULT****Anti-Microbial Activity by Agar well diffusion assay**

All the Four Treatment including Control posses' strong bactericidal effect against all selected pathogenic strains. Variability between Zone of Inhibition value also appeared within and between the treatment against all microbial strains taken under study, however flesh and liver extract from the treatment four (T4) (Table 6) of all selected treatment exhibit strong inhibitory effect comparatively to all other treatment (Control, T1, T2 and T3), (Table 2, Table 3 Table 4, Table 5). Difference in mean  $\pm$  SE values of ZOI of Flesh and liver extract of *Cirrhinus mrigala* against all microbes were found to be significantly higher when in all treatment when compared with Control also 400 microliters of flesh extract of *Cirrhinus mrigala* of Treatment four (T4) ( $0.95\pm 0.23$ )(Table 6) shows higher ZOI against *Aeromonas hydrophila* when compared with other treatment shown in (Table 6). 400 microliters of Liver extract of *Cirrhinus mrigala* of Treatment four (T4) ( $0.95\pm 0.34$ ) shows higher ZOI against *Escherichia coli* when compared with other treatment shown in (Table 6). 400 micro liters of flesh extract of *Cirrhinus mrigala* of Treatment four (T4) ( $0.95\pm 0.19$ ) shows higher ZOI against *Staphylococcus* species when compared with other treatment shown in (Table 6). 400 micro liters of Liver extract of *Cirrhinus mrigala* of Treatment four (T4) ( $0.85\pm 0.16$ ) shows higher ZOI against *Pseudomonas aeruginosa* when compared with other treatment shown in (Table 6).

**DISCUSSION**

Today's modern aquaculture sector is rapidly expanding, and there is a need for both growth-promoting and health-promoting diets [11]. Mrigal is the popular name for the *Cirrhinus mrigala*, an indigenous large carp. Which is widely dispersed throughout India's, Bangladesh's and Pakistan's inland waters. It is a valuable capture fishery in the Ganga River system, as well as one of the most significant species in the country's cultural fisheries due to high market demand [12]. Herbal extracts have been shown to reduce mortality in fish exposed to pathogenic challenges [13,14].



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Antibiotics and synthetic medications used to treat diseases may harm organs such as the liver and impair the growth of cultured fish, resulting in lower production. To solve the foregoing problems and enhance commercially viable production, adequate medicinal feed supplementation is essential to maintain fish health and survive environmental obstacles without reducing growth survival [15]. Plant extracts have anti stress, growth promotion, appetite stimulation, immune stimulant, and disease prevention properties in fish aquaculture. Alkaloids, terpenoids, tannins, saponins, glycosides, flavonoids, phenolics, steroids, and essential oils found in plants contribute to these activities [16]. Based on these properties we selected the three different medicinal plants such as *Azadirachta indica*, *Ocimum sanctum*, and *Abutilon indicum*. Four different plants, such as *Echinacea purpurea*, *Allium sativum*, *Nigella sativa*, and *Origanum marjorana*, were utilised as feed additions [17] to boost the growth and survival of *Oreochromis niloticus*. The ability of immune stimulants to promote growth rate was well known [18]. claims that *Cirrhinus mrigala* fed with curcumin-rich diet (1-1.5%) had significantly greater total immunoglobulin, serum protein, serum albumin, immunoglobulin, respiratory burst activity, and myeloperoxidase activity. Recent experiments have revealed that many substances, depending on their route of administration, can be used to improve the growth and non-specific immunity of fish [19]. show that feeding *Limoniaacidissima L.* fruit to *C. carpio* fingerlings for 30 and 60 days improved their immunological parameters. According to Paul and Giri (2015), a 1% supplement of Kharboj (*Cucumis melo*). can be used as an efficient plant attractant in the feed of rohu fingerlings [20]. Darsini, et al., reported that dietary supplementation with *Limoniaacidissima* fruit (LF) promotes growth and nutrient utilisation in *Cirrhinus mrigala* and *Cyprinus carpio* fingerlings, as evidenced by improved weight gain, FCR, FE, PER, SGR, and RGR after 30 and 60 days of feeding trials [21]. Tawwab et al., discovered a substantial rise in SGR in *Oreochromis niloticus* on a diet that included green tea (*Camellia sinensis*) [22]. Paul, et al., reported that *Cirrhinus mrigala*'s growth performance was improved by incorporating 1% awbel (*Cuscutareflexa*) into the diet [23]. Aly et al., observed SGR was significantly increased in Nile Tilapia while fed with *Echinacea purpurea* and *Allium sativum* enriched diet [24]. Zilberg et al., found that tilapia (*Oreochromis sp.*) fish resistance to *Streptococcus iniae* and *Streptococcus agalactiae* bacteria in the rosemary plant [25]. Our study revealed that All the Four Treatment including Control posses strong bactericidal effect against all selected pathogenic strains The antimicrobial effect of the medicinal herbs *Curcuma longa*, *Ocimum sanctum*, and *Azadirachta indica* against *A. hydrophila* was revealed that goldfish after disease challenge [6]. Nya et al., observed the control of *A. hydrophila* infection in rainbow trout, *O. mykiss*, after feeding *A. sativum* (0.5 and 1 g/100 g of feed for 14 days) [26]. According to Kumar, et al., the administration of *H. auriculata* extract has a beneficial effect on immunological indices and immune system activity in Mrigal fish [27]. Ahilan et al., discovered that adding *Phyllanthus niruri* and *Aloe vera* (*A. barbadensis*) as herbal additives can improve the growth performance and resistance to *A. hydrophila* infections in goldfish (*Carassius auratus*) [28]. According to Immanuel et al., six different n-butanol plant extracts from *Ricinus communis*, *Phyllanthus niruri*, *Leucas aspera*, *Manihot esculenta*, and the seaweeds *Ulva lactuca* and *Sargassum wightii* found to inhibit the growth of *V. Parahaemolyticus* [29]. Our study reported that Variability between Zone of Inhibition value also appeared within and between the treatment against all microbial strains taken under study, however flesh and liver extract from the treatment four (T4) of all selected treatment exhibit strong inhibitory effect comparatively to all other treatment (Control, T1, T2 and T3 and T4). The demand for alternative substances has grown as the use of antibiotics in food has become unpopular, and bacteria have developed resistance to antibiotics. Our final finding states that medicinal Plants are an excellent alternative due to their diverse compounds and properties.

**CONCLUSION**

According to the findings of this investigation, bacterial challenges its role in pathogen defense. Flesh and liver crude extracts from control and herbal plant treated fish revealed a wide range of bactericidal activity against human and fish pathogenic microorganisms. As a result these herbal plants can be used as feed additives for aquaculture, antibacterial compounds found in this plants could be considered as a potent immune stimulant hence it can be used as an alternative to antibiotics in aquaculture and human medicine. As a natural substance, it may be able to assist in the reduction of antibiotic resistance issues, making it a cost-effective option.





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**Table 1 – Treatments and their feed additives**

| Treatments   | Feed additives   |
|--------------|--|
| Control      | rice bran, groundnut oil cakes, wheat flour, and mineral mixture                             |
| Treatment -1 | 5% <i>Azadirachta indica</i> + control   |
| Treatment -2 | 5% <i>Ocimum sanctum</i> + control   |
| Treatment-3  | 5% <i>Abutilon indicum</i> + control   |
| Treatment-4  | 5% ( <i>Azadirachta indica</i> + <i>Ocimum sanctum</i> + <i>Abutilon indicum</i> ) + control |





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**Table 2: Zone of inhibition (ZOI) shown by liver and flesh extracts of *Cirrhinus mrigala* treated with control against different selected pathogenic microbial strains**

| Name of the bacteria           | Zone of inhibition (mm)      |           |           |           |           |           |           |           |
|--------------------------------|------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|                                | Liver                        |           |           |           | Flesh     |           |           |           |
|                                | Control                      |           |           |           |           |           |           |           |
|                                | Different concentration (µl) |           |           |           |           |           |           |           |
|                                | 100                          | 200       | 300       | 400       | 100       | 200       | 300       | 400       |
| <i>Aeromonas hydrophila</i>    | 06.0±0.15                    | 07.0±0.23 | 07.5±0.56 | 08.5±0.19 | 05.0±0.06 | 05.5±0.78 | 06.0±0.45 | 06.5±0.03 |
| <i>Escherichia coli</i>        | 08.5±0.12                    | 09.0±0.60 | 10.5±0.55 | 12.0±0.34 | 06.0±0.32 | 06.5±0.11 | 07.0±0.06 | 08.0±0.29 |
| <i>Staphylococcus species.</i> | 06.5±0.08                    | 07.0±0.13 | 08.5±0.24 | 09.0±0.07 | 07.0±0.94 | 07.5±0.16 | 08.5±0.53 | 09.0±0.05 |
| <i>Pseudomonas aeruginosa</i>  | 06.0±0.13                    | 06.5±0.94 | 07.0±0.15 | 07.5±0.04 | 05.0±0.46 | 05.5±0.66 | 06.0±0.18 | 06.5±0.07 |

The values are expressed in terms of (Mean ± Standard deviation)

**Table 3: Zone of inhibition (ZOI) shown by liver and flesh extracts of *Cirrhinus mrigala* treated with 5% *Azadirachta indica* +control against different selected pathogenic microbial strains**

| Name of the bacteria          | Zone of inhibition (mm)      |           |           |           |           |           |           |           |
|-------------------------------|------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|                               | Liver                        |           |           |           | Flesh     |           |           |           |
|                               | T <sub>1</sub>               |           |           |           |           |           |           |           |
|                               | Different concentration (µl) |           |           |           |           |           |           |           |
|                               | 100                          | 200       | 300       | 400       | 100       | 200       | 300       | 400       |
| <i>Aeromonas hydrophila</i>   | 06.5±0.33                    | 07.0±0.06 | 07.5±0.49 | 08.0±0.07 | 05.5±0.02 | 06.0±0.12 | 07.0±0.37 | 07.5±0.52 |
| <i>Escherichia coli</i>       | 07.0±0.19                    | 07.5±0.15 | 08.0±0.23 | 08.5±0.14 | 06.5±0.18 | 07.0±0.19 | 07.5±0.17 | 08.0±0.09 |
| <i>Staphylococcus species</i> | 06.0±0.16                    | 06.5±0.11 | 07.0±0.46 | 07.5±0.37 | 07.5±0.05 | 08.0±0.16 | 08.5±0.65 | 09.0±0.71 |
| <i>Pseudomonas Aeruginosa</i> | 06.5±0.19                    | 07.0±0.08 | 07.5±0.42 | 08.0±0.06 | 05.5±0.19 | 06.0±0.78 | 06.5±0.19 | 07.0±0.16 |

The values are expressed in terms of (Mean ± Standard deviation)

**Table 4: Zone of inhibition (ZOI) shown by liver and flesh extracts of *Cirrhinus mrigala* treated with 5% *Ocimum sanctum* +control against different selected pathogenic microbial strains**

| Name of the bacteria          | Zone of inhibition (mm)      |           |           |           |           |           |           |           |
|-------------------------------|------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|                               | Liver                        |           |           |           | Flesh     |           |           |           |
|                               | T <sub>2</sub>               |           |           |           |           |           |           |           |
|                               | Different concentration (µl) |           |           |           |           |           |           |           |
|                               | 100                          | 200       | 300       | 400       | 100       | 200       | 300       | 400       |
| <i>Aeromonas hydrophila</i>   | 07.0±0.16                    | 07.5±0.44 | 08.0±0.19 | 08.5±0.41 | 06.0±0.11 | 06.5±0.16 | 07.5±0.49 | 08.0±0.54 |
| <i>Escherichia coli</i>       | 06.0±0.34                    | 06.5±0.67 | 06.0±0.12 | 06.5±0.36 | 05.5±0.23 | 06.0±0.97 | 06.5±0.21 | 07.0±0.47 |
| <i>Staphylococcus species</i> | 06.5±0.87                    | 07.0±0.09 | 07.5±0.15 | 08.0±0.13 | 06.5±0.57 | 07.0±0.64 | 08.0±0.41 | 08.5±0.05 |
| <i>Pseudomonas Aeruginosa</i> | 04.5±0.09                    | 05.0±0.68 | 05.5±0.73 | 06.0±0.16 | 05.0±0.26 | 05.5±0.13 | 06.0±0.17 | 06.5±0.52 |

The values are expressed in terms of (Mean ± Standard deviation)





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**Table 5: Zone of inhibition (ZOI) shown by liver and flesh extracts of *Cirrhinus mrigala* treated with 5% *Abutilon indicum* +control against different selected pathogenic microbial strains**

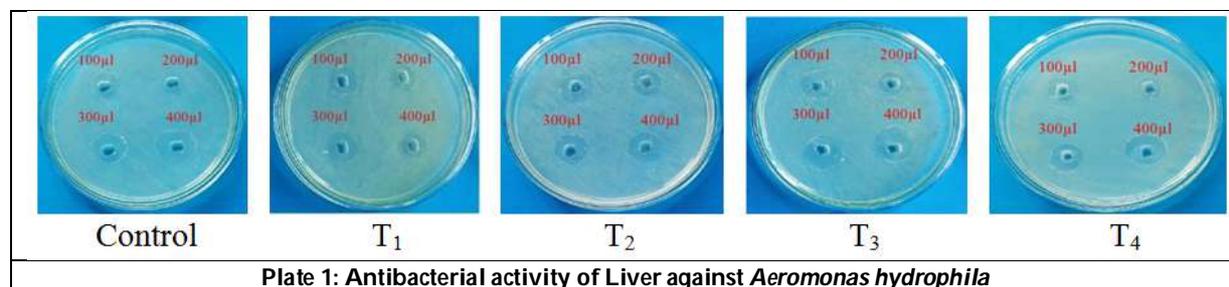
| Name of the Bacteria          | Zone of inhibition (mm)      |           |           |           |           |           |           |           |
|-------------------------------|------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|                               | Liver                        |           |           |           | Flesh     |           |           |           |
|                               | T <sub>3</sub>               |           |           |           |           |           |           |           |
|                               | Different concentration (µl) |           |           |           |           |           |           |           |
|                               | 100                          | 200       | 300       | 400       | 100       | 200       | 300       | 400       |
| <i>Aeromonas hydrophila</i>   | 07.0±0.65                    | 07.5±0.17 | 08.0±0.78 | 08.5±0.36 | 08.0±0.21 | 08.5±0.48 | 09.0±0.14 | 09.5±0.05 |
| <i>Escherichia coli</i>       | 06.0±0.16                    | 06.5±0.02 | 07.0±0.13 | 08.0±0.15 | 05.0±0.24 | 05.5±0.16 | 06.0±0.64 | 06.5±0.37 |
| <i>Staphylococcus species</i> | 06.5±0.51                    | 07.0±0.46 | 07.5±0.19 | 08.0±0.76 | 06.0±0.62 | 06.5±0.37 | 07.0±0.18 | 07.5±0.19 |
| <i>Pseudomonas Aeruginosa</i> | 05.0±0.17                    | 05.5±0.06 | 06.0±0.13 | 06.5±0.49 | 05.0±0.74 | 05.5±0.67 | 06.5±0.17 | 07.0±0.06 |

The values are expressed in terms of (Mean ± Standard deviation)

**Table 6: Zone of inhibition (ZOI) shown by liver and flesh extracts of *Cirrhinus mrigala* treated with 5% *Azadirachta indica* +5%*Ocimum sanctum* + 5%*Abutilon indicum* +control against different selected pathogenic microbial strains**

| Name of the bacteria          | Zone of inhibition (mm)      |           |           |           |           |           |           |           |
|-------------------------------|------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|                               | Liver                        |           |           |           | Flesh     |           |           |           |
|                               | T <sub>4</sub>               |           |           |           |           |           |           |           |
|                               | Different concentration (µl) |           |           |           |           |           |           |           |
|                               | 100                          | 200       | 300       | 400       | 100       | 200       | 300       | 400       |
| <i>Aeromonas hydrophila</i>   | 09.0±0.39                    | 09.5±0.18 | 09.0±0.06 | 09.5±0.23 | 10.0±0.19 | 10.5±0.16 | 11.0±0.14 | 11.5±0.43 |
| <i>Escherichia coli</i>       | 08.0±0.75                    | 08.5±0.42 | 09.0±0.14 | 09.5±0.34 | 07.0±0.33 | 07.5±0.27 | 08.0±0.08 | 08.5±0.06 |
| <i>Staphylococcus species</i> | 07.0±0.31                    | 07.5±0.16 | 08.0±0.07 | 09.0±0.11 | 08.0±0.13 | 08.5±0.19 | 09.0±0.14 | 09.5±0.19 |
| <i>Pseudomonas Aeruginosa</i> | 07.0±0.67                    | 07.5±0.19 | 08.0±0.11 | 08.5±0.16 | 06.5±0.34 | 07.0±0.15 | 07.5±0.17 | 08.0±0.11 |

The values are expressed in terms of (Mean ± Standard deviation)

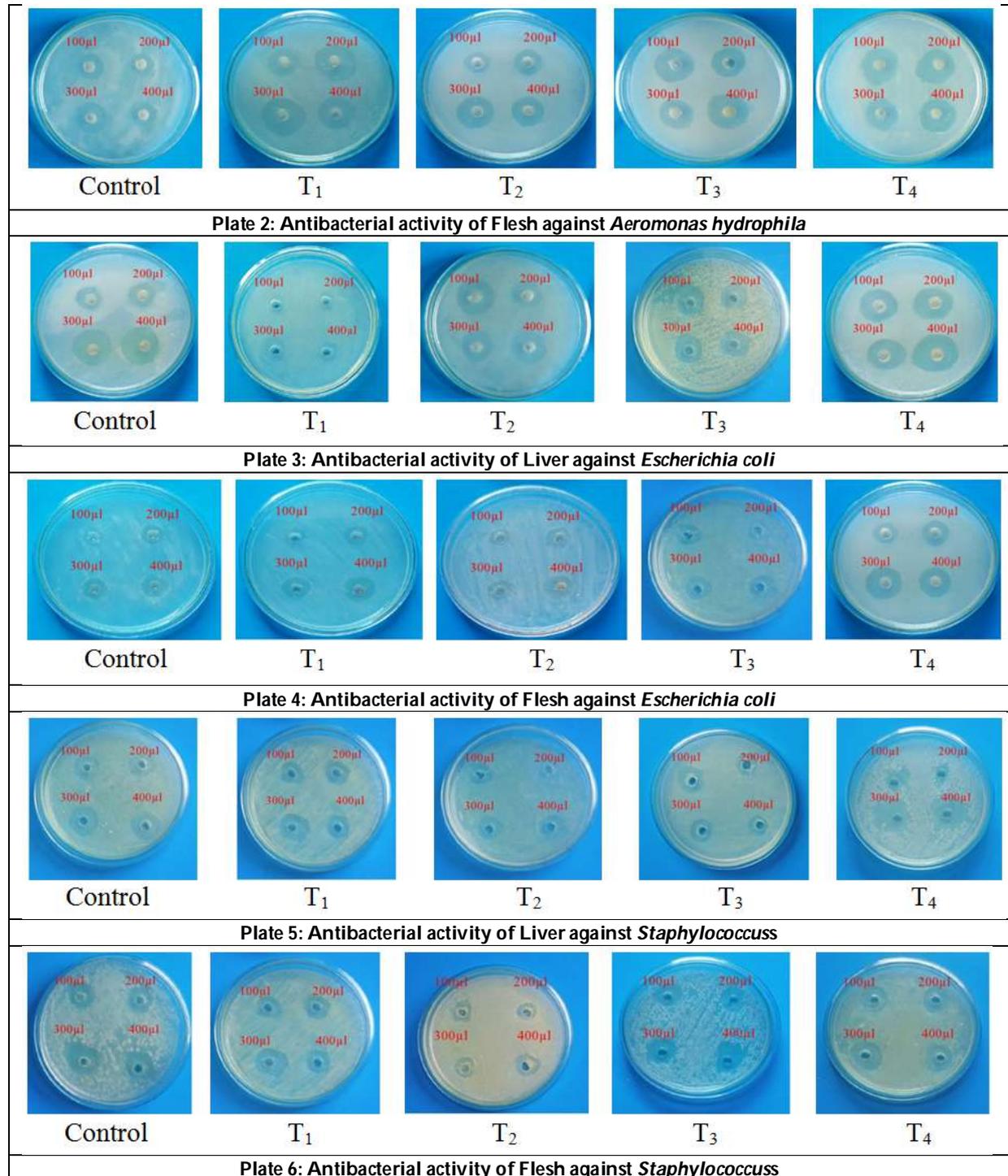


**Plate 1: Antibacterial activity of Liver against *Aeromonas hydrophila***



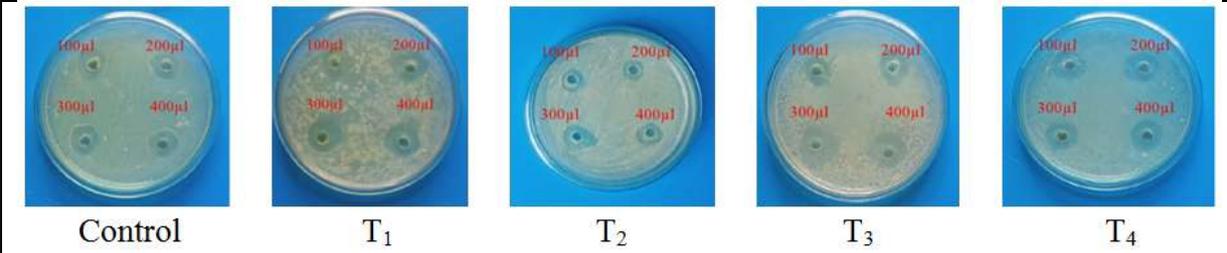


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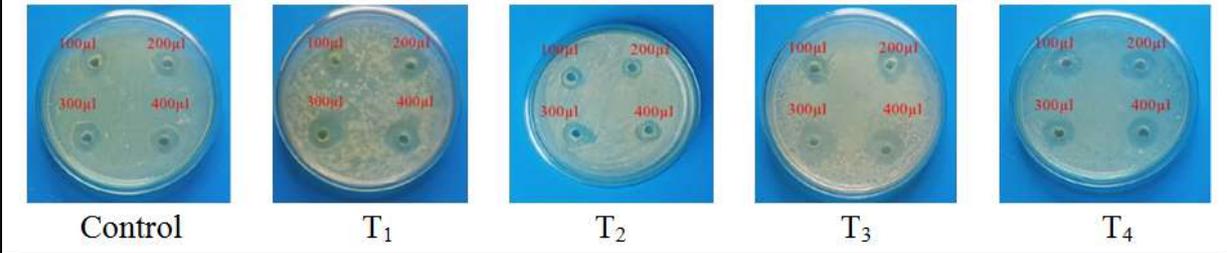




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**Plate 7: Antibacterial activity of Liver against *Pseudomonas aeruginosa***



**Plate 8: Antibacterial activity of Flesh against *Pseudomonas aeruginosa***





## On Kasaj Generalized Pre-Closed Sets and Generalized Semi Pre-Closed Sets in Kasaj Topological Spaces

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### ABSTRACT

This paper's aim is to establish a new concept of generalized -pre -closed sets and generalized -semi- pre closed sets are called  $KS_{gp}$ -closed and  $KS_{gsp}$ -closed in Kasaj topological spaces and investigate the relation between this set with other sets in Kasaj topological spaces. Characterizations of  $KS_{gp}$ -closed and  $KS_{gsp}$ -closed sets are given.

**Keywords:**  $KS_R(X)$ ,  $KS_{gp}$ -closed sets,  $KS_{gsp}$ -closed sets,  $KS - \alpha$ -closed set,  $KS - \beta$ -closed set,  $KS$ -semi-closed set,  $KS$ -pre-closed set.

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## INTRODUCTION AND PRELIMINARIES

In 2020, Kashyap G.Rachch and Sajeed [1] introduced partial extension of Micro topological space namely Kashyap G.Rachch and Sajeed topological spaces. Furthermore, they will specify Kasaj generalized -pre- closed sets and generalized semi- pre- closed sets and examine the basic features of these new classes to discover how they are related.





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**Definition 1.1.**

Let  $(U, \tau_R(X))$  be a nano topological space. Then Kasaj topology is defined by  $KS_R(X) = \{(K \cap S) \cup (K' \cup S') : K, K' \in \tau_R(X), \text{fixed } S, S' \notin \tau_R(X), S \cup S' = U\}$ . The Kasaj topology  $KS_R(X)$  satisfies the following conditions:

- (1)  $U, \emptyset \in KS_R(X)$ .
- (2) The union of elements of any sub collection of  $KS_R(X)$  is in  $KS_R(X)$ .
- (3) The intersection of the elements of the elements of any finite sub collection of  $KS_R(X)$  is in  $KS_R(X)$ .

Then  $(U, \tau_R(X), KS_R(X))$  is called Kasaj topological spaces and the members of  $KS_R(X)$  are called Kasaj open sets (KS-open sets) and the complement of a Kasaj open set is called a Kasaj-closed (KS-closed) and the collection of all Kasaj-closed set is denoted by  $KSCL(X)$ .

**Definition 1.2.**

A subset P of U in  $(U, \tau_X)$  is called

- (1)  $KS_g$ -closed set [3] if  $KS_{cl}(P) \subseteq V$ .
- (2)  $KS-\alpha$ -closed set [1] if  $KS_{cl}(KS_{int}(KS_{cl}(P))) \subseteq P$ .
- (3)  $KS-\beta$ -closed set [1] if  $int(cl(int(P))) \subseteq P$ .
- (4) KS-semi-closed set [1] if  $int(cl(P)) \subseteq P$ .
- (5) KS-pre-closed set [1] if  $cl(int(P)) \subseteq P$ .

**$KS_{gp}$ -CLOSED SETS AND  $KS_{gsp}$ -CLOSED SETS**

The objective of this paper is to introduced and investigate the  $KS_{gp}$ -closed sets and  $KS_{gsp}$ -closed sets in Kasaj topological spaces.

**Definition 2.1.**

A subset P of U in  $(U, \tau_R(X), KS_R(X))$  is called a Kasaj-generalized -pre-closed set (briefly  $KS_{gp}$ -closed) if  $KS_{pcl}(P) \subseteq V$  then  $P \subseteq V$  and V is KS-open set in  $KS_R(X)$ . The complement of  $KS_{gp}$ -closed set is  $KS_{gp}$ -open set in U.

**Definition 2.2.**

A subset P of U in  $(U, \tau_R(X), KS_R(X))$  is called a Kasaj-generalized -semi-pre-closed set (briefly  $KS_{gsp}$ -closed) if  $KS_{spcl}(P) \subseteq V$  then  $P \subseteq V$  and V is KS-open set in  $KS_R(X)$ . The complement of  $KS_{gsp}$ -closed set is  $KS_{gsp}$ -open set in U.

**Theorem 2.3.**

For any subsets of  $(U, \tau_R(X), KS_R(X))$  in Kasaj topological spaces satisfying the following theorems are hold:

- (1) Every KS-closed set is  $KS_{gp}$ -closed.
- (2) Every KS-pre-closed set is  $KS_{gp}$ -closed.
- (3) Every  $KS-\alpha$  closed set is  $KS_{gp}$ -closed.

**Proof: 1**

Let P be a KS-closed set in V. Let  $P \subseteq V$  and V be a KS-open in U. Since P is KS-closed set,  $KS_{cl}(P) = P \subseteq V$ . But  $KS_{pcl}(P) \subseteq KS_{cl}(P) \subseteq V$ . Therefore  $KS_{pcl}(P) \subseteq V$ . Hence P is  $KS_{gp}$ -closed set.

**Proof: 2) and 3)** is obvious.

The counterpart of the above theorem does not have to be true, as shown in the following example.

**Illustration 2.4.**

Let  $U = \{p, \beta, \delta, e, q\}$ , with  $U \setminus R = \{\{p, q\}, \{\delta, e\}, \{\beta\}\}$  and  $X = \{p, \beta\}$ . Then the nano topology,  $\tau_R(X) = \{U, \emptyset, \{\beta\}, \{p, \beta, q\}, \{p, q\}\}$ .  $S = \{p, \delta, e\}$ ,  $S' = \{\beta, q\}$ . Then  $KS_R(X)$  -open sets are  $\{U, \emptyset, \{p\}, \{\beta\}, \{q\}, \{p, \beta\}, \{p, q\}, \{\beta, q\}, \{p, \beta, q\}, \{p, \delta, e\}, \{p, \beta, \delta, e\}, \{p, \delta, e, q\}\}$  and  $KS_R(X)$ -closed sets are  $\{U, \emptyset, \{\beta, \delta, e, q\}, \{p, \delta, e, q\}, \{p, \beta, \delta, e\}, \{\beta, e, q\}, \{\delta, e, q\}, \{\beta, \delta, e\}, \{p, \delta, e\}, \{\delta, e\}, \{\beta, q\}, \{q\}, \{\beta\}$ .







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$\{ \beta, \delta, \epsilon \}, \{ \beta, \delta, \epsilon, \zeta \}, \{ \beta, \epsilon, \zeta \}, \{ \delta, \epsilon, \zeta \}, \{ \beta, \delta, \epsilon, \zeta \}, \{ \beta, \delta, \zeta \}, \{ \beta, \epsilon, \zeta \}, \{ \delta, \epsilon, \zeta \}, \{ \beta, \delta, \epsilon, \zeta \}$ .  $KS_{gp}$ -closed sets are  $\{ U, \emptyset, \{ \beta \}, \{ \delta \}, \{ \epsilon \}, \{ \beta, \delta \}, \{ \beta, \epsilon \}, \{ \delta, \epsilon \}, \{ \beta, \delta, \epsilon \}, \{ \beta, \delta, \zeta \}, \{ \beta, \epsilon, \zeta \}, \{ \delta, \epsilon, \zeta \}, \{ \beta, \delta, \zeta \}, \{ \beta, \epsilon, \zeta \}, \{ \delta, \epsilon, \zeta \}, \{ \beta, \delta, \epsilon, \zeta \}$ .  $KS_{gsp}$ -closed sets are  $\{ U, \emptyset, \{ \beta \}, \{ \delta \}, \{ \epsilon \}, \{ \zeta \}, \{ \beta, \delta \}, \{ \beta, \epsilon \}, \{ \delta, \epsilon \}, \{ \beta, \delta, \epsilon \}, \{ \beta, \delta, \zeta \}, \{ \beta, \epsilon, \zeta \}, \{ \delta, \epsilon, \zeta \}, \{ \beta, \delta, \zeta \}, \{ \beta, \epsilon, \zeta \}, \{ \delta, \epsilon, \zeta \}, \{ \beta, \delta, \epsilon, \zeta \}$ . It is clear that  $\{ \beta, \zeta \}$  is  $KS_{gsp}$ -closed set but not KS-closed, KS-semi-closed, KS-pre-closed, KS- $\alpha$ -closed, KS- $\beta$ -closed,  $KS_g$ -closed,  $KS_{gp}$ -closed.

**Theorem 2.9.**

The Union of  $KS_{gp}$ -closed set is  $KS_{gp}$ -closed.

**Proof**

Let P and Q be  $KS_{gp}$ -closed sets in U. Let V be a KS-open in U such that  $P \cup Q \subseteq V$ . Then  $P \subseteq V$  and  $Q \subseteq V$ . Since P and Q are  $KS_{gp}$ -closed sets,  $pcl(P) \subseteq V$  and  $pcl(Q) \subseteq V$ . Hence  $pcl(P \cup Q) = pcl(P) \cup pcl(Q) \subseteq V$ . i.e.,  $pcl(P \cup Q) \subseteq V$ . Therefore  $P \cup Q$  is  $KS_{gp}$ -closed.

**Remark 2.10.**

The intersection of  $KS_{gp}$ -closed set is need not be a  $KS_{gp}$ -closed and  $KS_{gsp}$ -closed set is need not be a  $KS_{gsp}$ -closed, as seen in the following example.

**Illustration 2.11.**

Let  $U = \{ \beta, \delta, \epsilon, \zeta \}$ , with  $U \setminus R = \{ \{ \beta, \delta \}, \{ \delta, \epsilon \}, \{ \zeta \} \}$  and  $X = \{ \beta, \zeta \}$ . Then the nano topology,  $\tau_R(X) = \{ U, \emptyset, \{ \zeta \}, \{ \beta, \delta, \zeta \}, \{ \beta, \delta \}, \{ \beta, \zeta \}, \{ \delta, \zeta \}, \{ \beta, \delta, \zeta \} \}$ .  $KS_R(X)$ -open sets are  $\{ U, \emptyset, \{ \beta \}, \{ \delta \}, \{ \zeta \}, \{ \beta, \delta \}, \{ \beta, \zeta \}, \{ \delta, \zeta \}, \{ \beta, \delta, \zeta \} \}$  and  $KS_R(X)$ -closed sets are  $\{ U, \emptyset, \{ \beta, \delta, \epsilon, \zeta \}, \{ \beta, \delta, \epsilon \}, \{ \beta, \delta, \zeta \}, \{ \beta, \delta \}, \{ \beta, \epsilon \}, \{ \delta, \epsilon \}, \{ \beta, \delta, \zeta \} \}$ .  $KS_{gp}$ -closed sets are  $\{ U, \emptyset, \{ \beta \}, \{ \delta \}, \{ \epsilon \}, \{ \beta, \delta \}, \{ \beta, \epsilon \}, \{ \delta, \epsilon \}, \{ \beta, \delta, \epsilon \}, \{ \beta, \delta, \zeta \}, \{ \beta, \epsilon, \zeta \}, \{ \delta, \epsilon, \zeta \}, \{ \beta, \delta, \zeta \}, \{ \beta, \epsilon, \zeta \}, \{ \delta, \epsilon, \zeta \}, \{ \beta, \delta, \epsilon, \zeta \} \}$ . If  $P = \{ \beta, \delta, \zeta \}, Q = \{ \beta, \delta, \epsilon, \zeta \}$ , then  $P \cap Q = \{ \beta, \delta, \zeta \}$  which is not in  $KS_{gp}$ -closed set.  $KS_{gsp}$ -closed sets are  $\{ U, \emptyset, \{ \beta \}, \{ \delta \}, \{ \epsilon \}, \{ \zeta \}, \{ \beta, \delta \}, \{ \beta, \epsilon \}, \{ \delta, \epsilon \}, \{ \beta, \delta, \epsilon \}, \{ \beta, \delta, \zeta \}, \{ \beta, \epsilon, \zeta \}, \{ \delta, \epsilon, \zeta \}, \{ \beta, \delta, \zeta \}, \{ \beta, \epsilon, \zeta \}, \{ \delta, \epsilon, \zeta \}, \{ \beta, \delta, \epsilon, \zeta \} \}$ . If  $P = \{ \beta, \delta, \zeta \}, Q = \{ \beta, \delta, \epsilon, \zeta \}$ , then  $P \cap Q = \{ \beta, \delta, \zeta \}$  which is not in  $KS_{gsp}$ -closed.

**Theorem 2.12.**

If P is a  $KS_{gp}$ -closed and  $P \subseteq Q \subseteq pcl(P)$ , then Q is  $KS_{gp}$ -closed.

**Proof**

Allow  $Q \subseteq V$ , when V is open in U. So  $P \subseteq Q$ , this indicates  $P \subseteq V$ . As P is  $KS_{gp}$ -closed,  $pcl(P) \subseteq V$ . As  $Q \subseteq pcl(P)$ , this indicates  $pcl(Q) \subseteq pcl(P)$ . Thus  $pcl(Q) \subseteq U$ . Hence Q is  $KS_{gp}$ -closed.

**Theorem 2.13.**

If  $int(Q) \subseteq Q \subseteq P$  and if P is  $KS_{gp}$ -open in U, then Q is  $KS_{gp}$ -open in U.

**Proof**

Suppose that  $int(Q) \subseteq Q \subseteq P$  and P is  $KS_{gp}$ -open in U, then  $(U-P) \subseteq (U-Q) \subseteq U - int(Q) = pcl(U-Q)$ . Since  $(U-Q)$  is  $KS_{gp}$ -closed in U, By above theorem if P is a  $KS_{gp}$ -closed and  $P \subseteq Q \subseteq pcl(P)$ , then Q is  $KS_{gp}$ -closed. Therefore Q is  $KS_{gp}$ -open in U.

**Theorem 2.14.**

If P is both KS-open and  $KS_{gp}$ -closed then P is KS-pre-closed in U.

**Proof**

Let P is open and  $KS_{gp}$ -closed in U, then  $pcl(P) \subseteq P$ . But  $P \subseteq pcl(P)$ . Therefore  $pcl(P) = P$ . Hence P is KS-pre-closed.





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**Theorem 2.15.**

$P \subseteq Q \subseteq U$ , where  $Q$  is KS-open and  $KS_{gp}$ -closed in  $U$ . If  $P$  is  $KS_{gp}$ -closed in  $Q$ . Then  $P$  is  $KS_{gp}$ -closed in  $U$ .

**Proof**

Let  $X$  be a KS-open set in  $U$  such that  $P \subseteq X$ . Since  $P \subseteq X \cap Q$ ,  $X \cap Q$  is KS-open in  $Q$  and  $P$  is  $KS_{gp}$ -closed in  $Q$ ,  $\text{pcl}(P) \subseteq X \cap Q$ . Now  $\text{pcl}(P) \cap Q \subseteq X \cap Q$ . Since  $P \subseteq Q$ ,  $\text{pcl}(P) \subseteq \text{pcl}(Q)$ . Since  $Q$  is KS-open and  $KS_{gp}$ -closed in  $U$ , By above theorem,  $Q$  is KS-pre-closed. Therefore  $\text{pcl}(Q) = Q$ , this implies  $\text{pcl}(P) \subseteq Q$ . Thus  $\text{pcl}(P) = \text{pcl}(P) \cap Q \subseteq X \cap Q \subseteq X$ . Hence  $P$  is  $KS_{gp}$ -closed in  $U$ .

**Theorem 2.16.**

An  $KS_{gp}$ -closed set  $P$  is KS-closed iff  $\text{pcl}(P) - P$  is KS-closed.

**Proof**

Necessity: Let  $P$  is KS-closed. Then  $\text{pcl}(P) = P$  and so  $\text{pcl}(P) - P = \emptyset$  is KS-closed.

Sufficiency: Suppose  $\text{pcl}(P) - P$  is KS-closed. Then  $\text{pcl}(P) - P = \emptyset$ . Since  $P$  is KS-closed. i.e.,  $\text{pcl}(P) = P$  (or)  $P$  is KS-closed.

**Theorem 2.17.**

Let  $P$  be a  $KS_{gp}$ -closed set and  $F$  be a KS-closed set in  $U$ . Then  $P \cap F$  is  $KS_{gp}$ -closed set in  $U$ .

**Proof**

Let  $P$  be a  $KS_{gp}$ -closed set in  $U$ . Then  $\text{pcl}(P) - P \in KS_R(X)$ , whenever  $P \subseteq V$  and  $V$  is open. Let  $F$  be a KS-closed set in  $U$ . Since every KS-closed set is  $KS_{gp}$ -closed. Hence  $F$  is  $KS_{gp}$ -closed. Since  $P$  and  $F$  are  $KS_{gp}$ -closed set of  $U$ , then their intersection  $P \cap F$  is also  $KS_{gp}$ -closed, finite intersection of any two  $KS_{gp}$ -closed set is  $KS_{gp}$ -closed. Thus  $P \cap F$  is  $KS_{gp}$ -closed.

**Theorem 2.18.**

Let  $(U, \tau_R(X), KS_R(X))$  be a Kasaj topological spaces and  $P \subseteq U$ . If  $P \subseteq Q \subseteq \text{pcl}(P)$ , then  $\text{pcl}(P) = \text{pcl}(Q)$ .

**Proof:** Since  $P \subseteq Q$ , then  $\text{pcl}(P) \subseteq \text{pcl}(Q)$  and Since  $Q \subseteq \text{pcl}(P)$ , then  $\text{pcl}(Q) \subseteq \text{pcl}(\text{pcl}(P)) = \text{pcl}(P)$ . Therefore  $\text{pcl}(P) = \text{pcl}(Q)$ .

**Theorem 2.19.**

Let  $P$  and  $Q$  subsets of  $(U, \tau_R(X), KS_R(X))$ . Then  $KS_{gp}\text{-cl}[KS_{gp}\text{-cl}(P)] = KS_{gp}\text{-cl}(P)$ .

**Proof**

Let  $E$  be  $KS_{gp}$ -closed set, containing  $P$ . Then by defn,  $KS_{gp}\text{-cl}(P) \subseteq E$ . As  $E$  is  $KS_{gp}$ -closed set and include  $KS_{gp}\text{-cl}(P)$  and is contained in every  $KS_{gp}$ -closed set containing  $P$ , it follows that  $KS_{gp}\text{-cl}[KS_{gp}\text{-cl}(P)] \subseteq KS_{gp}\text{-cl}(P)$ . Therefore  $KS_{gp}\text{-cl}[KS_{gp}\text{-cl}(P)] = KS_{gp}\text{-cl}(P)$ .

**Theorem 2.20.**

A subset  $P$  is  $KS_{gp}$ -closed iff  $KS_{gp}\text{-cl}(P) = P$ .

**Proof**

Let  $P$  be  $KS_{gp}$ -closed set in  $(U, \tau_R(X), KS_R(X))$ . Since  $P \subseteq P$  and  $P$  is  $KS_{gp}$ -closed set,  $P \in \{G: P \subseteq G, G \text{ is } KS_{gp}\text{-closed set}\}$  which implies that  $\cap \{G: P \subseteq G, G \text{ is } KS_{gp}\text{-closed set}\} \subseteq P$ . i.e.,  $KS_{gp}\text{-cl}(P) \subseteq P$ . Note that  $P \subseteq KS_{gp}\text{-cl}(P)$  is always true. Hence  $P = KS_{gp}\text{-cl}(P)$ . Conversely, Suppose  $KS_{gp}\text{-cl}(P) = P$ . Since  $P \subseteq P$  and  $KS_{gp}$ -closed set. Therefore  $P$  must be a  $KS_{gp}$ -closed set. Hence  $P$  is  $KS_{gp}$ -closed.

**Theorem 2.21.**

The Union of  $KS_{gp}$ -closed set is  $KS_{gp}$ -closed.





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**Proof**

Let  $P$  and  $Q$  be  $KS_{gsp}$ -closed sets in  $U$ . Let  $V$  be a  $KS$ -open in  $U$  such that  $P \cup Q \subseteq V$ . Then  $P \subseteq V$  and  $Q \subseteq V$ . Since  $P$  and  $Q$  are  $KS_{gsp}$ -closed sets,  $spcl(P) \subseteq V$  and  $spcl(Q) \subseteq V$ . Hence  $spcl(P \cup Q) = spcl(P) \cup spcl(Q) \subseteq V$ . i.e.,  $spcl(P \cup Q) \subseteq V$ . Therefore  $P \cup Q$  is  $KS_{gsp}$ -closed.

**Theorem 2.22.**

If  $P$  is a  $KS_{gsp}$ -closed and  $P \subseteq Q \subseteq spcl(P)$ , then  $Q$  is  $KS_{gsp}$ -closed.

**Proof**

Allow  $Q \subseteq V$ , when  $V$  is open in  $U$ . So  $P \subseteq Q$ , this indicates  $P \subseteq V$ . As  $P$  is  $KS_{gsp}$ -closed,  $spcl(P) \subseteq V$ . As  $Q \subseteq spcl(P)$ , this indicates  $spcl(Q) \subseteq spcl(P)$ . Thus  $spcl(Q) \subseteq U$ . Hence  $Q$  is  $KS_{gsp}$ -closed.

**Theorem 2.23.**

If  $P$  is both  $KS$ -open and  $KS_{gsp}$ -closed then  $P$  is  $KS$ -semi-pre-closed in  $U$ .

**Proof:** Let  $P$  is open and  $KS_{gsp}$ -closed in  $U$ , then  $spcl(P) \subseteq P$ . But  $P \subseteq spcl(P)$ . Therefore  $spcl(P) = P$ . Hence  $P$  is  $KS$ -semi-pre-closed.

**Theorem 2.24.**

$P \subseteq Q \subseteq U$ , where  $Q$  is  $KS$ -open and  $KS_{gsp}$ -closed in  $U$ . If  $P$  is  $KS_{gsp}$ -closed in  $Q$ . Then  $P$  is  $KS_{gsp}$ -closed in  $U$ .

**Proof**

Let  $X$  be a  $KS$ -open set in  $U$  such that  $P \subseteq X$ . Since  $P \subseteq X \cap Q$ ,  $X \cap Q$  is  $KS$ -open in  $Q$  and  $P$  is  $KS_{gsp}$ -closed in  $Q$ ,  $spcl(P) \subseteq X \cap Q$ . Now  $spcl(P) \cap Q \subseteq X \cap Q$ . Since  $P \subseteq Q$ ,  $spcl(P) \subseteq spcl(Q)$ . Since  $Q$  is  $KS$ -open and  $KS_{gsp}$ -closed in  $U$ , By above theorem,  $Q$  is  $KS$ -semi-pre-closed. Therefore  $spcl(Q) = Q$ , this implies  $spcl(P) \subseteq Q$ . Thus  $spcl(P) = spcl(P) \cap Q \subseteq X \cap Q \subseteq X$ . Hence  $P$  is  $KS_{gsp}$ -closed in  $U$ .

**Theorem 2.25.**

An  $KS_{gsp}$ -closed set  $P$  is  $KS$ -closed iff  $spcl(P) - P$  is  $KS$ -closed.

**Proof**

Necessity: Let  $P$  is  $KS$ -closed. Then  $spcl(P) = P$  and so  $spcl(P) - P = \emptyset$  is  $KS$ -closed.

Sufficiency: Suppose  $spcl(P) - P$  is  $KS$ -closed. Then  $spcl(P) - P = \emptyset$ . Since  $P$  is  $KS$ -closed. i.e.,  $spcl(P) = P$  (or)  $P$  is  $KS$ -closed.

**Theorem 2.26.**

Let  $P$  be a  $KS_{gsp}$ -closed set and  $F$  be a  $KS$ -closed set in  $U$ . Then  $P \cap F$  is  $KS_{gsp}$ -closed set in  $U$ .

**Proof**

Let  $P$  be a  $KS_{gsp}$ -closed set in  $U$ . Then  $spcl(P) - P \in KS_R(X)$ , whenever  $P \subseteq V$  and  $V$  is open. Let  $F$  be a  $KS$ -closed set in  $U$ . Since every  $KS$ -closed set is  $KS_{gsp}$ -closed. Hence  $F$  is  $KS_{gsp}$ -closed. Since  $P$  and  $F$  are  $KS_{gsp}$ -closed set of  $U$ , then their intersection  $P \cap F$  is also  $KS_{gsp}$ -closed, finite intersection of any two  $KS_{gsp}$ -closed set is  $KS_{gsp}$ -closed. Thus  $P \cap F$  is  $KS_{gsp}$ -closed.

**Theorem 2.27.**

Let  $(U, \tau_R(X), KS_R(X))$  be a Kasaj topological spaces and  $P \subseteq U$ . If  $P \subseteq Q \subseteq spcl(P)$ , then  $spcl(P) = spcl(Q)$ .

**Proof:** Since  $P \subseteq Q$ , then  $spcl(P) \subseteq spcl(Q)$  and Since  $Q \subseteq spcl(P)$ , then  $spcl(Q) \subseteq spcl(spcl(P)) = spcl(P)$ . Therefore  $spcl(P) = spcl(Q)$ .





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**Theorem 2.28.**

Let  $P$  and  $Q$  subsets of  $(U, \tau_R(X), KS_R(X))$ . Then  $KS_{gsp}\text{-cl}[KS_{gsp}\text{-cl}(P)] = KS_{gsp}\text{-cl}(P)$ .

**Proof**

Let  $E$  be  $KS_{gsp}$ -closed set, containing  $P$ . Then by defn,  $KS_{gsp}\text{-cl}(P) \subseteq E$ . As  $E$  is  $KS_{gsp}$ -closed set and include  $KS_{gsp}\text{-cl}(P)$  and is contained in every  $KS_{gsp}$ -closed set containing  $P$ , it follows that  $KS_{gsp}\text{-cl}[KS_{gsp}\text{-cl}(P)] \subseteq KS_{gsp}\text{-cl}(P)$ . Therefore  $KS_{gsp}\text{-cl}[KS_{gsp}\text{-cl}(P)] = KS_{gsp}\text{-cl}(P)$ .

**Theorem 2.29.**

A subset  $P$  is  $KS_{gsp}$ -closed iff  $KS_{gsp}\text{-cl}(P) = P$ .

**Proof**

Let  $P$  be  $KS_{gsp}$ -closed set in  $(U, \tau_R(X), KS_R(X))$ . Since  $P \subseteq P$  and  $P$  is  $KS_{gsp}$ -closed set,  $P \in \{G: P \subseteq G, G \text{ is } KS_{gsp}\text{-closed set}\}$  which implies that  $\cap\{G: P \subseteq G, G \text{ is } KS_{gsp}\text{-closed set}\} \subseteq P$ . i.e.,  $KS_{gsp}\text{-cl}(P) \subseteq P$ . Note that  $P \subseteq KS_{gsp}\text{-cl}(P)$  is always true. Hence  $P = KS_{gsp}\text{-cl}(P)$ . Conversely, Suppose  $KS_{gsp}\text{-cl}(P) = P$ . Since  $P \subseteq P$  and  $KS_{gsp}$ -closed set. Therefore  $P$  must be a  $KS_{gsp}$ -closed set. Hence  $P$  is  $KS_{gsp}$ -closed.

**CONCLUSION**

We made an effort to focus on the  $KS_{gsp}$ -closed and  $KS_{gsp}$ -closed sets. Additionally, we explore to study the characterizations of the  $KS_{gsp}$ -closed and  $KS_{gsp}$ -closed sets.

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## An *in vitro* Evaluation of the Cytotoxic Efficacy of Different Solvent Extracts of *Tylophora indica* against Hepatocellular Carcinoma (HepG2) Cells

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### ABSTRACT

The aerial part of the plant *Tylophora indica* (Asclpiadaceae) was successively extracted with hexane, chloroform and methanol at room temperature. The extracts were subjected to phytochemical screening to identify the different classes of compounds. The extracts were also tested for cytotoxic activity against HepG2 cells by MTT colorimetric assay. Even though the hexane extract did not contain any alkaloid showed the highest cytotoxic activity against the tested HepG2 cells. Cytomorphological studies have also been carried out. The present investigation showed that the nonalkaloidal constituents also contribute to the biological activities of the plant which may be investigated.

**Keywords:** *Tylophora indica*, successive extracts, MTT assay, HepG2 cells, Cytomorphology

### INTRODUCTION

Cancer is the leading cause of death in every country on the planet, and it is a significant impediment to extending life expectancy(1, 2).Hepatocellular carcinoma (and alcohol consumption are causes of liver cancer. It was found that 75% - 85% of the patients with liver cancer are HCC) is the second biggest cause of cancer-related mortality globally. It is a highly malignant and aggressive cancer form (3,4).HCC incidence has risen substantially in recent decades over the world(5).Chemo/radiotherapy, surgical resection, radio-frequency ablation, targeted treatments employing multi/tyrosine kinase inhibitors, and liver transplantation are currently available therapeutic options for HCC (6, 8). The developing countries account for 85% of liver cancer (9).Smoking, diabetes, poor dietary habits, hepatitis, an increase in iron concentration smoking, diabetes, poor dietary habits, hepatitis, infected with Hepatitis B and C virus (10, 11),study shows the effects of chemotherapy and radiation therapy warrant alternate modes of treatment (12,





13). Natural products or becoming more popular in cancer treatment (14). Plants currently account for more than 60% of anti-cancer drugs (15). Over 3,000 plant species are potential anticancer agents (16). *Tylophora indica* (Burm. f.) Merrill (family Asclitiataceae), a perennial climber is an end star plant commonly known as Antmool in Hindi, Arkaparni Sanskrit and Nanjaruppan in Tamil. It is distributed in the subtropic part of the world. In India, it is mainly found from Uttar Pradesh to Meghalaya up to an elevation of 1,260m in the sub Himalayan tract. In traditional medication, it is used to treat asthma, bronchitis, rheumatism, inflammation, tumors, allergies, dysentery, cough, and could, ext. The plant contain spenanthroindolizidine alkaloids (0.2-0.46%) of which tylophorine is the major constituent. Other chemical constituents include Stereos, terpenoids, lipids, flavonoids, tannins, glycosides and saponins. Biological activities such as antimicrobial, antioxidant, anti-asthmatic, anti-allergic, antiinflammatory, antirheumatic, antiulcer, antipsoriasis, anxiolytic, hypolipidemic, antitumor, hepatoprotective, anti-diabetic, diuretic, immune modulatory, anticancer activity, antidysenmery, antidiarrhoeal, antifeedant, mosquito larvicidal and insect repellent properties have been reported. Many of the activities are attributed to the alkaloids present. In this communication, we report the cytotoxic activity of the successive hexane, chloroform and methanol extracts of the aerial parts of the plant against hepatocellular carcinoma (HepG2) cells, *in vitro* by MTT assay.

## MATERIALS AND METHODS

### Collection of the plant material

The aerial part of the plant *T.indica* was collected from Kanyakumari district Tamil Nadu India. The identity was authenticated by the taxonomist at Entomology research institute Loyola College Chennai Voucher specimen No (ERI DD 1-5) has been deposited in the herbarium of the institute.

### Extraction

1 kg of the shade dried and coarsely powdered aerial part of the plant was successively extracted with hexane, chloroform and methanol at room temperature (48 h). In each case, extraction was is done twice. The extracts were filtered through Whatman No 1 filter paper and concentrated in a rotary vacuum rotary evaporator. The solvent free residues (39, 60 and 91g respectively) were stored in airtight glass containers kept at 4°C in a refrigerator until further use.

### Phytochemical screening of the extracts

The phytochemical screening of the various extracts was carried to identify the various classes of phytoconstituents by stated procedures (17, 18).

### Test for steroid (Lieberman-Burchard test)

A few mg of the substance is dissolved in 1.0 ml chloroform and treated with two to three drops of acidic anhydride acidic and one drop of con H<sub>2</sub>SO<sub>4</sub>. The mixture is heated gently if necessary. The appearance of green or blue-green color indicates the presence of a steroid.

### Test for Terpenoid (Noller's test)

A few mg substances in a dry test tube was treated with din pit and about 1 ml of thionyl chloridethe mixture is heated gently if necessary. The appearance of reddish pink color indicates the presence of terpenoid.

### Test for phenol

A few mg of substance dissolved in about 1.0 ml of alcohol retreated with a few drops of 0. 1% alcoholic FeCl<sub>3</sub> any colorations (Blue, Blue Green, red, brown ext.) indicate phenol.



**Dharmalingam Dinesh et al.,****Test for quinole**

A few mg of the substance dissolved in about 1.0 ml of alcohol and treated with a few drops of an alkali solution (NaOH, KOH or NH<sub>4</sub>OH). The appearance of a dark color (red, reddish pink, blue violet ext.) indicates the presence of quinole.

**Test for flavonoid (Shinoda test)**

A few mg of the substance dissolved in about 1.0 ml alcohol is treated with magnesium turnings and three drops con HCL. The appearance of reddish pink color indicates the presence of flavonoid. Oxygenation at C-3 is necessary.

**Test for tannin**

A few mg of the substance dissolved in about 1.0 ml of alcohol is treated with a few drops of lead acetate solution bulky precipitated indicates the presents of tannin. The addition of gelatin solution also precipitates tannins.

**Test for alkaloid**

A few mg of the substance was dissolved in about 1.0 ml of 2% HCL or acetic. To the clear solution is added 2 or 3 drops of Dragendorff's reagent. Red orange precipitate indicates the presence of alkaloids. The addition of excess reagent should be avoided. Similarly, the addition of Meyers reagent gives a creamy yellow precipitate for alkaloids.

**Test for Glycoside /sugar**

A few mg of the substance watch glass was mixed with an equal quantity of anthrone. The mixture and dissolved in a few drops of alcohol and dried in a water bath. 2or 3 drops of Con H<sub>2</sub>SO<sub>4</sub> was added and rubbed with a glass rod. The mix is gently headed, if necessary. The appearance of dark green color indicates the presence of Glycoside/sugar.

**Test for Saponin**

A few mg of the substance is shaken with water appearance of permanent lather indicates the presence of saponin.

**Cell line and culture conditions**

A humanliver cancer cell line (HepG2) was procured from National Centre for Cell Sciences (NCCS, Pune India). The obtained cells were grown as a monolayer in a complete tissue culture medium Duldecco's Modified eagles medium (DMEM, Himedia) supplemented with 10% fetal bovine serum (FBS), penicillin (100 units/mL) and streptomycin (1 mg/mL). The cells were grown and maintained in 5% CO<sub>2</sub> and 95% air with 90% relative humidity at 37°C in a CO<sub>2</sub> incubator. Upon reaching 80-90% confluency the cells were trypsinized and passaged.

**Cell viability assay**

Mosman's(1983) approach was utilised to assess the cell viability of HepG2 cells using MTT analysis. (19, 20)The cytotoxicity of the successive hexane, chloroform and methanol extracts of *Tylophora indica* were tested by the MTT colorimetric assay. Briefly, concentrations of 100,200,300,400 and 500 µ/ml of the three extracts were added to 1x10<sup>5</sup>cells/ml medium 200µl medium in a 96 well microstate plate and incubated for 48hr. after treatment the medium was removed and yellow MTT 3-(4, 5-dimethylthiazol-2-yl)-2, 5-diphenyltetrazolium bromide solution, 100 µ/ml (5mg/ml in PBS) was added to each well and incubated for 4hr. purple form azan derivative was precipitated as detected by inverted microscopy. MTT solution was decanted and the form azan crystals were dissolved in 100 µl DMSO after agitation for 5min. the absorbance was measured at 570nm in an ELISA micro plate read. Cell viability percentage was calculated using the formula cell viability % = OD of control- (OD of tested sample / OD of control) x 100

**Statistical analysis**

The results of the MTT colorimetric assay were subjected to statistical analysis. All experiments were done in triplicate and the data were expressed as men± standard deviation. One-way analysis of variance (ANOVA) was performed using Graph pad prism version 5 software.



**Dharmalingam Dinesh et al.,****Cytomorphological Studies**

The morphological changes induced by the successive hexane, chloroform and methanol extracts on HepG2 cells were assessed. HepG2 cells ( $1 \times 10^5$  cells/ml) were placed in 100 mm plates and incubated for 24 h. The culture media was then removed and fresh hexane, chloroform and methanol extracts were added at different concentrations viz. 100, 200, 300, 400 and 500  $\mu\text{g/ml}$  and incubated for 24 h. The incubated HepG2 cells were viewed under an inverted microscope at 40 $\times$  magnification.

**RESULTS**

The cytotoxic activity of the three successive extracts viz. hexane, chloroform and methanol of the aerial part of the plant was performed by MTT colorimetric assay of HepG2 cells the results are given in Table 2 and Fig 4 – 6. The IC 50 values of the three extracts were found to be 298.27  $\mu\text{g/ml}$ , 478.24  $\mu\text{g/ml}$ , and  $\geq 500 \mu\text{g/ml}$  respectively. The morphological changes of treated HepG2 cells with successive hexane chloroform and methanol extracts at different concentrations are given in Figures 7a-7f, 8a-8f and 9a-9f. The morphological profiles of the various extracts showed that the hexane extract is the most effective in inhibiting the cell growth of HepG2 cells. These cells were lysed and degraded as the concentration of the extract was increased. This showed the highest cytotoxic potential of the hexane extract than the other extracts as also confirmed by the cell viability assay.

**DISCUSSION**

*Tylophora indica* has been a well-known drug used in folk and traditional medicines for a long time. The indiscriminate use of the drug in treating respiratory disorders like asthma, tumors, dysentery, diarrhea, psoriasis, and liver disorders has made the drug rare and is now listed as a plant. Several Pharmacological studies on the antitumor activity of the extracts, and isolated phenanthroindolizidine alkaloids as tylophorine and many of the synthesized analogs have been reported (21). One of the basic concepts of most contemporary cancer therapeutics is the activation of apoptosis by medicinal plant extracts and their derived compounds (22-26). The aqueous and alcoholic extracts of the plant, the alkaloids, and their synthetic analogs have been tested for cytotoxic activity against several cancer cell lines such as liver cancer, skin cancer, colon cancer cell line, etc. Even though the plant extracts and alkaloids showed prominent anticancer activity the use of the plant and the alkaloids has declined since the 1960s due to severe side effects (21, 27). The ethanol extract was found to be toxic to baby hamster kidney fibroblast cells (28). The plant extract was found to be toxic even at 20  $\mu\text{g/ml}$  (29). A single dose (12- 100 mg/kg) of pure alkaloids from the plant was found to cause indolence, salivation, respiratory obstruction and diarrhea in male rats (30). In the present study, we have investigated the cytotoxic activity of the successive hexane, chloroform and methanol extracts of the aerial parts of the plant against hepatocellular carcinoma HepG2 cells. It was found that hexane extract was the most active compared to the other two extracts. It should be noted that the hexane extract is devoid of alkaloids which are mainly responsible for the toxic effects observed in the plant. Hence bioactivity guided fractionation of the active hexane extract may be carried out to isolate the active constituents. It would be worthwhile to investigate whether the hexane extract shows other cytotoxic activities reported for the plant together with a toxicity assessment.

**CONCLUSION**

In the present study, we have investigated the cytotoxic activity of the successive hexane, chloroform and methanol extracts of the aerial parts of the plant against hepatocellular carcinoma HepG2 cells. It was found that hexane extract was the most active compared to the other two extracts. It should be noted that the hexane extract is devoid of alkaloids which are mainly responsible for the toxic effects observed in the plant. Hence bioactivity guided fractionation of the active hexane extract may be carried out to isolate the active constituents. It would be worthwhile



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to investigate whether the hexane extract shows other cytotoxic activities reported for the plant together with a toxicity assessment.

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**Table 1: The results of the phytochemical screening of the various extracts**

| S. No | Phytochemical constituent | The test results of the extracts |            |          |
|-------|---------------------------|----------------------------------|------------|----------|
|       |                           | Hexane                           | Chloroform | Methanol |
| 1     | Steroid                   | +                                | +          | +        |
| 2     | Terpenoid                 | +                                | +          | +        |
| 3     | Phenol                    | +                                | +          | +        |
| 4     | Flavonoid                 | +                                | +          | +        |
| 5     | Quinone                   | -                                | -          | -        |
| 6     | Tannin                    | -                                | -          | +        |
| 7     | Alkaloid                  | -                                | + (traces) | +        |
| 8     | Glycoside                 | -                                | -          | +        |
| 9     | Saponin                   | -                                | -          | +        |

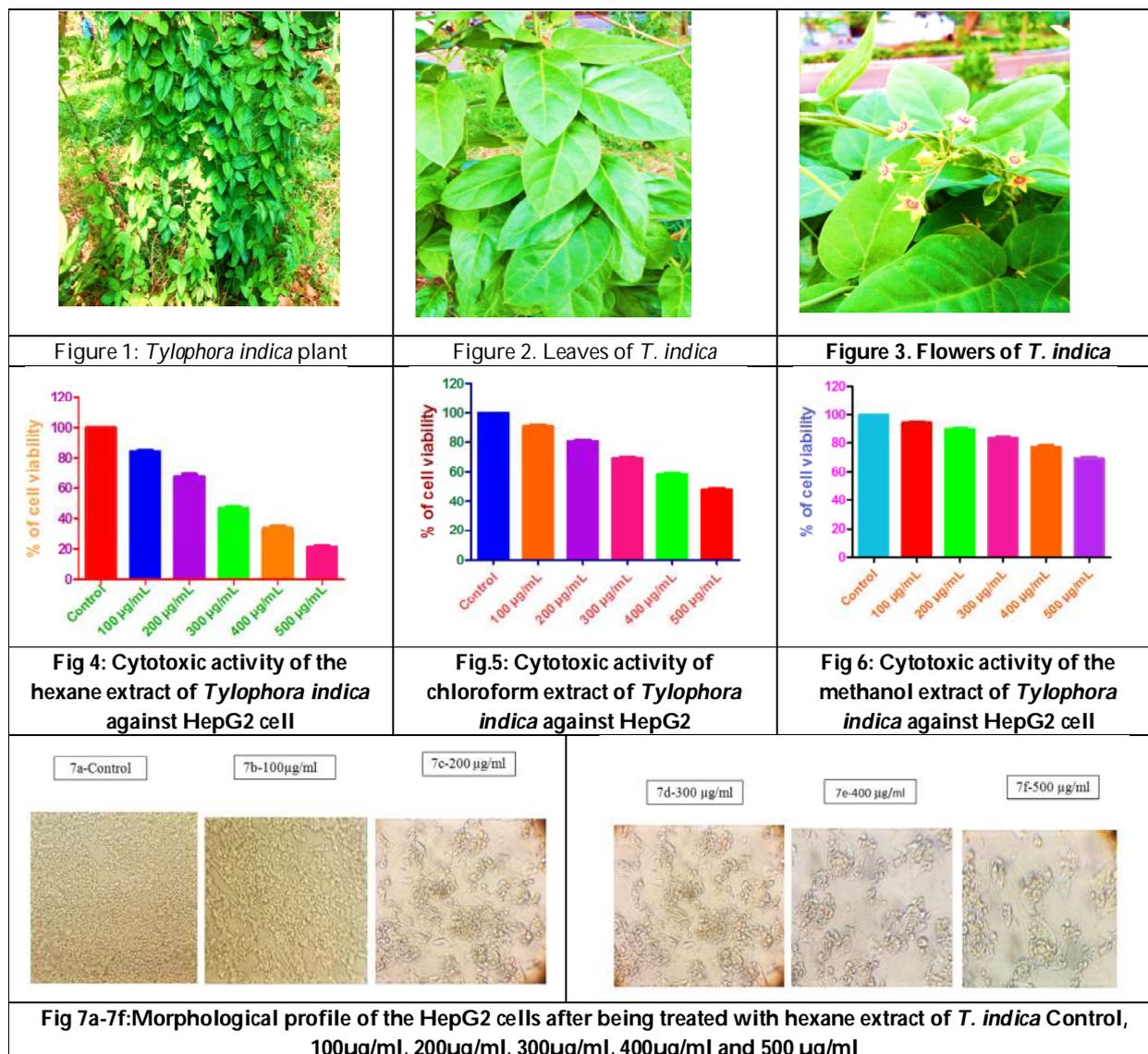




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**Table 2: Cytotoxic activity of the various extracts of the aerial part of *Tylophora indica* against HepG2 cell line**

| Concentration<br>µg/ml | Percentage cell viability of the extracts |              |              |
|------------------------|---|--------------|--------------|
|                        | hexane                                    | Chloroform   | methanol     |
| 100                    | 84.44 ± 0.83                              | 90.95 ± 1.37 | 94.34 ± 0.87 |
| 200                    | 67.91 ± 1.61                              | 83.64 ± 1.06 | 89.66 ± 1.04 |
| 300                    | 46.44 ± 1.32                              | 69.25 ± 0.96 | 83.46 ± 0.71 |
| 400                    | 33.68 ± 1.48                              | 58.43 ± 0.70 | 77.34 ± 1.23 |
| 500                    | 21.38 ± 0.99                              | 48.30 ± 0.84 | 69.41 ± 1.18 |





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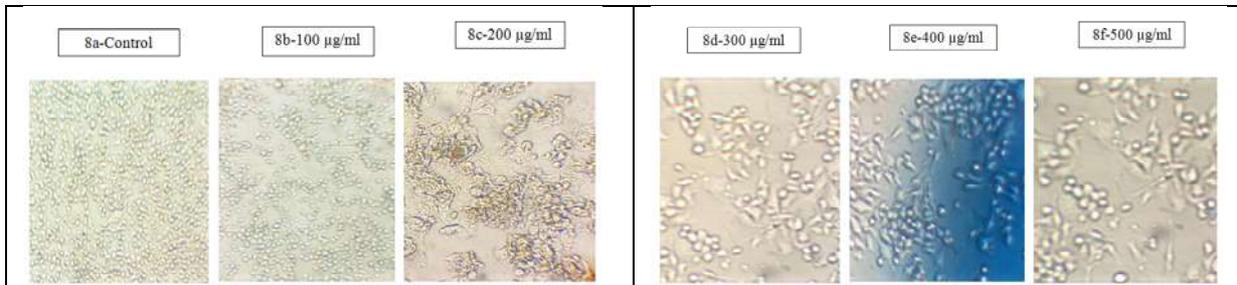


Figure 8a-8f: Morphological profile of the HepG2 cells after being treated with chloroform extract of *T. indica* Control, 100µg/ml, 200µg/ml, 300µg/ml, 400µg/ml and 500 µg/ml

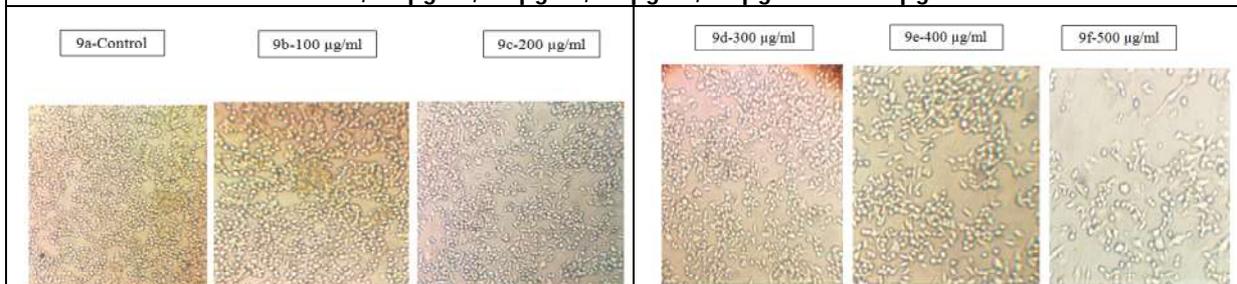


Figure 9a-9f: Morphological profile of the HepG2 cells after treated with Methanol extract of *T. indica* Control, 100µg/ml, 200µg/ml, 300µg/ml, 400µg/ml and 500 µg/ml





## Life Attitude, Moral Values and Parental Bonding: A Correlation Study

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### ABSTRACT

A healthy relationship between a child and parent demands consistent effort and comprehension. The cornerstone for your children's development, socially & emotionally, is the relationship you make with them as they grow up. However, it is not always straightforward. You may find it harder to bond with them as they become older, their moods change, and they face new obstacles. There are a number of considerations in such circumstances. The paper investigates the scope of existence of any relationship between moral values, life attitude and parental bonding through a pilot study. The study intends to understand their existing relation, if any, in order to explore adolescents' behaviour in a better manner. The paper also stresses on examining the relationship between life attitude, parental bonding & moral values and to explore if moral values help in formation of life attitude. Parental bonding, life attitude and Moral values have been assessed on 40 adolescents aged 15-18 years. Pearson's Correlation, Mean has been used as statistical technique to analyze and interpret the result. After collecting the data from 40 adolescents of age group 15-18 years, it is analyzed that a positive correlation exists between moral values and life attitude among adolescents.

**Keywords:** Parental Bonding, Values, Life Attitude, Adolescents

### INTRODUCTION

Morals or morality refers to the righteousness of your decisions, actions, intentions or perception. Morality represents the action which is approved as right by the society or perceiver that is further based on societal norms or regulations. Morality involves right judgment, right decision making and right behaviour as approved by the society or observer. A person sometimes may be found cheating his/her moral thought process or dishonest to his/her own moral cognitions. In such a situation a person finds himself in clutches of inner guilt. Our personal preferences,





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choices and desires generally form the basis of our value system. When these intensify, they take the shape of our values and become an enduring part of our character. These then become our criteria for our selections, choices, judgments, relationships and our decisions in day-to-day life and lend strength to our character. These also determine our approach towards life and how we tend to handle situations. Values inculcate positive attitude and emotional intelligence in a person which aid and guide him in distinguishing between the right and the wrong. This ultimately helps a person in leading a quality life (Gill, 2015).

In olden times, students were sent to gurukuls to gain knowledge. Honesty, wisdom, social service, cooperation, faith, courage used to be a part of the education system apart from imparting other skills. But in the present times, there is a shift from such moral culture. The exposure to media and internet have brought new culture into existence. Privacy, nuclear families, self satisfaction, self pleasure, lack of sentiments for others, dishonesty, selfishness and luxury are among some of the emerging values among adolescents. As a result, present youth is more adorned by lust, pride, over confidence, arrogance and self comforts. Modern education system is more concerned in working as a source to get associated with a good profession and less emphasis on moral values among youngsters. Changes pertaining to the moral values have imposed serious threats and consequences to society. Anger, violence, agitation, crime, adultery, frauds, scams, drug addictions, diminishing mental health are resultantly more predominant in the society.

The statistics as put forth by Varghese & Michael (2014), from 2003 to 2012, the total crime in India is increased by 39.10%, while the total increase in population is 11.55% only. The last 25 years of India from the year 1988 to 2012 record the increase in crime rates by 65.73% with the increase in population growth rate by 52.80%. If the data is referred then it is evident that the number of people who are involved in crime and related antisocial activities has been continuously increasing. In 1960, there were 134.5 incidents of crime rate over 1 lakh of population. This rate of crime was increased to 172.2 in 1970 and it further rose to 195.9 in 1980. Between 1990-2000, a minor downfall in rate of crime was also observed with crime rate ranging between 184.7 and 169.9, but in 2010 these crime rates further increased back to 184.5. The years between 2008 to 2012, show an average rate of crime to be 184.89 per 1 Lakh of Indian population. The values like endurance, respect towards individual, equality, love for nation, pro social behaviour, charity, justice have faded away or have been replaced by intolerance, corruption, gambling, conflicts, aggression and violence in today's world. (Barahate, 2014).

#### LIFE ATTITUDE

Life Attitude indicates the overall value system and opinion a person holds for living, happiness, adversity, pain, joy, tears, health and death. The people who hold positive attitude towards life, life seems to be more meaningful to them. (King, Hicks, Krull & Del Gaiso 2006).

There can be few dimensions of looking at one's life attitude or attitude towards life-

1. Affirmation of meaning and value of life – means the assertion of the intrinsic and innate meaning, value and goals in life irrespective of circumstances; constructive values of life like liberty of pursuing one's visions, desires or happiness.
2. Acceptance means the realization or acceptance that suffering and negative times are an inescapable aspects of one's life; a readiness to confront the reality which is present, irrespective of the fact that one is dejected; recognition of one's own weaknesses, limitations and all the unfortunate circumstances that have come one's way.
3. Courage - The mental readiness to confront any obstacles, barriers and unforeseen dangers in life so that one can remain loyal and genuine towards one's own determinations and life objectives and then to be able to stay alive.
4. Faith - The readiness to hold trust in God or the acceptance of the presence of the supreme power while confronting doubtful and hopeless circumstances.
5. Self-transcendence - The ability to get up against all odds, life challenges, situational constraints, and other limitations with the zeal to serve humanity and mankind and leave behind the imprints of good deeds in this world. (Wong, P. T. P., Leung, M., Steinfort, T., & Vroon, E. J. 2002)





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### **PARENTAL BONDING**

A good parenting or the strength between parent child relationship lies in nurturing/ building strong roots of social, physical and emotional development within a child. Parent- child relationship forms the very foundation of the personality of a child, his overall behaviour and the quality of choices in life that the child would make. It also develops the decision making ability within an individual. Parental bonding lays the foundation of a child's physical, emotional, psychological well being. Parental bonding refers to the emotional and committed relationship a child feels in his/her parents. Some of the advantages of strong parental bonding may include emotional security and healthy attachment, greater chances of sharing happy and contented relationships with other people, higher quotient of emotional regulation when faced with stressful and difficult situations. Not only this, parental bonding also promotes a child's linguistic development and overall psychological well –being, confident and optimistic social norms . When parents provide a healthy involvement to their child and take part or intervene in their child's day-to-day activities in a positive/ constructive way, then they indirectly empower their child to acquire better social and academic skills from the environment.

A child eventually develops healthy cognitive, social, emotional, and motivational skills when given a secure environment by the parents. A stronger problem- solving ability can also be seen exhibited by the children who are given positive and constructive parenting. As asserted by the researchers and theorists as the child grows the development of interpersonal relationships within a child is also affected by the types of bonding a child shares with the parent (the first bonding). Children who share a secure bond of attachment with their parents are found to be emerging as an emotionally, physically healthy and functional adults.

They possess high skills of self-regulation, self-confidence, self-understanding, self-esteem, self-competence, problem solving and quality friendships when they grow up as an adult. Blum and Rinehart (1997)highlighted in their study the relevance of family and the home environment in protecting adolescents from damage across all health outcomes studied. The teenager's sense of connectivity with parents and family appears as the most consistently protective factor. Furthermore, few studies revealed that family bonding/ relationships during teenage have significant additional effects on various dimensions, such as individual's independence and autonomy, personality of adolescent as well as individual's pathology and problematic behavior. Amber & Carlson (2012), Parents have a direct impact on their children's aberrant conduct. Raising a child requires constant supervision and support, as well as persistent corrections when these areas are absent, adolescent delinquent conduct is more common. Structure of the family is directly influenced by the parents. While social and emotional development among adolescents is influenced by parenting styles, at the same time, the parental values and morals are also transmitted to their children that consist of belief systems about acceptable and non-acceptable behaviours by the society.

Litovsky and Dusek (1983) asserted that adolescents who find their parents to be accepting and those who enjoy the independence given by their parents, feel high about their persona and they have more opportunities to involve themselves in social skills as compared to the children who find their parents rejecting, cold and controlling. Studies have further revealed that better psychological & social adjustment as well as academic achievement is found among college going students who are securely attached to their parents during their transition period from school to college as compared to students who are insecurely attached to their parents. Higher degree of parenting stress was linked to having a higher child behaviour issues. Negative parenting styles were positively connected to parenting stress, and they partially mediated the relationship between parental stress and child behaviour problems (Miranda 2020)Studies have further revealed that better psychological & social adjustment as well as academic achievement is found among college going children, securely connected to their parents during their transition period from school to college as compared to students who are insecurely attached to their parents. The feelings of positive bonding increases the use of alternate options in a non-threatening manner but disagreement is sometimes understood as a hostile gesture which also promotes an antagonistic reaction in situations of maladaptive bonding (Hauser et al, 1991) Moreover, it was discussed that adolescents whose parents are lesser involved in controlling psychologically and behaviorally reflect increased levels of individuality. They score higher on scales of ego development and psychological competence. Specific correlations indicate relations between deviance and types of parenting. Issues





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like polydrug problems, property crimes and low social conformity is found to be associated with poor parenting (Newcomb 1999). Cultural differences are found in the Finnish and Chinese people in terms of the collective and family values. Finnish people are found to be more individualistic, self regulated and self-determined (Niemi et al 2002). Stronger life- satisfaction among boys and girls of all ages, is linked with parent- child relationship rather than family affluence or family structure (Dallago et al 2011) Family structure is of utmost importance for boys aged 13 years, after adjustment for their attitudes and health behaviours towards peers and school. Easy and healthy communication with parents plays a significant role (as protector) only among girls. On the other hand difficult or unhealthy parent – child communications act as a risk factor and leads to low levels of life satisfaction both among boys and girls (Dallago & Curri 2011). Spiritual health, life attitude and well-being have found to be positively correlated and spiritual health is the overall indicator of well being and life attitude (Chou & Tang, 2016).

## METHODOLOGY

For the purpose the study, Parental bonding life attitude and Moral values have been assessed on a population (sample) of 40 adolescents under the age range of 15-18 years. The tools that are used in the study are Life attitude scale by Wong, P. T. P., Leung, M., Stein fort, T., & Vroon, E. J. (2002); Parental Bonding Instrument (PBI) by Gordon Parker, Hilary Tupling and L.B. Brown. (1979); Moral Values Inventory by Amareswaran N. (2013). In this pilot study Standard Deviation (Pearson's Correlation), Mean has been used as statistical technique to analyse and interpret the result. After collecting the data from 40 adolescents of age group 15-18 years, it is analysed further and interpreted to reach a conclusion. Tables were prepared wherever necessary to present the data.

## RESULT

**Table 1. Descriptive Statistics of variables**

|   | Mean     | Std. Deviation | N  |
|---|----------|----------------|----|
| <b>Moral Values</b>                       | 306.4250 | 16.29203       | 40 |
| <b>Mother Care</b>                        | 27.0500  | 7.12507        | 40 |
| <b>Mother Control</b>                     | 18.0750  | 7.48807        | 40 |
| <b>Father Care</b>                        | 24.5250  | 7.86419        | 40 |
| <b>Father Control</b>                     | 15.8500  | 7.87580        | 40 |
| <b>Affirmation of meaning &amp; value</b> | 13.4500  | 1.96051        | 40 |
| <b>Acceptance</b>                         | 14.2000  | 2.61357        | 40 |
| <b>Courage</b>                            | 12.6000  | 2.04814        | 40 |
| <b>Faith</b>                              | 30.0750  | 6.11592        | 40 |
| <b>Self Transcendence</b>                 | 24.5750  | 4.51145        | 40 |

**Table 2 . Correlations Between Moral Values & subscales of Life Attitude**

|                     |                            | Affirmation of meaning & value | Acceptance | Courage | Faith | Self Transcendence |
|---------------------|----------------------------|--------------------------------|------------|---------|-------|--------------------|
| <b>Moral Values</b> | <b>Pearson Correlation</b> | .345*                          | -.339*     | .430**  | .399* | .342*              |
|                     | <b>Sig. (2-tailed)</b>     | .029                           | .032       | .006    | .011  | .031               |
|                     | <b>N</b>                   | 40                             | 40         | 40      | 40    | 40                 |





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| Table 3. Correlations Between Moral Values & subscales of Parental Bonding |                     |              |             |                |             |                |
|--|---------------------|--------------|-------------|----------------|-------------|----------------|
|  |                     | Moral Values | Mother Care | Mother Control | Father Care | Father Control |
| Moral Values   | Pearson Correlation | 1            | .076        | -.160          | .144        | -.300          |
|  | Sig. (2-tailed)     |              | .642        | .325           | .377        | .060           |
|  | N                   |              | 40          | 40             | 40          | 40             |
| Mother Care  | Pearson Correlation |              | 1           | -.521**        | .652**      | -.518**        |
|  | Sig. (2-tailed)     |              |             | .001           | .000        | .001           |
|  | N                   |              |             | 40             | 40          | 40             |
| Mother Control   | Pearson Correlation |              |             | 1              | -.196       | .714**         |
|  | Sig. (2-tailed)     |              |             |                | .225        | .000           |
|  | N                   |              |             |                | 40          | 40             |
| Father Care  | Pearson Correlation |              |             |                | 1           | -.406**        |
|  | Sig. (2-tailed)     |              |             |                |             | .009           |
|  | N                   |              |             |                |             | 40             |
| Father Control   | Pearson Correlation |              |             |                |             | 1              |
|  | Sig. (2-tailed)     |              |             |                |             |                |
|  | N                   |              |             |                |             |                |

## DISCUSSION

Values are core set of an individual persona. We may call it a personal philosophy or set of belief system that an individual carries and holds in all circumstances of life. To an extent the concept of moral character and conscience as given by psychoanalysts is similar to the concept of moral behaviour used by psychologists. (Donelson, 1973). The word 'Moral' comes from its Latin origin 'Mos' which means rule or practice, customs or a belief system while accomplishing things. The study aims to know the existence of any relationship between life attitudes and moral values & moral values and parental bonding among adolescents. The research tries to explore if moral values help in formation of life attitude for an individual or if parental bonding acts as a predictor of formation of moral values within an individual. Moral courage is that ability of an individuals that drive him/her to overcome his/her fear and fight for his or her core belief system or values. It is the readiness to be able to stand for the truth and accomplish things which are right while confronting external forces, and which would further strengthen a person to respond in some distinguished unique way (Lachman 2007). Global Life Attitude Scale score is calculated by summing up the scores of all responses as given by respondents. The scores of subscales are obtained by summing up the scores of responses to items corresponding to the subscales. The subscales that are used in this study are- Affirmation of meaning and value, Acceptance, Faith, Courage and Self-transcendence. Attitude scores of moral values are taken as dependent variable. Significant correlation is found between moral values and affirmation of meaning & values, moral values & acceptance, moral values & faith, and also between moral values & self - transcendence (as a sub set of Life attitude) at 0.05 level. Significant correlation is found between moral values and courage (as a sub set of Life attitude) at 0.01 level.

Parental bonding instrument was used to assess the relation between the two variables. 'Care' and 'overprotection' or 'control', gives the measure of fundamental style of parenting as perceived by the child. The measure is called 'retrospective', when an adult (over 16 years) is made to recollect as to how they are able to recollect memories related to their parents which are linked to their early life before 16 years of their life. No significant correlation is found between moral values and mother care, mother control, father care and father control. Adolescents with moral values tend to explore a positive meaning and purpose in life even during adverse situations. People with a value system show acceptance towards their weakness and strengths as a person. They show awareness towards their limitations and still future ready to face the challenges of life. The study suggests that an individual with moral





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values is better equipped with convictions to pursue their goals. People with a value system expresses his / her faith in God or the divine power even in stressful situations or in times of ambiguity. "More than half of Americans share Laura Schlessingers's belief that morality is impossible without belief in God" (Pew Research Center,2007). Such individuals have the ability to stand up and work towards human-kind and also leave their footprints in order to make a difference with their presence in this world. Cocodia et al (2015) concluded out that Self Transcendence reflects social and emotional competence through moral foundations within an individual. The adolescents perceived their parents parenting styles as caring or protective/ over protective. It is that the mother who are perceived as caring by their children also tend to exhibit their protective parenting style. Similarly the adolescents perceived their mothers to be caring and father as protective.

## CONCLUSION

The present study asserts that there is a significant correlation between the moral values of an individual and their attitude towards life. The moral values of an adolescent help him/ her in shaping his/her life attitudes. The way an individual looks at life is largely dependent on his/her value system. Life attitude is a positive predictor of value system among adolescents and vice versa. The study also reveals that there is no significant correlation between the moral values exhibited by adolescents in relation their bonding with the parents. The kind of bonding they share with the parents has limited role to play with the values system they hold. This pilot study can be further analysed for its limitations. Researchers can further assert as to which values are dominant among individual. The study does not reveal that which moral values are shaped, nurtured and affected by holding a positive attitude towards life. There can be further analysis on methods to search if the values change with time among adolescents.

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## Traffic Road Congestion Management – A Case Study Cuttack City

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### ABSTRACT

Cuttack, the millennium city, beyond planned expansion, has become geriatric as a cosmopolitan agglomeration. The old capital city has many roads narrowed and traffic congestion is a regular feature at peak hours like other large and medium cities of India like Calcutta, , Pune, Madras, Hyderabad, Delhi etc. jeopardising its traffic flow and prone to regular accidents. The present study mainly focuses on evaluating the traffic congestion problem in the city of Cuttack. Short term action plan needed are multi-tyre parking, shift of fish and vegetable vending zone, upgradation of few roads, and wee hour municipal trash collection and disposal. In this study, traffic junctions suffering from the problem of traffic jamming assessed. The missing connectors, and upgradation to link roads/ring road, where, the traffic study was conducted. Those roads/ junctions where the traffic congestion is already a glitch in the transportation system investigated and various reasons of traffic congestion discussed. A road safety audit is those traffic junctions, which are going to have new intersections that can create traffic issues in the city. The process to avoid and plan the uninterrupted movement by GIS and RS dataof traffic and vehicles identified. A revised plan forunremitting flow of traffic, the widening of roads, connectors, interlinks with provision of Automated Traffic Management System (ATMS), provision of Variable Message Signs (VMS), weight-in-Motion (WIM) System with a central control room for Traffic Surveillance and continuous.

**Keywords:** Cuttack city, Traffic Congestion, Black spot, Round about Road traffic crash





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## INTRODUCTION

Traffic congestion is a process in which the transportation or movement from one place to for delay in cities now a day and in urban areas the traffic flow is haphazard due to improper planning of roads, the main system of the planning show mitigates the sudden increase in volume of traffic at a point. Road networks are the lifelines of a country in every aspect, whether it may be in the form of developing the country economically or defending the borders. Road networks are a key element for the economic growth of every country. It is essential to develop a strategic and sustained expansion and adequate maintenance of these networks to guarantee quality connections between the various regions of a country another place becomes hectic. The movement becomes very slow due to stagnant positions of traffic. Traffic congestion is the main reason Cuttack is one of the oldest city and the business capital of Odisha. The word Cuttack derives its name from the anglicized Sanskrit word *Kataka*, which has two meanings-one being military camp and the other being the seat of government, protected by the army. The ancient Barabati Fort, one of the oldest military congregations from Muslim period. This city takes pride in the fact that it had been the capital of Odisha. The growth of population, restricted within network of rivers, the expansion was impossible. The artefact has the option of shifting of old capital to new Bhubaneswar about 30km away, from 1948 (Fig 1). Geographically, it is located at a latitude of 20 degree 03" to 20 degree 40" N and a longitude of 84 degree 58" to 86 degree 20" E. Cuttack city is flanked by Mahanadi river on the north and Kathajodi river on the south. Covering a geographical area of 3932km<sup>2</sup>, the District is highly populated. The District experiences tropical climate, with the summer being hot and the winter cold. The maximum temperature that this District experiences is well above 40 degree Celsius (during summer) and the minimum is as low as 10<sup>o</sup> C (during winter). Summer generally lasts from March to June and winter, from October to February. Rainfall is generally heavy during the monsoons, which occur during the months of July and August. The average rainfall received is around 1892.55 mm in the District. South West monsoon is primarily responsible for the rainfall, flood and cyclones, Mishra et al.,

The case study is in Cuttack city of Odisha state. traffic refers to movement of vehicles on roads from one place to another. congestion refers to excessive of vehicles at a place resulting in slower speed or no movement of vehicles which causes traffic at certain spots, hence by using GIS we are going to study and solve the process (GOO, 2018 [2]).

## LITERATURE REVIEW

The connectivity of an area points towards the various road network that joins the location where risk and vulnerability accidents lies, by observing the trauma, nature of accident, the black spots are identified and leaving aside the orthodox traffic management, innovative pertinent action shall minimize it. The players are PTD's (Public transport drivers), safety management in junctions and roads, safe road mobility, Hi-tech vehicles, Safe road use, upgraded Trauma response and fast hospital care, Heath et al., 2006[3], MoRTH 201, The Lancet 20th Dec, 2019[4], WHO's action plan, 2020 [5], Fanai et al., 2022 [6] Fisa et al., 2022[7], Tavakkoli et al., 2022[8].

The space management for urban transport planning and use of GIS and RS is one of the efficient tool for map making, carrying out space availability and management in Cosmo polis and urban areas for the intra and interior traffic management, Yigitcanlar, et al., 2014[9], Chiteculo et al., 2022[10], Sumany et al., 2022[11], Loo et al., 2022[12].The Urban means of transport is its lifeline as population density; higher mobility and greater economy in urbans are much higher than rural areas of India, cannot be spared during disasters like floods, storms, and pandemics.Khanh et al., 2020[13],Zaho et al., 2020[14], Yadav et al., 2020[15], Chen et al, 2021[16], Wang et al., 2022 [17]. Deprived of proper monitoring, orthodox management of traffic, multifaceted official/federal capacities, and diverge urban transport policies and governance in states of Indi, asymmetrical zoning of land are major players in road congestion and cause of delay in transit/travel time. , geospatial planning based on large scale (1:50000maps), inept wide-ranged growth and mobility plans, the road congestion is mounting high and complex, particularly in old Indian cities,Kar et al., 2015[18], Solanki et al., 2016[19], Deepasree et al., 2020[20], Verma et al., 2021[21].

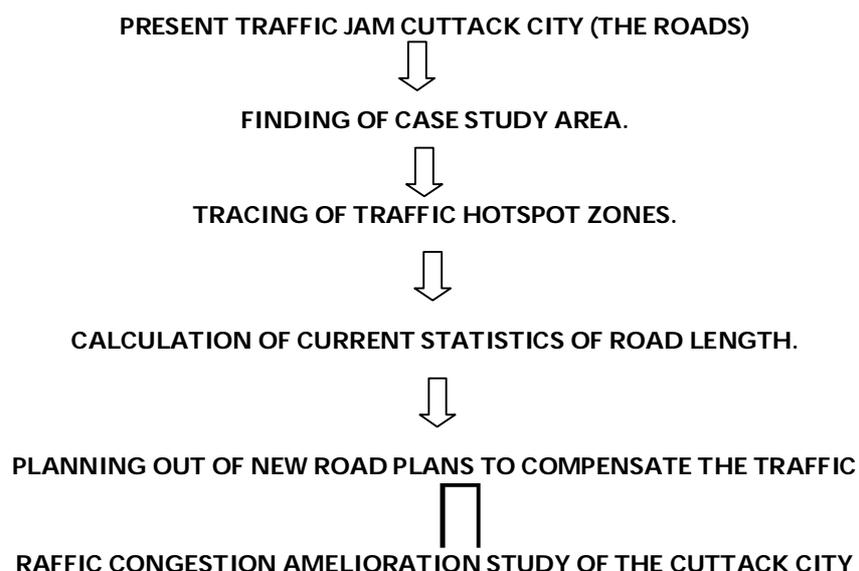




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## METHODOLOGY

According to Odisha urban parking policy, 2013 identified that Fast sprawl of urbans and scarce public conveyance structure accentuated personal vehicles lodging substantial area on town roads on Promote Public-Private Partnership (PPP). The numbers of motorized vehicles based on their registration is rapidly growing in Bhubaneswar, Cuttack, Balasore, Angul, Talcher and Rourkela cities of Odisha in 21st century (GOO data 2018[2], Dash et al., 2021[22]). The Cuttack corridor extending up to Bhubaneswar has emerged as twin city complex demanding mass Rapid Transit System and witnessing futuristic infrastructural expansion demanding traffic demand study, selection of transport system for RSA (road safety audit), (Ratho 2013[23]). In name of agglomeration of Cuttack city a number of projects taken like JICA (ISIP project), JUNURUM etc. moving at snails space and adding to the road congestion in Cuttack city, (Panda A 22nd Mar 2022[24]). The noise level index in some paces of Cuttack streets are >100DB which greater than the WHO norms of 70DB (Swain et al., 2014[25]) mode. Proficient parking, mass transit structure, non-motorised vehicle, electric vehicle, mass transport and long travel time needs prioritisation as city comprehensive mobility master Plan to make the National Urban Transport Policy 2006 successful.



The Mass Transit Model comprises of connectivity within the intra city, the inter city, bypasses/ ring roads, Old city connections, feeder connections and service integrations. The flared and diverted roads can ameliorate the traffic.

### Demography of the case study area

Cuttack, the millennium city of Odisha is an upland with township growth in the interspace between rivers the Mahanadi, the Kathajodi, of Odisha having 298Km<sup>2</sup> of area. The CMC (Cuttack Municipal Corporation) has population of about 6.10Lakh and the growth is at 14%/decade in 2011, and projected for 2022 to congestion of the city. The intra connectivity proposed on analysis of traffic, road size, and importance of the transit ends is the purpose of this investigation Dey et al., 2022 [26].



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763,000, at 1.46% escalation from 2021. Since the business hub, the floating population is about 15000/day (Census India 2011 and <https://www.macrotrends.net/cities/21222/cuttack/population>). The upsurge of the city have grown both horizontally and vertically (Fig 3).

### Tracing of traffic hotspot zones

Traffic congestion points within the Cuttack city are Link road, Manglabag square, Ranihat square, Bajrakabati square, Badambadi square, OMP square, Dolamundai road, Jobra road, Subhash Chandra Bose square, and Road is a medium to connect people from one place to another place and gives a proper direction of the destination. There Nayabazar Square. These squares are congested during peak hours and festive days like Ganesh Puja, Deshhara, Kali Puja, Blijatra etc. The civilians of Cuttack city are live with goodwill, caring and peace loving are various types of roads based on traffic volume. They are very heavy traffic roads, heavy traffic roads, medium traffic roads and light traffic roads. The length of the roads inside the network, from one congestion point to another point considered. The Major roads need connection with each other by interconnecting roads whose length and shape length area in Table 2.

### Networks with revenue settlement

*The network revenue settlement deals with the reasons occur when many vehicles even heavy vehicles plying through, an explicit route at the same time, passing through narrow same lane, simultaneous roaming of animals and passengers, without pedestrian path, lack of public prudence and knowledge of traffic rules, and crowdie vending zones or shops or towpath sellers etc.,*

### PROCESS TO SOLVE

The road congestion can have minimization by improving or applying some basic initiatives. They are improvement of the traffic system across the city, increasing the pavement dimensions, footpath for pedestrians and bicyclists, increasing awareness of traffic control and awareness among the vehicle users, road users and traffic managers. Apart from ring roads and the connectors, removal of illegal occupancy and encroachment by the side of the road. Construction of round about, parking places, alternate routes and approaches, underpasses and over passes needs prioritized. The modified network for smooth passage of traffic fat different congestion points through vehicle underpasses (VUP), pedestrian underpasses (PUP) and over bridges, (Fig-6 and Table 1). This is the new road network plan to regulate the smooth flow of the traffic throughout the main the parts of the area and the road length have been mentioned to check the distance from one traffic point to another.

## RESULTS FROM INVESTIGATION

The mobility demand have escalated with mounting population, modernization and number of vehicle occupancy in Cuttack. The population rise from 1950 to 2022 of Bhubaneswar city from 20K to 1100K and Cuttack from 105k to 763k shows that surge is fast and hence the growth of transport infrastructure. The mobility and transport routes have increased to cater to the growing demand. Motorization is the 2<sup>nd</sup> highest in Cuttack city in independent India next to Bhubaneswar, the capital.

After the completion of the proposed extension of the old and new constructions, some special structures shall be required after clearance of environmental Impact assessment (EIA), Mishra et al, 2021 [27]. The ATMS for safe operation (Automated Traffic Management System), and for information dissemination VMS arrangements (Variable Message Signs), WIM plan for record of weight in motion along with establishment and operation of central traffic control room need provision with priority. The need for various passenger, vehicle transit, and proposed junction designs are in Fig 10 (a) & 10(b)

### The traffic congestion chart

The present traffic congestion chart and the proposed congestion minimization chart at various black spots are in Fig 11(a) and Fig 11(b).



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## DISCUSSION

There are multiple reasons that causes traffic congestion. The players they create traffic congestion are sharing and caring of vehicles, car kilometer travel within the Cuttack city need optimization, encouraging more pedestrians and bicyclists, encouraging public transport, reduce car occupancy rate and introducing plying of rule for odd even registration number within the city, augment efficiency of vehicles and reduce use of fuel for unit road freight. It is desired to design self-explaining roads with forgiving roadside by opting for the best need design standards considering the design speed, horizontal vs. vertical geometry, (C-S) cross-sections, at-grade or grade separated junctions, service roads provisions for both slow and fast traffic. In addition, road fixtures and furniture's needs provision like guard Rails, traffic signage, roadside PV or electrical illumination provisions etc.

The infrastructural measures to be taken within the city are widening the existing ring road from 2 to 4 lane, keep a special lane for first moving vehicle, and parking zones to allow traffic to reach their destination without entering within the town. The unremitting flow, use of one-way traffic for entry and exit, alternate routes for time saving are the choices. Other requirements are widening of all the roads width and maintain regularly for comfortable drive even in artery roads. Building speed breakers to careless driving and reduce accidents by lessening speed of vehicles. The various measures to avoid or minimizing traffic congestion are installation of CCTV cameras, speed display boards, use of unmanned aerial vehicles during peak hours for monitoring and management of traffic volume, speed and law breakers. The rule breakers need to be imposition of heavily penalty to reduce insensitive parking, over speed and alcoholic drivers. The modern GIS mobile traffic control system through UAV, remote control system, and traffic management by trained police (Outayet al., 2020).

The doldrums Cuttack city from traffic flow view shall have fast mobility by implementing a well-judged traffic management system. The well planned transport and road infrastructures shall ensure smooth movement of vehicles on roads, minimize accidents on roads, avoid delay in timing of passengers and vehicles with freight, boost economic of the region, reduce the anxiety among the passenger/rider on road, encourage more bicycles, Parking, and pedestrians and saving of fuel ([29]). From the above study, it is of opinion that the renovations and upgradation road network shall minimize the network traffic and smooth flow of traffic in Cuttack amidst the traffic hotspots with single regime speed flow keeping in mind the traffic volume (Van Aerde 1995[30]).

## CONCLUSION

The millennium city have a poor road network, traffic management system, so that the doldrums city during peak hours, need to have fast traffic movement without interruption. To start with, a devoted traffic transit system with a well-judged Intelligent Transport System (ITS), Parking policy, multimodal integration of railways and transport, Traffic Information Management Control Centre (TIMCC), by formulating an urban transport fund and Advertisement Policy with proper Road safety audit. The better planning can only be possible with a map of small scale 1:1000m. To achieve this like other cities (Varanasi, Bhubaneswar, Ahmadabad etc.), the bid data of the towns need to be accumulated by using modern survey technologies like total stations, Unmanned aerial vehicle (UAV), Differential Global Positioning System (DGPS) and Light Detection and Ranging (LIDAR) by the GIS (Geographical information system) and Remote sensing tools.

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**Table 1 : The new road network plan to minimize the traffic congestion within the city**

| ROAD_NAME | DESCRIPTION | LENGTH KM |
|-----------|-------------|-----------|
| 1         | City road   | 8.08      |
| 2         | City road   | 1.965     |
| 3         | City road   | 2.981     |
| 4         | City road   | 3.11      |
| 5         | City road   | 1.676     |
| TOTAL     |             | 17.812    |

**Table 2 (a): The traffic congested existing roads in Cuttack city with their length**

| TRAFFIC CONGESTION ROAD NETWORK STATISTICS. |                              |           |
|---|------------------------------|-----------|
| ROAD_NAME                                   | DESCRIPTION                  | LENGTH KM |
| 1   | Link Road - Badambadi        | 2.125     |
| 2   | Link Road - OMP              | 1.047     |
| 3   | B - D - B - R - M            | 1.858     |
| 4   | Badambadi - Judicial Academy | 3.474     |
| 5   | Dolamundai - Dargha Bazar    | 1.509     |
| 6   | Dargha Bazar - Buxi Bazar    | 0.839     |
| 7   | D - C - H - C                | 1.737     |
| 8   | Judicial Academy - Trishulia | 3.508     |





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**Table 2 (b): The proposed new network to minimize the traffic congestion in Cuttack city**

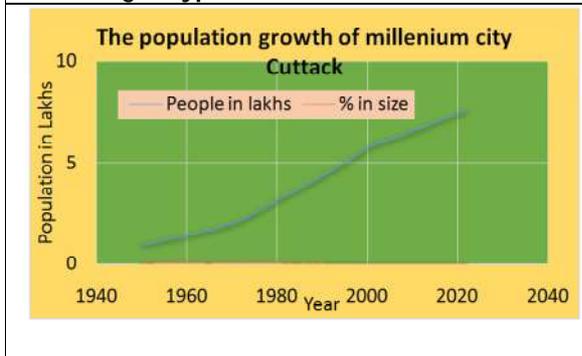
| NEW ROAD NETWORK PLAN TO MINIMISE THE TRAFFIC CONGESTION. |             |           |
|---|-------------|-----------|
| ROAD_NAME   | DESCRIPTION | LENGTH KM |
| 1   | City road   | 8.08      |
| 2   | City road   | 1.965     |
| 3   | City road   | 2.981     |
| 4   | City road   | 3.11      |
| 5   | City road   | 1.676     |



**Fig. 1. The political and roadmap of Cuttack district showing all types of roads around Mahanadi R.**



**Fig. 2. Map showing traffic network, distance between the traffic congestion points.**



**Fig. 3. The growth of population in the cuttack city in the year 1950 to 2022**

| FID | Shape #     | OID_ | Name                         | Shape_Leng | LENGTH (KM) |
|-----|-------------|------|------------------------------|------------|-------------|
| 0   | Polyline ZM | 0    | Link Road - Badambadi        | 0.019951   | 2.125       |
| 1   | Polyline ZM | 0    | Link Road - CMP              | 0.009556   | 1.047       |
| 2   | Polyline ZM | 0    | B - D - B - R - M            | 0.017216   | 1.853       |
| 3   | Polyline ZM | 0    | Badambadi - Judicial Academy | 0.032682   | 3.474       |
| 4   | Polyline ZM | 0    | Dsamundai - Dargha Bazar     | 0.014277   | 1.509       |
| 5   | Polyline ZM | 0    | Dargha Bazar - Buxi Bazar    | 0.007753   | 0.839       |
| 6   | Polyline ZM | 0    | D - C - H - C                | 0.016313   | 1.737       |
| 7   | Polyline ZM | 0    | Judicial Academy - Trishula  | 0.032059   | 3.508       |

**Fig. 4. The inter connecting roads their shape, length within the Cuttack city**





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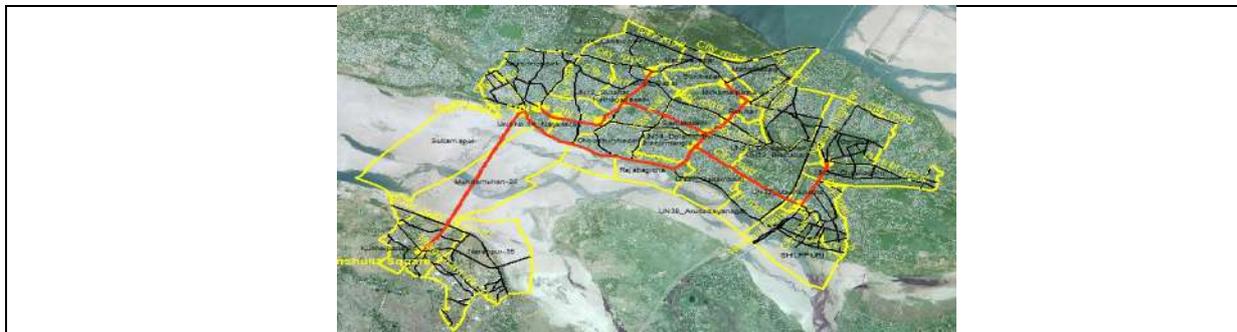


Fig.5. Road Congestion occur during peak hours various stretches shown in Red



Fig.6. Congestion point at important square inside the city and Figure-5 interlinking congestion point

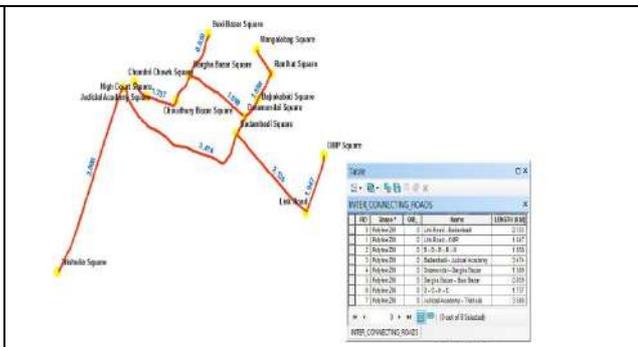


Fig.7. Congestion network showing the distance at each node



Fig.8. proposed modification of the major, artery roads and connectors in Cuttack city

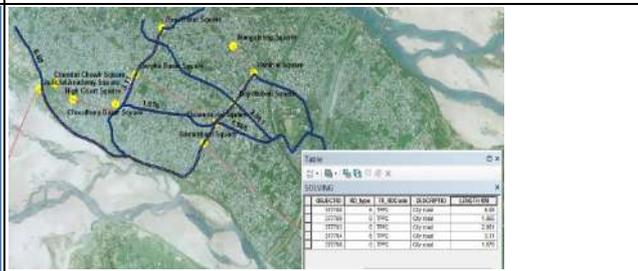


Fig.9. New road network plan with distance at each node at black spots and traffic jam stretch





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Fig.10 The existing congested routes and the proposed improvements to minimize congestion



Fig. 11(a): Existing congestion network (Red) Fig 9(b):The network (Blue need upgrade)

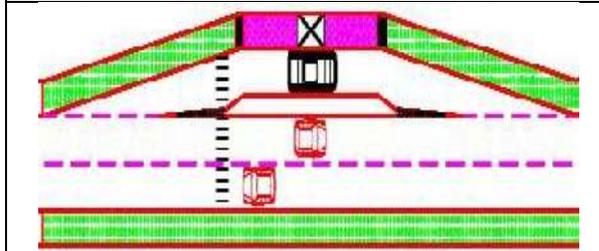


Fig.12 (a): Passenger Transit desirable, Separate Lay bye for buses and taxis for better restriction and improve visibility

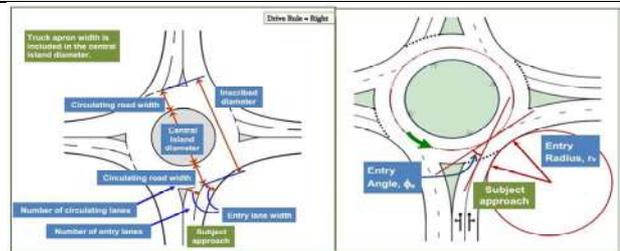


Fig. 12(b): Proposed Junction Design, : Roundabout Geometry parameters, Channelization, provision of stacking lanes, adequate turning radii (Dash et al., 2021[22])

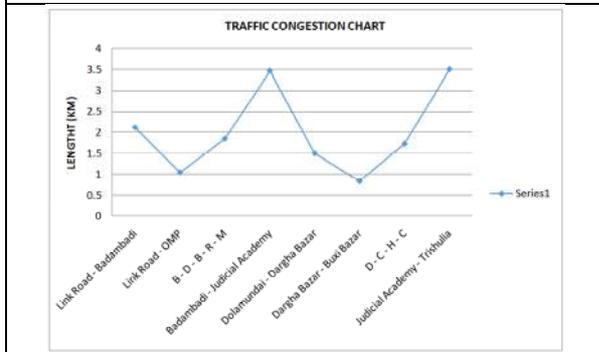


Fig 13(a): The traffic congestion chart at nodal black spots within Cuttack city during peak traffic

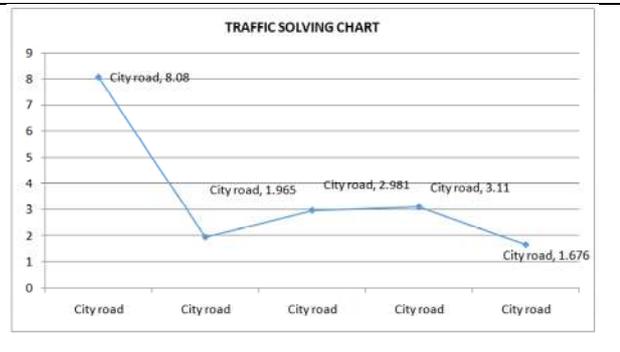


Fig 13(b): The traffic congestion minimization after finalization of all remodeling





## Effect of Science Practical Activities on Students' Achievements: A Study in High School Level

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### ABSTRACT

The modern technological society expects every individual has to equipped with adequate knowledge exposure in science and technology and hence teaching science subject from lower class to high level education is considered as an important process. The present study was undertaken to study the effect of practical activities on students' science achievement at high school level. For the experimentation of the study, the 120 sample students were selected randomly from two government and two private aided schools around the Dindigul district of Tamil Nadu, India. The main finding of study reveals that there was a positive effect of implementation of science practical activities on students achievement level.

**Keywords:** Academic achievement, Experimental design, High school students, Practical activities, Science subject.

### INTRODUCTION

Science has shrunk the globe and completely altered human perceptions, and it has an all-encompassing impact on all aspects of human life. Science is everyone's concern in the present era in which we live, and one cannot imagine a world without it. It helps us solve difficulties in our daily lives while also assisting us in understanding the universe's greatest mysteries. To put it another way, one of the most important sources of information is science. It



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performs a number of services for the benefit of our society, including the generation of new information, the improvement of education, and the improvement of our quality of life. The true goal of science education is to instill in students a healthy habit of research and reasoning rather than a mass of facts to memorise. If science is badly taught and understood, it amounts to little more than filling the mind with dead information, and it may even lead to a new belief (Indian Education Commission, 1966). As a result, rather than focusing on scientific inquiry procedures, teachers' primary goal in teaching science classes would be to develop students' substantive scientific understanding (Abraham & Millar 2008).

Science cannot be studied without the use of a laboratory, and learning by doing is one of the cornerstones of science education. There are a variety of reasons why students should engage in science practical activities in school. Some of the reasons are to encourage accurate observations and descriptions, to transform theories into practical applications, to keep students interested in scientific subjects, and to foster a logical and reasonable way of thinking (Dillon 2008). They can also inspire students, pique their interest in teaching and learning, improve scientific knowledge acquisition, provide hands-on experience with scientific knowledge, and broaden their horizons (Hodson 1990).

Practical activities have a significant impact on the science learning process. Students are engaged in science practicals by supporting them in comprehending general principles of science and the scientific investigation method, as well as the development of crucial skills. Furthermore, practical tasks help students learn by building a link between the world of real objects and observable facts on the one hand, and the world of conceptions on the other (Bryson et al., 2002). Practical activity in science, according to Science Community Representing Education (SCORE), is any science teaching and learning activity in which students manipulate and/or observe real products and materials rather than the virtual environment. Individually or in small groups, it can be done (Singh, 2020). The majority of practical activities at the school level are group activities, which allow pupils to collaborate and discuss the tasks that have been assigned to them. It allows them to gain a better understanding of their subject, and as a result, they have a favourable attitude toward the value of practical exercises, which has a significant impact on students' science achievement (Hinne, 2017). According to most scientists and science educators, practical work in the form of a laboratory practical is an essential aspect of science curricula (Bradley, 2005).

**NEED AND SIGNIFICANCE OF THE STUDY**

Science is not a thing to be talked about but a practical subject and the correct way to learn is by doing. Practical in science provide clarity in the mind of student learner and support to manipulate the objects and verify the reality. Students can gain new knowledge, concepts, and skills in the science laboratory and further gain a deeper understanding of rules, processes, principles, laws, theories, and natural phenomena (Iheiamazu et al., 2020). According to Nnorom and Zitaobi (2020), the main goals of practical activity in science are inherent to the nature of scientific activity, namely, the development of scientific skills and methodologies, the development of problem-solving capacity, and the development of a feel for the phenomenon. Students must learn to address problems scientifically and acquire the skills of a practical scientist. In order to improve science learning and understanding, it is also vital to provide effective practical exercises. According to Ok am and Zakari, (2017), practical activity has been able to develop students' positive attitudes and increase motivation for good science learning. We know that science practicals mostly conducted in higher secondary school levels and rarely at high school level. Also, only few studies are conducted on school science practicals and therefore this study is need of the hour and focused to analyse the effect of practical activities on science achievement of high school students. The following are the objectives of study.

**OBJECTIVES OF STUDY**

- To study the effect of science practical activities on students science achievement at high school level;
- To analyse effect of gender on the students' science achievement due to the implementation of practical activities; and
- To analyse effect of school management on the students' science achievement due to the implementation of practical activities.





## METHODOLOGY

### Research Design

The *post-test control group experimental group* research design was used in the study to know the impact of science practicals to the high school students. The student participants were divided into control and experimental groups with reference to their previous achievement test scores in science subject. For the experimentation, the selected science contents were taught to control group students in conventional method of teaching and to experimental group students with use practical activities.

The content topics to control group were discussed and taught through following method of teaching.

- Contents of text book were taught through lecture method;
- Teaching and learning on content happened from parts to the whole;
- Teacher asked questions to verify whether students were followed teaching information;
- At end, a separate assessment was conducted to students to oral questions; and
- Students reply their answers orally to the question asked by teacher.

And, the experimental group students received their content discussion and teaching learning through following method.

- Contents of text book were taught through practical activities with hands-on material approach;
- Teaching and learning on content happened from whole to parts;
- Teacher observed the students' activities and asked questions to clarify the students' queries in content learning;
- Students explained the concepts to teacher through demonstration; and
- At end, there was no separate assessment to students but assessment was integrated with practical activities.

The experimentation process to students was given for a period of three weeks and then conducted a test to both control and experimental groups to know whether there is an impact of practical activities on students' science achievement test.

### Study Sample

The goal of study was to assess the effect of science practical activities on students' academic attainment. 120 students from class IX were selected randomly as sample from two government and two private aided schools in Dindigul district of Tamil Nadu, India. Among them, 60 students were selected from government high schools and the remaining 60 students were selected from private aided high schools which. Further, the sample includes 30 male and 30 female students were selected each from government and private aided schools. For experimentation purpose, the sample were divided into two groups, namely, control group and experimental group with 60 students in each.

### Instrument

The Science achievement test in science subject portions of class IX in Tamil Nadu Textbook Corporation was administered to both group of students. The Science achievement test consists of three parts, such as, Physics, Chemistry and Biology with 15 multiple choice questions in each parts. The score One Marks assigned to the right response of students to each question in the achievement test and similarly the score Zero Mark assigned to the wrong response to questions. Therefore, the achievement test prepared with 45 questions in total and its maximum score is 45. The achievement test was administered to both control group and experimental group students after two week experimentation and the data were collected from the sample and subjected to analysis. The results are summarised as follows with reference to the data analysis report.





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## RESULTS

### Analysis on Control Group and Experimental Group

The collected achievement scores from control and experimental groups were analysed and to verify the statistical difference in their achievements, 't' and 'p' values are calculated using the mean and standard deviation scores and the details are given in table-1. The overall data analysis indicates that the mean scores of control and experimental groups are 26.88 and 31.61 respectively. It means that the students learnt from the practical activities in experimental groups had better science achievement than that of control group students. Further, the t-value and its corresponding p-value show that there was a significant difference between the science achievements of control and experimental groups since the p-value (=0.00) is less than 0.05. The subject branch wise comparison also indicates that there were significant difference between the achievements of control and experimental groups in Physics, Chemistry and Biology since their p-values are less than 0.05. Moreover, in all three branches of science, the achievement scores of experimental group students were better than scores of control group students.

### Analysis on School Management wise Achievement Scores of Experimental Group Students

The achievement scores of experimental groups were analysed with reference to the students school management and verified the statistical difference in their achievements through 't' and 'p' values based on mean and standard deviation scores. The details of school management wise analysis are given in table-2. The overall experimental group data analysis with reference to the school management indicates that there was a significant difference between the achievement scores of government and private aided school students since the p- value (0.01) is less than 0.05. Also the students from government school secured more marks than that of private aided school students. The subject branch wise comparison analysis on student achievement of experimental group government and private aided schools indicates that the students' differ in their achievement in Physics subject since their p- value (0.01) is less than 0.05 but not in Chemistry and Biology. In all three subjects, the government school students scored more marks than that of private aided schools.

### Analysis on Gender wise Achievement Scores of Experimental Group Students

The gender wise achievement scores of experimental groups were analysed and verified the statistical difference in their achievements through 't' and 'p' values based on mean and standard deviation scores. The details of school management wise analysis are given in table-3. The overall experimental group data analysis with reference to the students' gender indicates that there was no significant difference between the achievement scores of female and male students since the p- value (0.21) is greater than 0.05. Also the female students secured more marks than that of male students in overall achievement. Further, female students secured more marks in Physics and Chemistry subjects than that of male students but not Biology subject.

## DISCUSSION

The main findings of study reveals that the practical activities in teaching science subject enhance the science achievements among students and this result is coincide with the research finding of a research study by Sshana, & Abulibdeh (2020). The findings also show that there was no significant difference between the students' science achievement which is parallel to the result found by Chaochao Jia et.al (2020). Further, the study found that there was a significant difference between the science achievement of government and private aided schools and this finding is matched with one of the finding of a research study by Gokul Raj and Nirmala Devi (2014).





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## CONCLUSION

Science is a subject dealing with the concepts easily understand through practical activities. The most significant contribution to the practical teaching of science is that all students should be permitted to discuss things for themselves and placed in the role of original observers. Science cannot be taught or learned by simply chalking and chatting. Science demonstrations are held to ignite students' curiosity and awe, as well as to persuade them of the veracity of the principles. Science education in schools fosters a spirit of inquiry, inventiveness, objectivity, and aesthetic sensibility. Its goal is to help students acquire well-defined knowing, doing, and being abilities. The main finding of the present study confirmed this fact and hence the teachers and school administrators should care on making necessary facilities in the schools to facilitate the science learning through experiential learning.

## CONFLICTS AND INTEREST

None.

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**Table-1. Mean, SD and 't' scores of Student Achievement Scores - Group wise**

| Achievement in Subject | Group        | N  | Mean  | SD   | t     | p-value |
|------------------------|--------------|----|-------|------|-------|---------|
| Physics                | Control      | 60 | 8.73  | 1.25 | 7.92  | 0.00    |
|                        | Experimental | 60 | 10.53 | 1.24 |       |         |
| Chemistry              | Control      | 60 | 9.10  | 1.27 | 7.24  | 0.00    |
|                        | Experimental | 60 | 10.81 | 1.30 |       |         |
| Biology                | Control      | 60 | 9.05  | 1.13 | 5.42  | 0.00    |
|                        | Experimental | 60 | 10.27 | 1.33 |       |         |
| Overall                | Control      | 60 | 26.88 | 2.52 | 10.41 | 0.00    |
|                        | Experimental | 60 | 31.61 | 2.44 |       |         |

**Table-2. Experimental Group Students' Achievement Scores - School Management wise**

| Achievement in Subject | School     | N  | Mean  | SD   | t    | p-value |
|------------------------|------------|----|-------|------|------|---------|
| Physics                | Government | 30 | 10.93 | 0.98 | 2.62 | 0.01    |
|                        | Private    | 30 | 10.13 | 1.36 |      |         |
| Chemistry              | Government | 30 | 10.97 | 1.19 | 0.99 | 0.33    |
|                        | Private    | 30 | 10.63 | 1.40 |      |         |
| Biology                | Government | 30 | 10.50 | 1.38 | 1.37 | 0.18    |
|                        | Private    | 30 | 10.03 | 1.25 |      |         |
| Overall                | Government | 30 | 32.40 | 2.08 | 2.66 | 0.1     |
|                        | Private    | 30 | 30.80 | 2.55 |      |         |

**Table-3. Experimental Group Students' Achievement Scores - Gender wise**

| Achievement in Subject | Gender | N  | Mean  | SD   | t    | p-value |
|------------------------|--------|----|-------|------|------|---------|
| Physics                | Female | 30 | 10.70 | 1.21 | 1.04 | 0.31    |
|                        | Male   | 30 | 10.37 | 1.27 |      |         |
| Chemistry              | Female | 30 | 11.10 | 1.24 | 1.82 | 0.07    |
|                        | Male   | 30 | 10.50 | 1.31 |      |         |
| Biology                | Female | 30 | 10.20 | 1.42 | 0.39 | 0.71    |
|                        | Male   | 30 | 10.33 | 1.24 |      |         |
| Overall                | Female | 30 | 32.00 | 2.33 | 1.27 | 0.21    |
|                        | Male   | 30 | 31.20 | 2.52 |      |         |





## Least explored Magical Plant *Achyranthes aspera* L.: Future prospects and Potentials as Antioxidants Powerhouse

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### ABSTRACT

Nowadays, plant-based products are very popular due to their availability in nature and most importantly these products have very less side effects as compared to other products. Moreover, in ancient era the only major source of medicines were plants while the chemical based drugs are the recent development of human beings but still these herbal medications are underrated and we ignore many potential medicinal plants in our surroundings. *Achyranthes aspera* L. is also one of these underrated plants that contain many properties due to which this plant is used traditionally for the treatment of diseases but still many more properties need to be discovered.

**Keywords:** Ethanobotany, Anti-obesity, Anti-Inflammatory, Traditional medicine, Anti-depressant, Anti-fertility, Magical plant

### INTRODUCTION

In our nature, a lot of medicinal aid is present in abundance for many years and major varieties of modern-day drugs have been isolated from the nature and marketed. According to the World Health Organization and other studies which have shown that 80% of the world's total population still depends on the natural resources for their preliminary treatment of the illness (Ekor, 2014). Therefore an increase in the use of herbal medicines can be easily visible, however, more research is still needed to use these medications with their full potential. *Achyranthes aspera* L. is an annual herb widely distributed in India as a weed. It is used for its medicinal properties as it exhibits many



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activities which are helpful in treating various diseases and illness such as in Nepal *Achyranthes aspera* L. is used as an ethnomedicine for the treatment (Singh, et al., 2012). Although, this plant has been used traditionally in folk medicine, homoeopathy, Ayurveda, Unani, and Traditional Chinese Medicine but still many more discoveries are yet to be needed to discover its full potential as a medicinal plant. Various extracts of roots, shoot, leaves, and whole plant exhibit many different medicinal properties like anti-inflammatory activity, wound healing activity, hepatoprotective activity, diuretic activity and many more. Ethan botanical studies and Ayurveda showed the use of *Achyranthes aspera* L. in the treatment of diseases related to the abdomen, lymphadenitis-cervical, haemorrhoids, itching, obesity and dried roots are used in vomiting, tumor, tympanitis, leucoderma, colic, fistula-in-ano, heart diseases, deafness, pyrexia, blood disorder, disease of tooth and liver disorders (Goyal, et al., 2007).

### Botanical description

According to the classification *Achyranthes aspera* L. belongs to the Amaranthaceae family and morphologically it is an annual or perennial herb with 1 – 2 m in height and erect often with a woody base. It is also known as Rough chaff tree in English, (Nadkarni, et al., 1976). Stems are angular, simple or may be branched from the base often with the tinge of purple colour, branches are striate or absolutely quadrangular, pubescent, while the leaves are thick, simple, entire and opposite, 3.8 – 6.3 × 22.5 – 4.5 cm, elliptic-obovate, softly and finely pubescent on both the sides, petiolate, 6 – 20 mm long petiole, along with the greenish white flowers flowering and fruiting is throughout the year with numerous axillary or terminal spikes up to the length of 75 cm, seeds are sub cylindrical and truncated at the apex with round base and reddish brown (Hasan, 2014), (Anonymous, 2005).

### Part used

Generally whole plant can be used but different parts such as roots, leaves, stem and seeds can also be used separately or in combination as per the requirements.

### Distribution

It is widespread from tropics to subtropics of Asia, Africa, America, Australia, and Europe with abundant in plantation of the hills, plains up to 1400m, tropics, wastelands, roadsides, open grasslands (Fern, et al., 2014).

### Compounds and chemical constituents

A number of phytochemicals are present in abundance in *Achyranthes aspera* L. out of which six compounds were isolated and identified from the ethanolic root extract of *Achyranthes aspera* L. as n-hexacosanyl n-decanate, n-hexacos-11-enoic acid, n-hexacos-14-enoic acid, n-hexacos-17-enoic acid, trans-13-docosenoic acid, and strigmasta-5, 22-dien-3-β-ol. Among all these compounds n-hexacos-14-enoic acid was a new aliphatic acid isolated and identified from any natural and synthetic source for the first time (Sharma, et al., 2009). Saponins A and B were isolated from the seeds of *Achyranthes aspera* L. among these saponins D-Glucuronic Acid and β-D-galactopyranosyl ester of D-Glucuronic Acid were identified as saponin A and saponin B respectively (Hariharan, et al., 1970). Whereas the protein quality of seeds exhibits the close resemblance to the Bengal gram and it can be compared with its isoleucine, leucine, valine, and phenylalanine content due to the values obtained by the cysteine and ten essential amino acids however these seeds contain higher contents of cysteine, methionine, and tryptophan as compared to most of the other pulses. While on the other hand it can be comparable to the whole egg protein due to its deficiency in lysine, threonine, and arginine content (Satyanarayana, et al., 1964).

### Applications

Numerous properties of *Achyranthes aspera* L. have been reported in different studies which shows, anthelmintic, antiviral, antihypertensive, diuretic, wound healing, nephroprotective, and hepatoprotective activities (Table 1) in which various extracts of different parts of this plant has been used with different models and experiments to discover the full potential of this traditionally used plant so that it can be incorporated in modern lifestyle and diseases can be cured and treated.



**Ekta Sharma et al.,****Anti-allergic activity**

Significant anti-allergic activity has been reported in both milk induced eosinophilia and milk induced leukocytosis in mice when the petroleum ether extract of the plant was incorporated. Steroids were present when the petroleum ether extract was screened phyto-chemically and literature also shows the existence of steroids such as ecdysterone, ecdysone and  $\beta$ -sitosterol. This indicates that the steroids might be responsible for the anti-allergic activity due to their presence in the plant (Datir, et al., 2009).

**Anti-depressant activity**

Studies shows anti-depressant effect in both mice and rats by using forced swimming test while the tail suspension test was also incorporated in rats when methanolic extract of the leaves of *Achyranthes aspera* L. has been used to study the effects (Barua, et al., 2009).

**Anti-HBV activity**

It has been reported that active molecules (flavonoids, alkaloids, and other active molecules contains hydroxyl groups) of methanolic extract of *Achyranthes aspera* L. possess anti HBV activity (Manickan, et al., 2021).

**Anti-helminthic activity**

Anti-helminthic activity of *Achyranthus aspera* has been reported when ethanolic extract of stems were tested by using *Pheretima posthuma* (Indian adult earthworms) this activity has been produced by the presence of tannins (Ganesh, et al., 2021). Another study on the leaves of *Achyranthes aspera* L. has also confirmed that ethanolic extract possess a significant anti-helminthic activity as compared to the standard drug albendazole which only shows moderate activity when tested on *Pheretima posthuma*, while the different concentrations (20, 40, 60, 80 mg/ml) of extract cause paralysis (in 68.60+0.26, 52.32+1.08, 48.30+0.68, 42.18+0.26 minutes respectively) and death (in 84.2+0.3, 68.0+0.86, 60.13+0.76, 38.46+0.23 minutes respectively) of the earthworms (Hasan, et al., 2015).

**Anti-inflammatory activity**

It was reported that the shoots and leaves of *Achyranthes aspera* L. have a significant anti-inflammatory activity with low toxicity due to the absence of cyanogenic glycoside (Alkari, et al., 2014). Further studies revealed that the alcoholic extract of *Achyranthes aspera* L. shows anti-inflammatory activity against both acute and chronic inflammation (exudative and proliferative phase) in wistar rats by using the both acute and chronic inflammatory model (carrageenan-induced paw edema test and cotton pellet test) after the oral administration (Vijaya, et al., 2009). An alkaloid, water soluble Achyranthine was isolated from the *Achyranthes aspera* L. shows the decrease in heart rate and blood pressure, dilated blood vessels and possess anti-inflammatory activity (Gokhale, et al., 2002).

**Anti-malarial activity**

It has been reported that phytochemical screening of aqueous extract of shoot of *Achyranthes aspera* L. exhibits the presence of alkaloids, balsam, flavonoids, phenols, saponins, and tannis. Further anti-malarial activity has been reported in the of shoots of *Achyranthes aspera* L. without causing any gross toxicity and mortality in the Swiss albino mice as compared to the negative control when the aqueous extract was given to them up to 5000mg/kg/body weight in a single dose which may also establish the traditional use of *Achyranthes aspera* L. for the treatment of malaria among the some locals of Nigeria (Mankilik, et al., 2021). It was also reported that the saponins of the ethyl acetate extract shows the mosquito larvicidal activity then the further studies were performed on different extracts of the hexane, chloroform, ethyl acetate, acetone, and methanol leaf extract against *Culex quinquefasciatus* and *Aedes aegypti* (larvae) to study the activity (Bagavan, et al., 2008).

**Antimicrobial activity**

Ethanolic and aqueous extract of roots were compared to test their antifungal activity by agar well diffusion method with ethanol and distilled water as negative control and Clotrimazole (1% w/w) used as positive control against *Trichophyton rubrum* where ethanolic extract is more effective in comparison to the aqueous extract (Mishra, et al., 2016). Seeds of the *Achyranthes aspera* L. were used to isolate *Achyranthes aspera* L. Trypsin inhibitor (AATI) and tested



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for its antimicrobial activity against the selected pathogenic microbes which shows the significant effect on the growth of *Proteus vulgaris* with 28 mm zone of inhibition then followed by another 26mm zone of inhibition by *Bacillus subtilis*, then *Staphylococcus aureus* with 25 mm, *Escherichia coli* with 20 mm, and *Klebsiella pneumonia* with 14 mm zone of inhibition (Konala, et al., 2012).

**Anti-obesity**

A study shows that there was a significant decrease in total cholesterol, total triglycerides and LDL-C level in hyperlipidemic rats while the HDL-C shows a significant increase in the level when the seed saponins of *Achyranthes aspera* L. was administered orally for four weeks in tested animals and serum liver enzyme activity also remained unaffected along with the improvement in serum antioxidant (Khan, et al., 2015). Antiobesity effect of the *Achyranthes aspera* L. have been studied and it was suggested that high fat diet induced increase in serum lipids can be prevented by the ethanolic extract rich in saponins which also controls the body and visceral organ weights (Lathaa, et al., 2011).

**Contraceptive activity**

Spermicidal activity in human and rat sperm has been reported by various root extracts of *Achyranthes aspera* L. from which hydroethanolic, n-hexane and chloroform extracts were found to be most effective for acrosome status, sperm immobilization, 5'-nucleotidase activity, sperm viability, and nuclear chromatin decondensation (Paul, et al., 2010). Studies shows that 50% ethanolic extract of the root of *Achyranthes aspera* L. and leaf of *Stephania hernandifolia* can affect the sperm motility (Paul, et al., 2006). Contraceptive and hormonal properties were also reported in n-butanol fraction of aerial parts (Wadhwa, et al., 1986). The benzene extract of the whole plant have been reported to shows abortifacient activity in mice (Pakrashi, et al., 1977).

**Diuretic activity**

Significant diuretic effect has been reported in adult male albino rats when isolated saponins from the seeds of *Achyranthes aspera* L. have been given to them orally (Thorat, et al., 2020). Also the decoction of the whole plant is used in the treatment of pneumonia and has diuretic properties (Vasudeva, et al., 2006).

**Enzyme inhibition activity**

Strong  $\alpha$ - amylase and urease inhibitory effects have been reported in various leaf extracts (acetone, aqueous and methanol) of *Achyranthes aspera* L. out which methanol extracts were the most effective against the both enzymes as compared to the others therefore this can be used to treat various diseases caused by these enzymes but to find the exact mechanism and chemical constituents responsible for this inhibitory effect further studies are required (Prakash, et al., 2021).

**Free radical scavenging activity**

Studies shows that in a dose-dependent manner free radical scavenging activity has been showed by both aqueous and ethanol extracts of the leaves which indicates that *Achyranthes aspera* L. may shows antioxidant activity by inhibiting lipid peroxidation and increase SOD and catalase activity (Edwin, et al., 2008).

**Hepatoprotective activity**

Studies show that *Achyranthes aspera* L. act as a promising source to treat CCl<sub>4</sub> induced liver damage when their methanolic extract of roots is used (Fahim, et al., 2018). Furthermore, the hepatoprotective activity has been reported in the *Achyranthes aspera* L. when methanolic extract of the aerial parts was given to the albino rats using rifampicin as the hepatotoxicity inducer to study the activity (Bafna, et al., 2004).

**Nephroprotective activity**

Nephroprotective activity has been reported in methanolic extract of the whole plant of *Achyranthes aspera* L. when study was carried out on male albino rats by inducing lead acetate nephrotoxicity in the rats (Jayakumar et al., 2009).





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**Phagocytic activity**

It has been reported that *Achyranthes aspera* L. helps in stimulating the cell-mediated immune system and a study has been conducted to analyse the effects on various in-vitro methods of phagocytosis like chemotaxis and neutrophil locomotion due to which hydro alcoholic extract of aerial parts was subjected in different concentrations (25, 50, and 100 mg/ml) shows the increase in the neutrophil phagocytic function (Mali et al., 2006).

**Wound healing activity**

It is investigated that the leaves of *Achyranthes aspera* L. possess wound healing activity which was clearly showed by the ethanolic and aqueous extracts of the plant. Furthermore, two wound models i.e. excision and incision wound model were used to study the wound healing activity (Edwin, et al., 2008).

**Others**

Root extract of *Achyranthes aspera* L. is used in treatment of diabetes (Akhtar, et al., 1991) and hypertension, asthma, malarial fever, (Vasudeva, et al., 2006) and it is also suggested that to improve the appetite fumes of both *Achyranthes aspera* L. and *Smilax ovalifolia* roots were inhaled together which is also important as it can cure various types of gastric disorders also (Bhattarai, 1992). However, phosphorylase activity has been reported by the saponins of this plant on the heart (Ram, et al., 1971).

**CONCLUSION**

All the properties of *Achyranthes aspera* L. shows that this plant has an extensive traditional use for the treatment of various illness and studies which are so far done can prove that many diseases can be cured by using the *Achyranthes aspera* L. however more research is still required to fulfill the desired outcomes. Certain properties such as nephroprotective and hepatoprotective activity shows that this plant is safe for use and if there will be any harmful effect then it will not cause any major harm to the vital organs due to its protective nature.

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**Table 1: Different parts of *Achyranthes aspera* with their different activities.**

| S. NO. | PART USED    | ACTIVITY                   | REFERENCES              |
|--------|--------------|----------------------------|-------------------------|
| 1.     | Aerial parts | Contraceptive Activity     | Wadhwa, et al., 1986.   |
| 2.     | Aerial parts | Hormonal Activity          | Wadhwa, et al., 1986.   |
| 3.     | Aerial parts | Hepatoprotective Activity  | Bafna, et al., 2004.    |
| 4.     | Aerial parts | Phagocytic Activity        | Mali et al., 2006.      |
| 5.     | Aerial parts | Anti-allergic Activity     | Datir, et al., 2009.    |
| 6.     | Whole plant  | Abortifacient Activity     | Pakrashi, et al., 1977. |
| 7.     | Whole plant  | Pneumonia treatment        | Vasudeva, et al., 2006. |
| 8.     | Whole plant  | Diuretic Activity          | Vasudeva, et al., 2006. |
| 9.     | Whole plant  | Nephroprotective Activity  | Jayakumar et al., 2009. |
| 10.    | Leaves       | Free radical scavenging    | Edwin, et al., 2008.    |
| 11.    | Leaves       | Wound healing Activity     | Edwin, et al., 2008.    |
| 12.    | Leaves       | Anti-depressant Activity   | Barua, et al., 2009.    |
| 13.    | Leaves       | Anti-inflammatory Activity | Alkari, et al., 2014.   |
| 14.    | Leaves       | Anti-helminthic Activity   | Hasan, et al., 2015.    |
| 15.    | Leaves       | Anti-HBV Activity          | Manickan, et al., 2021. |
| 16.    | Leaves       | Enzyme inhibition Activity | Prakash, et al., 2021.  |
| 17.    | Stems        | Anti-inflammatory Activity | Alkari, et al., 2014.   |
| 18.    | Stems        | Anti-helminthic Activity   | Ganesh, et al., 2021.   |
| 19.    | Stems        | Anti-malarial Activity     | Mankilik, et al., 2021. |
| 20.    | Seeds        | Anti-obesity               | Lathaa, et al., 2011.   |
| 21.    | Seeds        | Anti-microbial Activity    | Konala, et al., 2012.   |
| 22.    | Seeds        | Diuretic Activity          | Thorat, et al., 2020.   |
| 23.    | Roots        | Hypertension treatment     | Vasudeva, et al., 2006. |
| 24.    | Roots        | Asthma treatment           | Vasudeva, et al., 2006. |
| 25.    | Roots        | Spermicidal Activity       | Paul, et al., 2010.     |
| 26.    | Roots        | Anti-fungal Activity       | Mishra, et al., 2016.   |





## Antiviral Potential of Neem (*Azadirachta indica* A. Juss)

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### ABSTRACT

Medicinal plants are very important for the treatment of many human diseases. As long-term use of allopathic drugs can lead to drug resistance and other problems, antimicrobials from plants have gained importance as an alternative. *Azadirachta indica* (Neem) is a medicinal plant native to Indian subcontinent. Neem has been extensively used in Ayurveda, Unani, and Homeopathic medicines owing to its wide range of medicinal properties. Neem and its ingredients are known to have anticancer, immunomodulatory, antidiabetic, neuroprotective, antioxidant, anti-inflammatory, wound healing activities and antimicrobial potential such as antiviral, antibacterial, antifungal and antimalarial activities. Antiviral activity of neem and its components against different human and animal viruses has been reported by many researchers.

**Keywords:** *Azadirachta indica*, neem, neem compounds, antiviral, human viruses, animal viruses

### INTRODUCTION

*Azadirachta indica* (A. Juss), commonly known as neem, is a tropical evergreen tree that is native to the Indian subcontinent [1]. For over 2000 years neem has been extensively used in Ayurvedic medicine by Indians [2]. Every part of neem i.e. stem, bark, roots, leaves, gum, seeds, fruits and flowers are known to have a vast range of bioactive components. Various parts of the neem tree have been used in Ayurveda for their antipyretic, antacid, antiparasitic, antibacterial, antiviral, antidiabetic, contraceptive, antidermatitic, anticancer, anti-inflammatory, antioxidant, antifungal, dental, and other healing and protective properties [1].



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Neem is a source of multitude biologically active compounds that are chemically diverse and structurally complex. Around 406 compounds, which are chemically diverse and structurally complex, have been isolated from different parts of neem with multiple biological activities [3]. Some of the important bioactive neem compounds are azadirachtin, 6-desacetyl nimbinene, gedunin, nimbadiol, nimbolinin, nimbin, nimbiol, nimbidin, nimbidol, nimbanene, nimbolide, quercetin, salannin, sodium nimbinat, etc. [4].

Viral infections are global health problem and viral infections are generally treated using synthetic drugs that act either as viral protein inhibitors or nucleic acid inhibitors or enzyme inhibitors. However, there are reports of viruses developing resistance against these drugs [5, 6]. This has led to the identification of novel sources for antiviral drugs and plants have emerged as reliable natural sources for this purpose. Neem has attracted the attention of researchers owing to its vast medicinal properties [7]. Neem bioactive compounds had been experimentally proven to be antiviral in nature and many studies have shown that neem extracts and components can significantly inhibit coxsackie B viruses, dengue virus, herpes simplex virus, polio virus, human immunodeficiency virus, etc. [8, 9]. This review summarizes the reported antiviral role of neem and its active ingredients.

**Antiviral activity of neem against human viruses****Dengue virus**

Crude aqueous extract of neem leaves was evaluated for antiviral potential against Dengue virus type-2. *In vitro* antiviral activity was assessed in C6/36 (cloned cells of larvae of *Aedes albopictus*) cells. The neem leaves aqueous extract completely inhibited 100–10,000 TCID<sub>50</sub> of virus (indicated by the absence of cytopathic effects) at its maximum non-toxic concentration of 1.897 mg/ml. The *in vivo* studies results showed that neem leaves extract at its maximum non-toxic concentrations of 120–130 mg/ml effectively inhibited viral replication, which was evident by the absence of Dengue related clinical symptoms in suckling mice and absence of virus specific 511 bp amplicon in RT-PCR [8].

Two chemicals from neem such as kaempferol 3-O- $\beta$ -rutinoside and epicatechin were screened at different concentrations for *in vitro* antiviral activity against DENV-2 (dengue virus) strain. The selected compounds showed dose dependent inhibition of DENV-2 infectivity wherein maximum viral inhibition of 77.7% and 66.2% were recorded for 100  $\mu$ M kaempferol 3-O- $\beta$ -rutinoside and 1000  $\mu$ M epicatechin, respectively without significant cell toxicity [7].

**Herpes simplex virus**

Aqueous extract of neem plant bark i.e. neem bark extract (NBE) significantly blocked the entry of Herpes simplex virus type 1 (HSV-1) into cells at concentrations ranging from 50 to 100  $\mu$ g/ml. Virions treated with NBE failed to bind the cells indicating the attachment step blocker role of NBE. Cells treated with NBE also inhibited HSV-1 glycoprotein-mediated cell-cell fusion. These results revealed the anti-herpetic potential of neem bark extract [10]. Aqueous and methanol extracts of neem leaves and stem, and leaves powder were screened for antiviral potential against HSV-2. Screening was carried out by cytopathic effect inhibition (CPE) assay followed by dose response, antiviral, and cytotoxicity assay conducted at eight concentrations from 3.125 to 400  $\mu$ g/ml. Aqueous and methanol extracts of neem leaves and stem failed to exhibit anti-HSV potential while neem leaves powder demonstrated moderate antiviral activity, in primary screening at a concentration of 100  $\mu$ g/ml against HSV-2 [11].

Sulfonoquinovosyldiacylglyceride (SQDG) isolated from methanolic extract of *A. indica* leaves was screened for antiviral activity against herpes simplex virus (HSV) in Vero cells. In plaque reduction assay, SQDG inhibited HSV-1 and HSV-2 with the EC<sub>50</sub> of 9.1 and 8.5  $\mu$ g/ml. 100% inhibition of HSV-1 and HSV-2 (post-infection) was achieved at 20  $\mu$ g/ml and 17.25  $\mu$ g/ml of SQDG, respectively. Results indicated that SQDG neither inactivated the virus nor prevented HSV penetration in to Vero cell but inhibited HSV-1 within 4–6 h post-infection during the immediate early period of virus multiplication [12].



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Anti-herpetic activity of two polysaccharides (P1 and P2) isolated from the neem leaves and their chemically sulfated derivatives (P1S and P2S) were studied using HSV-1 and HEp-2 cells. Both P1S and P2S exhibited significant anti-herpetic activity with 50% inhibitory concentration of 31.1 µg/ml and 80.5 µg/ml, respectively. Comparatively, at 200 µg/ml concentration, P1S showed better inhibitory effect (91.8%) than P1 (50%), P2 (71.1%) and P2S (70%). The neem components brought about the inhibition of viral adsorption, viral nucleic acid synthesis and viral protein synthesis, in the range of 25 – 50 µg/ml concentrations. Also the compounds were non-cytotoxic in HEp-2 cells up to 1000 µg/ml concentration [13].

**Human immunodeficiency virus**

Acetone-water neem leaf extract was screened at 10 µg/ml concentration for protection of lymphocytes against invasion by HIV (Human immunodeficiency virus). The extract was also evaluated in 10 patients with HIV / AIDS at 1000 mg daily for 30 d. In the absence and presence of the extract, 0% and 75% of lymphocytes were protected, respectively. The neem extract inhibited the binding of HIV to target lymphocytes by preventing the interaction of viral surface glycoprotein with CD4 and a seven-transmembrane co receptor of the target lymphocyte. In the treated patients, haemoglobin concentration, mean CD4<sup>+</sup> cell count and erythrocyte sedimentation rate, which were initially 9.8 g/dl, 126 cells/µl and 90 mm/h respectively, improved to 12.1 g/dl, 241 cells/µl and 49 mm/h. Mean bodyweight and platelet count, which were initially 57 kg and 328 x 10(3)/mm<sup>3</sup> respectively, increased to 60 kg and 359 x 10(3)/mm<sup>3</sup>. The results indicated the antiretroviral potential of acetone-water neem leaf extract [14].

Acetone-water neem leaf extract (IRAB) was tested for the treatment of 60 HIV / AIDS patients at 1.0 g daily for 12 weeks. Out of 60 patients, 50 patients (83.33%) showed significant improvement, which was evident by increase in mean CD4<sup>+</sup> cells to 266 cells/µl (159%), decrease in erythrocyte sedimentation rate from 64 mm/hr at baseline to 16 mm/hr at week 12, decrease in total number of incidences of HIV / AIDS-related pathologies from 120 at baseline to 5 and significant increase in mean bodyweight, hemoglobin concentration, and lymphocyte differential count by 12%, 24% and 20%, respectively [15]. The hydroacetone extract (50% acetone) of *A. indica* leaves was evaluated for its anti-retroviral potential. Results of syncytium formation assay on HIV-1 infected C8166 CD4<sup>+</sup> cells indicated that the extract blocked HIV-1 envelope-mediated membrane fusion. Replication of HIV-1 in C8166 CD4<sup>+</sup> cells was inhibited by the neem extract through the inhibition of HIV-1 reverse transcriptase activity, which resulted in the subsequent decrease in HIV p24 antigen concentration. At the dose range in which the extract was effective, no cytotoxicity was observed on target cells [16].

HIV patients were made to consume daily (morning and evening) 250 ml of *A. indica* and *Senna siamea* decoction for 6 months. Regularly, CD4<sup>+</sup> and CD8<sup>+</sup> levels were measured by flow cytometry. Hepatic and renal toxicity and oxidative stress were evaluated spectrophotometrically by measuring ALT, AST, ALP, BUN, CREAT, SOD, CAT, and GSH parameters. After 6 months of treatment, significant increase in the CD4<sup>+</sup> level was observed, while no signs of toxicity (hepatic and renal toxicity, oxidative stress) were detected [17].

**Polio virus**

NIM-76, a spermicidal fraction from neem oil exhibited significant antiviral activity against Polio virus by inhibiting the viral replication in Vero cell lines [18]. Two polysaccharides (P1 and P2) isolated from the leaves of *A. indica* and their chemical sulfated derivatives (P1S and P2S) were screened for antiviral potential against poliovirus type 1 (PV-1). The polysaccharides P1, P1S, P2 and P2S showed significant antiviral activity against PV-1 with inhibitory concentrations (IC<sub>50</sub>) of 80 µg/ml, 37.5 µg/ml, 77.5 µg/ml, and 12.1 µg/ml respectively. The inhibitory effect of tested compounds was better when added concomitantly with the virus infection, was lesser when added after viral infection and was least at pre-treatment. The polysaccharides did not show any cytotoxic effects on HEp-2 cells even at the highest concentration of 200 µg/ml tested [2].

**SARS-CoV**

Neem capsules (consisting of neem-leaf extract with active metabolites, particularly nimbolide, nimbin, and salannin) was evaluated for prophylactic effects in the persons at high risk of COVID-19 infection due to contact with



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COVID-19 positive patients. The results indicated that neem capsules reduced the risk of COVID-19 infection in participants receiving them, which showed the potential of neem capsules as a prophylactic treatment for the prevention of COVID-19 infection. Neem capsules given at a dose of 50 mg twice a day were safe and well tolerated in participants having a high risk of COVID-19 infection [9]. Methanolic neem bark extract (NBE) was screened against SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus-2) *in vitro* using Vero E6 and A549-ACE2 cells. NBE inhibited SARS-CoV-2 infection and replication by reducing envelope and nucleocapsid gene expression in Vero E6 and A549-ACE2 cells at EC of 150 µg/ml and 200 µg/ml concentrations respectively [19].

**Others**

NCL-11, a methanolic extract fraction from neem leaves, was investigated for its antiviral activity against Coxsackie B viruses. After 96 h of incubation, at a concentration of 1000 µg/ml, NCL-11 inhibited plaque formation by 6 antigenic types of Coxsackie virus B in Vero cells, and best activity was observed against Coxsackie virus B-4. The active concentration of extract i.e. 1000 µg/ml was not cytotoxic to Vero cells. The extract was found to interfere at the early stages of viral replication cycle [20]. Aqueous extract of neem leaves was assessed for antiviral activity against Hepatitis C virus (HCV). In *in vitro* study, neem extract was incubated with serum of HCV infected patients when the extract inhibited the HCV specific peptide of 14 KDa. In *in vivo* study 20 patients were given neem extract at fasting state for two weeks and tested for seropositivity of HCV, which significantly decreased in about 15 patients out of 20 after two weeks of treatment with neem extract [21].

**Antiviral activity of neem against animal viruses**

Chloroform, n-hexane, and methanol extracts of neem leaves, seeds, and seed kernels were evaluated for their antiviral activities against Newcastle disease virus (NDV) and infectious bursal disease virus (IBDV) in culture of VERO cell and in chicken embryos. Neem extracts had a significant inhibitory action on both, NDV of 5000 TCID<sub>50</sub> (tissue culture infected dose fifty) and IBDV of 500 TCID<sub>50</sub>, at 3 to 4 µg/ml concentrations in Vero cell cultures. In chicken embryos, neem extracts exhibited antiviral inhibitory concentration fifty (IC<sub>50</sub>) of 4 µg/ egg against NDV and 1 to 4 µg/egg concentrations against IBDV [22]. Pectic arabinogalactan from *neem* and its sulfated derivative were analyzed for antiviral activity against bovine herpes virus type-1 (BoHV-1). These macromolecules showed significant antiviral activity against BoHV-1 with IC<sub>50</sub> values ranging from 31.12 to 105.25 µg/ml, which was substantially lower than the cytotoxicity values (>1600–1440 µg/ml). The anti-herpetic activity was observed at the step of virus adsorption to the cell and anionic groups, in particular the sulfate groups, were found to be very important for this anti-viral effect [23].

*In vitro* screening of four fractions obtained by column chromatography of neem seed kernel alcohol extract for antiviral activity against the duck plague virus (DPV) was carried out. Fraction 4 caused the inhibition of virus protein expression and significant reduction in the number of plaques, which was evident from direct immunofluorescence assay and plaque reduction assay respectively. Fractions 1 to 3 were inactive [24]. Aqueous extracts of neem leaves and neem bark were investigated for antiviral potential against Newcastle Disease (ND) virus using embryonated SPF chicken eggs and SPF chickens. In *in-vitro* virus inhibition assay, neem bark extract inhibited the growth of ND virus at the maximum concentration of 10<sup>4</sup> EID<sub>50</sub> in embryonated eggs at 5.6 mg/ml concentration. In *in vivo* virus inhibition assay, neem bark extract protected all the chickens from ND virus infection even after 10 days post inoculation [25].

Ethanol leaf extract of *A. indica* was evaluated for antiviral activity against foot and mouth disease (FMD) virus using BHK-21 (baby hamster kidney) cell line. Ethanol extract of neem exhibited stronger anti-FMD virus activity at concentrations 6–25 µg/ml that was nontoxic to the BHK-21 cell line (Ishrat Imran *et al.*, 2016). Aqueous extract of neem flowers, leaves and bark were evaluated for antiviral activity against Highly Pathogenic Avian Influenza (HPAI) H5N1 and velogenic Newcastle Disease (ND) virus by *in vitro* assay in embryonated chicken eggs. Neem bark extract showed better antiviral activity against HPAI - H5N1 at 2 mg/ml and velogenic Newcastle Disease (ND) virus at 5.6 mg/ml at virus concentration of 10 to 10000 EID<sub>50</sub>. Toxicity assay showed that the extract was not toxic to embryonated chicken eggs [26].



**Ashok N. Pyati and Girish.K****Molecular docking and simulation studies on antiviral potential of neem compounds**

Eight compounds such as tetratriacontane, 127-40-2, 6-o-acetylningbandiol, rutin, tiplasinin, hyperoside, nimocinoline and quercitrin obtained from neem were screened for antiviral potential against influenza virus using molecular docking approach. The compounds tested were found to have perfect binding with the conserved residues (R19, R35, S42 and D39) of Influenza virus NS1 protein. Thus these compounds could be potential sources for the antiviral drug development against all the strains of influenza virus [27]. Nimbin, nimbidol, gedunin, salannin, azadirachtin and azadirone obtained from the leaves of neem were evaluated for their antiviral potential against dengue virus. The structures of these selected neem compounds were screened against the envelope protein of dengue virus by molecular docking studies. Out of the different neem compounds studied nimbin was found to be more effective against the envelope protein of all the four types of dengue virus (dengue 1–4) [28].

*In-silico* analysis of neem leaf's active chemicals (nimbaflavone, rutin, and hyperoside) against Influenza virus nucleoproteins (H1N1, H1N2, H2N2, H2N3, H5N1, H7N2, H7N3, H7N7 and H9N2) was carried out. Molecular docking showed that all three compounds from neem leaf extract screened had perfect binding with conserved residues of influenza virus nucleoprotein. The compound hyperoside along with drugs LGH, Naproxen, BMS-885838, and BMS-883559 that showed best interactions with conserved residues of influenza virus nucleoprotein might be utilized as a universal drug against influenza strains [5]. Molecular docking and simulation studies revealed that a compound named 3-Deacetyl-3-cinnamoyl-azadirachtin from neem possessed good binding activity with Hepatitis C virus (HCV) NS3/4A protease. Thus this chemical could be a potential inhibitor of HCV [29]. Neem components were screened for their antiviral activity against zika virus by molecular docking and simulation approach using auto dock software. The results revealed that the neem components like nimbin, nimbolide, catechin, gallic acid, gedunin, azadirachtin, mahmoodin, epicatechin, margolone, and Gamma linolenic acid (GLA) had better antiviral activity against zika virus [30].

Bioactive chemicals from neem were evaluated for their binding activity against VP24 protein of Ebola virus (EBOV) through *in silico* docking studies. Azadirachtin, margolonone, mahmoodin, isomargolonone, gedunin, margolone, nimbidin, and nimbin exhibited low binding affinity toward target in comparison to the standard brincidofovir. While catechin, epicatechin, gallic acid and nimbolide, exhibited better binding than the standard. These neem compounds with significant binding activity could be potent drugs for the treatment of EBOV [31]. Small molecules of neem such as azadirachtin, nimbin, nimbidin, salannin, pongamol, meliantriol, meldonin, gedunin, and tannins (catechin, epicatechin, epigallocatechin, gallic acid and galloocatechin) were investigated against the proteins of Dengue virus (DENV) and humans that are involved in the processes of infection, by molecular binding simulation using Autodock software. Neem compounds such as gedunin and pongamol exhibited potential activity (high affinity against DENV and human proteins, and thereby blocking them from natural interaction) against the Dengue virus [32].

Nimbocinol obtained from neem was analysed for the potency to target Papain like protease (PLpro) of SARS-CoV-2 by molecular docking study and the activity was compared with synthetic analogs such as remdesivir, chloroquine and favipiravir. Nimbocinol exhibited maximum binding affinity against PLpro SARS-CoV-2 which was better than remdesivir, chloroquine and favipiravir, and could be a potential drug to hinder the replication process of SARS-CoV-2. ADMET (Absorption, Distribution, Metabolism, Excretion and Toxicity) studies further validated the drug like properties of nimbocinol [33]. 49 bioflavonoids from *A. indica* were analyzed virtually (molecular docking and simulation) against Dengue virus (DENV) serine protease enzyme. Based on the results, four chemicals such as kaempferol-3-O-rutinoside, rutin, hyperoside, and epicatechin were identified as potent viral protease inhibitors against reference compound quercetin [7]. Bioflavonoids from *A. indica* such as gedunin, nimbolide, ohchinin acetate, and kulactone were evaluated for antiviral activity against Japanese encephalitis (JE) virus by structure-based virtual screening of compounds against JE RdRp (RNA-dependent-RNA-polymerase) using MTiOpenScreen server and Auto Dock Vina. All these compounds exhibited significant binding affinity against JE RdRp and could be potential candidates for the development of antiviral drug against JE Virus [34].



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Neem compounds were evaluated against SARS-CoV by estimating their binding affinity for viral proteins using molecular docking and simulation studies. Rutin showed highest binding affinity for SARS-CoV main protease (M<sup>Pro</sup>) while lupeol exhibited significant binding affinity against the SARS-CoV-2 M<sup>Pro</sup>. Nimbinene showed significant binding affinity against spike protein and 5,7-Dihydroxy-4'-methoxy-8.3'-di-C- exhibited highest binding affinity for non-structural protein, NSP10-NSP16 protein complex. These neem compounds might be potential components for developing herbal formulations against SARS-CoV-2 [35]. A total of 19 bioactive compounds from the neem extracts were studied for their ability to block the cell entry of SARS-COV-2 virus, using *in silico* methods. The results of these studies showed that three compounds such as azadirachtin H, quentin and margocin could disrupt the spike RBD-ACE2 interaction, and thus had the potential to inhibit viral cell entry [36].

**CONCLUSION**

Use of natural products for the prevention and treatment of many human and animal diseases is constantly increasing worldwide owing to their availability, effectiveness and low cost. From ancient time neem is well-known for its medicinal properties. Antiviral potential of neem and its products have been researched and documented, and are still being enthusiastically researched worldwide owing to their effectiveness, less side effects and affordable properties. However, there is still a need of detailed studies to have exact knowledge of the antiviral bioactive principals present in neem and to clearly understand their mode of action and toxicity in animal models. This review is helpful for the researchers aiming at novel antiviral drugs from neem by providing brief information of the work that has been already done. *A. indica*, though researched extensively regarding antimicrobial potential, still represents a good source of novel antiviral agents especially against emerging viral diseases.

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## A Retrospective Study of Incidence of Normal and Anomalous Origin of Left Circumflex Artery in Angiogram Images

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### ABSTRACT

Left circumflex artery is the branch of the Left coronary artery supplying blood to the heart during diastole. Anomalous origin of coronary arteries is of diverse pattern and patho physiology causing sudden infarction and mortality. Hence it is vital to study its variations. To study the origin of the Left circumflex artery and its variations using angiogram images. 209 angiogram images of individuals were retrospectively studied after obtaining consent. The study included both the sex with age intervals of 22 – 81 years. The incidence of origin of the Left circumflex artery was observed and its variations were noted. Results were tabulated and studied with appropriate statistical analysis. Left circumflex artery was observed to originate from the branching of the left main coronary artery in 94.25 % and directly from the left posterior aortic sinus in 5.26 %. An anomalous origin of 0.47% from the right coronary sinus was observed. Incidence of 0.47% anomalous origin and 5.26% of normal variants of origin of the Left circumflex artery were noted in angiogram images.

**Keywords:** Left circumflex artery, Coronary artery, Ram us Left circumflex artery, Left circumflex artery variants, Cardiac death, Anomalous origin





## INTRODUCTION

Coronary artery disease is one of the leading causes of morbidity and mortality [1]. Coronary vasculature develops from the sinusoids, in situ vascular endothelial network, and coronary buds on the aortic sinuses [2]. The right and left coronary arteries arising from the aorta are the major blood vessels supplying the heart in diastole. These coronary vessels when blocked due to atherosclerosis lead to sudden cardiac death. Coronary artery origin anomalies have been reported in 1% of the population ranging from 0.3-5.6 % [2].

The left circumflex coronary artery arises as one of the terminal branches of the left coronary artery. It runs in the atrioventricular groove around the left cardiac border and ends in the left of the crux of the heart by anastomosing with the right coronary artery, supplying the left atrium and the left ventricle. The circumflex coronary artery lies close to the mitral annulus and may be damaged in mitral valve replacement [3].

Variations in the origin of the left circumflex artery were observed in the previous literature[4,8]. They are i) Origin from the Left posterior aortic sinus, commonest ranging from 0.41-0.67%[9], ii) Anomalous origin from the right coronary sinus or right coronary artery, second most common anomaly with an incidence of 0.37%. It can cause sudden death, especially in young athletes [9]iii) from the Pulmonary artery, iv) Congenital absence of the artery(rare) and v) from Twin circumflex artery. The anomalous origin of the left circumflex artery increases its risk of life-threatening consequences in young adults when the anomalous vessel passes between the aorta and pulmonary artery [9]. These factors predispose increased risk in any interventional therapeutic procedures like aortic or mitral valve replacement surgeries [10]. A coronary angiogram reveals better anatomy of the coronary arteries and their dimensions when compared to the cadaveric specimens which are altered by the preservation techniques. As there is less information on the pattern of anomalies of origin of a left circumflex artery in patients screened for coronary heart diseases, this study was attempted.

### Aim and Objectives of the study

- i) To estimate the incidence of origin of the left circumflex artery from the left coronary artery.
- ii) To study the incidence of anomalous origin of the left circumflex artery.

## MATERIALS AND METHODS

The study was retrospectively done using coronary angiogram images of 209 patients who underwent screening coronary angiogram for the risk factors of coronary heart disease in AVM hospital, Salem, after obtaining informed consent and Institutional ethical clearance. The present study was an integral part of the Ph.D. thesis. The study included coronary angiogram images of 128 males and 81 females of the age interval 22 – 81 years who underwent treatment for risk factors for cardiovascular diseases like diabetes mellitus, hypertension, and lipid disorders. Coronary angiogram images of blocked coronary arteries, transgender population, and those who underwent coronary artery bypass grafting were excluded from the study. The origin of the Left circumflex artery and its variations were studied based on Angelini's normal and anomalous coronary artery classification [5,7]. Results were tabulated and studied with appropriate statistical analysis.



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## RESULTS

The left circumflex coronary artery originated from the left main coronary artery (Fig no:1) in 94.25 % (198 out of 209 individuals) tabulated in Table no:1. In 5.26 % (11 out of 209 individuals) it originated directly from the left posterior aortic sinus (Fig no:2) and in 0.47 % (1 individual) it originated from the right coronary sinus (Fig no:3). Origin of the left circumflex coronary artery from the right coronary artery, from the pulmonary artery, or presence of twin left circumflex coronary artery and congenital absence of left circumflex artery was not observed in the present study. The total incidence of variations in the origin of left circumflex coronary observed in the present study was 5.73%.

## DISCUSSION

The left main coronary artery terminates by dividing into the left anterior descending artery and left circumflex artery. In the present study, 94.25 % of the left circumflex artery originated from the termination of the left main coronary artery following the normal pattern of branching. The separate origin of the left circumflex coronary artery from the left posterior aortic sinus was the commonest finding in most of the previous literature [4,9], which was also observed in the present study. The present study recorded a 5.26% of origin of the left circumflex artery from the left posterior aortic sinus which was higher in incidence and smaller in sample size compared to previous literature [2,4,8,11] depicted in Table no:2.

Angelini's [5] classification of nomenclature of variant and an anomalous variant of coronary arteries states that any coronary anomaly observed greater than 1% in the general population is a normal variant and an anomaly encountered in less than 1% in the general population is the anomalous variant. Based on this Angelini [5], the left circumflex artery arising from the left coronary sinus (5.26%) is considered, a standard variant of coronary anomalies, while few authors [10] suggest that these variations should not be overlooked in occlusive vessels and they don't always present as benign or non-ischaemic.

Aydar et al [11] observed an increased frequency of separate origin of the left circumflex artery in the female gender. The present study observed the origin of the left circumflex artery from the left posterior aortic sinus (3.34 %) in males compared to (1.91 %) in females. Statistically in the present study when compared between genders, the findings were not significant, which contradicted the findings of Aydar et al [11]. In the present study, a total incidence of 5.73 % of variations in origin of the left circumflex coronary artery was observed, similar to the findings of Angelini [5]. The differences in the frequency of incidence can be due to sample size, gender, and geographic and genetic variations.

The next commonly reported anomalous origin of the circumflex artery was its origin from the Right coronary sinus [2,4,9,11,12,13]. In the present study, the origin of the Left circumflex artery from the right coronary sinus was observed at 0.47% which coincided with the findings of previous literature [2,8,11,12,13] as shown in Table 2. Cannulation of the orifice of these anomalous vessels becomes difficult in diagnostic angiography.

Origin of Left circumflex artery from pulmonary artery [6], from right coronary artery [12], Total absence of circumflex artery [13,14] and Presence of Twin circumflex arteries [15] were reported in other previous works of literature, but not seen in the present study population. Any anomalous coronary artery origin





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passing between the aorta and pulmonary can be compressed leading to a decreased blood supply to the area it supplies, leading to cardiac death [9]. Left circumflex origin from the pulmonary artery, the right coronary artery is clinically important if the anomalous artery follows a retro aortic path, which may be injured during any aortic root surgeries [12,14]. Extremely rare variation like the absence of left circumflex artery with the presence of super dominant right coronary artery was observed in the previous literature [16]. The dominant right coronary artery vascularizes the area supplied by the missing left circumflex artery. When the single super dominant right coronary artery is blocked due to atherosclerosis, it can cause life-threatening circumstances [6].

The previous works of literature have similar findings of normal and anomalous origin of left circumflex coronary artery in their population and differ only numerically when compared to the present study. Most of the normal variants of origin of the left circumflex coronary artery are asymptomatic and are coincidentally encountered during a diagnostic angiogram. Anomalous variants may present with angina, arrhythmias, myocardial infarction, or sudden death. The presence of variations should be checked during the screening angiogram procedure and not be overlooked as normal variants but should be evaluated and treated for better prognosis and to prevent further complications. In the present study, the frequency of anomalies between male and female samples was statistically similar. Gender, ethnicity, and genetic factors play a great role in the variations observed in different populations. The study is limited by the small sample size and only inclusion of only patients who had undergone diagnostic angiogram and not the general population.

## CONCLUSION

Origin of the left circumflex artery from the left posterior aortic sinus is the commonest variation observed. The variation in the origin of the Left circumflex artery did not differ statistically between gender. Knowledge of these variations of normal and anomalous origin will be a guide for any interventional cardiac procedures and enhance the significance of early screening of coronary artery anomalies in this population before any therapeutic or surgical interventions. Any anomalous origin should be thoroughly investigated to prevent untoward complications.

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Table 1. Incidence of Origin patterns of Left circumflex artery

| Site of origin of circumflex artery          | Males (n=128) | Incidence % Males | Females (n=81) | Incidence % Females | Total % |
|--|---------------|-------------------|----------------|---------------------|---------|
| Left coronary artery (Normal)                | 120           | 57.41             | 77             | 36.84               | 94.25   |
| Left posterior aortic sinus (Normal variant) | 7             | 3.34              | 4              | 1.91                | 5.26    |
| Right coronary sinus (Anomalous variant)     | 1             | 0.478             | 0              | 0                   | 0.47    |





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Table 2. Comparison of Incidence of origin of Left circumflex artery

| Author, Ref, Year Study Population  | Incidence % of Anomalous origin of Left circumflex artery from |                             |                       |                  |                              |                                       |
|-------------------------------------|--|-----------------------------|-----------------------|------------------|------------------------------|---------------------------------------|
|                                     | Left posterior aortic sinus                                    | Right anterior aortic sinus | Right coronary artery | Pulmonary artery | Absence of circumflex artery | Accessory or Twin circumflex arteries |
| Yamanaka and Hobbs[4] 1991 American | 0.405  | 0.36                        |                       | 0.003            | -                            | -                                     |
| Mavi et al[11] 2002 Turkey          | 0.12   | 0.07                        | 0.08                  | -                | -                            | -                                     |
| Aydar et al [12] 2011 Turkey        | -  | 0.24                        |                       | -                | -                            | -                                     |
| Yuksel et al[13] 2013 Turkey        | -  | 0.169                       |                       | -                | -                            | -                                     |
| Graidis C et al [8] 2015 Greece     | 0.58   | 0.23                        | -                     | -                | -                            | -                                     |
| Villa AD [2], 2016                  | 0.41   | 0.32-0.67                   | 0.37                  | -                | -                            | -                                     |
| Sreepadma S[14] 2018 South Indian   | -  | -                           | 0.12                  | -                | 0.1                          | -                                     |
| Present study South Indian          | 5.26   | 0.47                        | -                     | -                | -                            | -                                     |

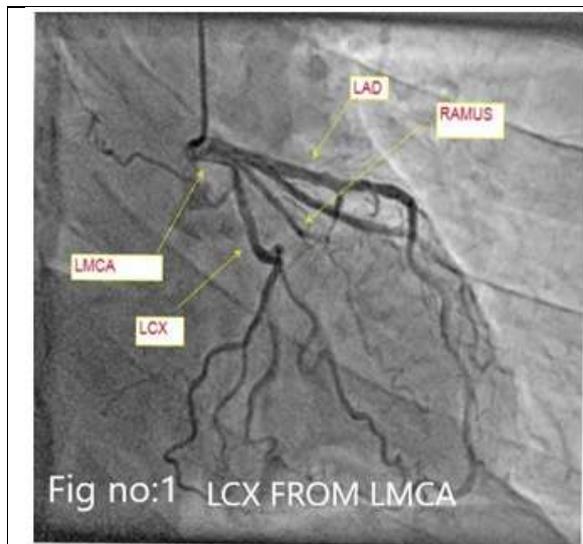


Fig no:1 Angiogram image showing Left circumflex artery arising from the LMCA. The normal pattern of branching of LMCA. LCX- Left circumflex artery, LMCA- Left Main coronary artery, LAD – Left anterior descending artery Ramus branch from LMCA



Fig no:2 Angiogram image showing: Left circumflex artery arising from the left posterior aortic sinus LCX- Left circumflex artery LCS- Left coronary sinus





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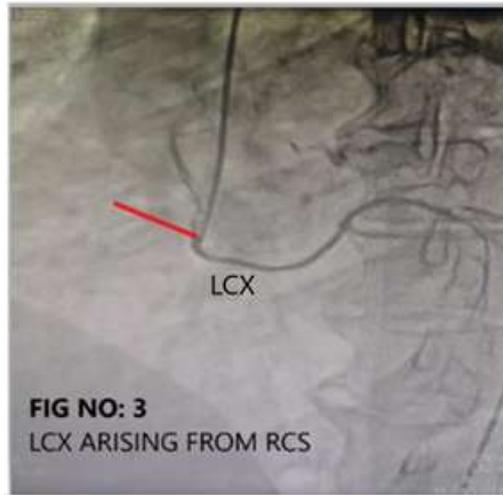


Fig no:3 Angiogram image showing Left circumflex artery arising from the Right coronary sinus.  
LCX- Left circumflex artery, RCS- Right coronary sinus





## Formulation and Optimization of Nanostructured Lipid Carriers of Simvastatin using Box-Behnken Design

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### ABSTRACT

Nano-structured lipid carriers (NLC) are latest methodology for delivering poorly soluble drugs with low oral bioavailability. In the present investigation, simvastatin was prepared as NLCs using compatible excipients to improve oral bioavailability with the aid of Box-behnken design. The formulations were evaluated by determining the parameters such as particle size(nm), entrapment efficiency (%), polydispersity index. Other studies conducted are in-vitro release study of simvastatin and DSC analysis. The stability evaluation of optimized formulation was also performed for formulation stored in 4°C and 25°C, at certain interval for one month. The optimized formulation had a particle size (PS), polydispersibility index (PDI) and entrapment efficiency (EE) was found to be of 86.19 nm, 0.199 and 83.5% respectively. The in-vitro release study of optimized formulations shown the controlled release of drug. From present study we can come to a conclusion that NLCs is a possible approach for the controlled delivery of simvastatin with improved oral bioavailability.

**Keywords:** Blood Brain Barrier, Nano-structured Lipid Carriers, Simvastatin

## INTRODUCTION

Simvastatin is statin group drug, which are inhibitors of 3-hydroxy-3-methylglutaryl-coenzyme-A (HMG-CoA)[1]. Simvastatin are suggested for hypercholesterolemia for its effects on lowering cholesterol and it also reduce risk of cardiovascular diseases. Conventional Simvastatin have poor aqueous solubility and bioavailability less than 5% on oral administration. NLC have shown to be quite effective in manifesting the potentiality to improve the solubility of



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hydrophobic drugs and offer a sustained and controlled release of agents. Collectively, the NLCs significantly enhances the solubility and permeability of the drug and might provide a promising Nano platform for the hydrophobic drug delivery. Simvastatin belongs to the to the BCS class II category – low solubility and high permeability. The solid lipid in nanoparticles methods of formulation is an alternative for overcoming the problems associated with liposomes and gained more attraction to the use of solid lipid nanoparticles and its carriers since the invention in 1990s [2-4]. Solid lipid nanoparticles are micro sized particles made of biologically compactable lipids which are solid at room temperature and body temperature [2,5]. When solid lipid nanoparticles compared with liposomes, solid lipid nanoparticle have delayed degradation rate, provide a good control release and superior protection for the incorporated drug [6]. These are easily produced in the larger system by high pressure homogenization techniques with are already existing in the industries [2]. There are limitations associated with solid lipid nanoparticles like expulsion of drug while storing triggered by the polymorphism of lipid employed, gelation and low drug loading capacity [7]. In this perspective, NLC can be considered as SLN alternative for improvising both hydrophilic and lipophilic drug delivery. NLCs have benefits for the delivery of drugs, for example, usage of biodegradable and physiological lipids of low systemic toxicity and cytotoxicity, ability to produce on large industrial scale, controlled drug release, prevention of drug degradation and better bioavailability [8,9]. The objective of the current study was to implement a simple methodology for the formulation simvastatin NLC and to optimize it by using Box- Behnken design. Seventeen formulations with various lipid concentrations were studied for the optimization of the formulation for minimal particle size and polydispersity index, a maximum entrapment efficiency (EE) and to increase oral bioavailability. Formulated SV-NLCs were screened and investigated for the physicochemical characteristics, in-vitro drug release properties and stability.

## MATERIAL AND METHODS

### MATERIALS

The active ingredient Simvastatin API was purchased from Yarrow Chem products, Mumbai. The solid lipid, Glyceryl Monostearate (GMS), liquid lipid, Oleic acid (OA) and surfactant, tween 80 was obtained from Lobe Chemie, Mumbai.

### METHODS

#### Solubility studies

Lipid selection was done with regard to its ability to solubilize SV. Hence, SV solubility in various lipids were determined in order to select appropriate solid and liquid lipids for formulating desired NLC. Shake flask method was used for solubility analysis. An excess amount of SV was vortexed with selected liquid lipids. The mixture obtained was set aside for several hours and then visually analysed for insoluble drug.

#### Compatibility study between drug and lipids

##### FT-IR Spectroscopic analysis

FT-IR helps in the identification of drug and detection of drug- excipients interactions. FT-IR measurement for pure Simvastatin drug, lipid Glyceryl Monostearate and physical mixtures of Simvastatin and Glyceryl Monostearate were taken at room temperature. The sample powder is mixed with KBr in the ratio 1: 3 and prepared pellets by applying a pressure of 600 kg/cm<sup>2</sup> using KBr press. Spectra all were obtained by scanning in a range 4000 - 400 cm<sup>-1</sup> (4 cm<sup>-1</sup> –resolution) [10].



**Differential scanning calorimetry (DSC)**

In this typical study, around 5mg of sample was taken in a pan made of aluminium and it was hermetically sealed. Scanning was done at a rate of heating from 30 to 300°C and reference used was an empty pan. The DSC measurements of pure drug (Simvastatin) and mixture of Simvastatin and GMS was carried out. When sample is heated or cooled, amount of energy absorbed or release (in J/Kcal units) by it can be measured by using DSC analysis [10].

**Physical compatibility of solid lipid and liquid lipid**

Solid and liquid lipid selected based on ability to dissolve simvastatin, was taken in a glass vial in 1:1 ratio. The melted mixture was then left in room temperature to get congealed [11]. The vial was analyzed visually for the separation of lipids into layers.

**Selection of ratio of solid to liquid lipid (S: L)**

Selection of S: L lipid ratio to be taken was based on trial and error. In a range of ratios 100:00 to 50:50, the selected lipids were melted together by heating at 80°C until a clear lipid solution was formed. To this lipid solution aqueous phase, containing surfactant and distilled water was added and homogenized, followed by sonication. By checking the consistency and particle size of formulation solid to lipid ratio is determined [12].

**Preparation of Simvastatin loaded Nanostructured Lipid Carriers**

Different simvastatin loaded NLC formulations were prepared using different composition as given in the table. Hot homogenization was used for the preparing NLCs. In this method, the solid matrix Glyceryl Mono-Stearate was melted along with the liquid matrix, oleic acid by heating at 80°C. This forms the lipid phase and to this 40 mg of simvastatin was added. This mixture was stirred until drug is completely dissolved and a clear solution was obtained. Aqueous and lipid phases are prepared separately. Aqueous phase was prepared using distilled water into which surfactant, tween 80 was mixed and heated to a temperature similar to lipid phase. After attaining definite temperature by both phases, to the lipid phase, the aqueous phase was slowly added with vigorous shaking. Then the dispersion was mixed by a homogenizer at 10000 rpm for 5 minutes. After homogenization, it was sonicated for 5 minutes. Further the characterisation of NLC dispersion was performed to evaluate parameters like size of NLC particles (PS), polydispersity index (PDI) and efficiency to entrap the drug (%EE) [10].

**Experimental design for the formulation (DOE)**

For the determination of influence of independent variables on the factors like PS, PDI and %EE, Box–Behnken design (BBD) was used which have 17 experimental run with five centre points, given in table 1. Based on the preliminary screening of the various factors that can affect the response, three independent variables were chosen. The dependent and the independent variables selected are as shown in Table 1 with optimized formulations of low, medium, and high levels of preparations. Solid lipid: liquid lipid concentration, Surfactant concentration, and Homogenization speed belong to the independent variable. The above three are analyzed by design for three responses that are particle size, polydispersity index, and entrapment efficiency; these three are dependent variable. Design matrix comprises of 17run experiments with three variables - solid lipid: liquid lipid concentration ( $M_1$ ), Surfactant concentration ( $M_2$ ) and Homogenization speed( $M_3$ ) and their responses such as particle size ( $N_1$ ), polydispersity index ( $N_2$ ) and entrapment efficiency ( $N_3$ ). The reports of 17 formulations data were filled in the design. Design of experiment (DOE) was employed in the analyses of data. The best suited one are selected. It would show the minimum particle size range, having minimum polydispersity index and maximum entrapment efficiency was optimized.

**Characterisation of simvastatin-loaded Nano-structured Lipid Carriers****Particle size(nm) and Polydispersity Index measurement**

For determining the particle size (PS) and poly dispersity index (PDI) of Simvastatin loaded NLCs formulation, dynamic light scattering (DLS) technique was used with the aid of a zetasizer.



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Particle size analyzers uses dynamic light scattering technique, which measures at 90°C which is scattering angle. The sample was diluted with milli Q water and sonicated for at least 15s for removing air bubbles and froth before analysis[10].

### Drug encapsulation efficiency

Entrapment efficiency of prepared SV-NLC was calculated by an indirect method. To separate free drug in supernatant, for about 40 minutes 5ml of SV-NLC formulation was allowed to centrifuge at 15000 rpm with a maintained temperature of 4°C, using cooling centrifuge. Supernatant was withdrawn and simvastatin concentration in it was analysed after proper dilution with the aid of UV-Visible spectrophotometer at 238nm(10). The following equation was used for calculating % drug entrapment efficiency:

$$\% EE = \left[ X_a - \frac{X_s - X_p}{X_a} \right] \times 100$$

Where  $X_a$  is the total amount of drug,  $X_s$  is drug in supernatent after centrifugation and  $X_p$  is the drug in medium.

### In-vitro release study

The discharge of simvastatin from optimized formulation was performed using PBS of pH-7.4. The technique of diffusion was utilized with the aid of dialysis membrane to evaluate the release rate of release of drug in an in-vitro set up. Dialysis membrane employed was of 12000–14000nm molecular weight and 2.4 nm pore size. The activation of membranes was done prior to experiment by soaking it overnight (about 24 hrs) in buffer solution. 5 ml of optimized NLC formulation and simvastatin drug solution both containing 40 mg of drug was taken separately in the double side opened glass tube tied with activated dialysis membrane at one end. This glass tube was placed in a larger beaker with 200 mL phosphate buffer (release medium) of pH 7.4 Lobe chemie, Mumbai. Gentle stirring of the release medium was done using magnetic stirrer with speed of 50 rpm while maintaining  $37 \pm 5^\circ\text{C}$ . At every 1hour time intervals till 12<sup>th</sup> hour and thereafter at 24<sup>th</sup> hour, 5 mL of aliquot was removed from medium and exact same volume of newly prepared buffer was refilled in the medium in order to retain the conditions in a sink state. The samples were assayed by means of UV Spectroscopy at 238nm and the aggregate of percentage release of drugs versus time was plotted[13].

### Stability studies

The SV loaded NLCs stability was carried out by keeping the optimized formulation at 25°C and 4 °C for about one month. 1 ml of the sample were taken at 7<sup>th</sup>, 15<sup>th</sup> and 30<sup>th</sup> day and analyzed for size of particle (nm), polydispersity index and entrapment efficiency(%) for checking stability [13].

## RESULTS AND DISCUSSION

### Solubility study

Selection of liquid and solid lipid for formulating NLCs is very significant as it can disturb the entrapment efficiency of drug. If the drug has good affinity towards the lipids, it will show high entrapment efficiency (%). The SV solubility in various liquid lipids such as coconut oil, oleic acid, castor oil was determined. Highest solubility of SV is observed in Oleic Acid. SV solubility in different solid lipids like, Glycerol Monostearate (GMS), stearic acid and compritol 888ATO was studied. The drug was found to be better soluble in GMS and compritol 888 ATO. However, GMS was chosen as it is nontoxic in nature when compared with compritol 888 ATO and its physical compatibility with oleic acid.

### FT-IR Spectroscopic analysis

The FTIR spectral analysis was performed for simvastatin, GMS and mixture of drug and lipids and spectra are shown in the Figure 1. Characteristic absorption peaks at 3551.07  $\text{cm}^{-1}$  (-O-H stretch), 2877.89 $\text{cm}^{-1}$  (methyl -C-H stretching), 1705.13 $\text{cm}^{-1}$  (-C=O stretching), 1462.09 $\text{cm}^{-1}$  (aromatic -C=C- Stretching) has revealed by the FT-IR spectra of SV. GMS has shown the absorption peaks at 3450.77 $\text{cm}^{-1}$  (-O H stretch); 2920.32 $\text{cm}^{-1}$  (- CH<sub>2</sub> stretch); 1739.85 $\text{cm}^{-1}$  (-C=O stretch). The physical mixture was presented with absorption peaks at 3551.07 $\text{cm}^{-1}$  (- OH Stretch); 2920.32 $\text{cm}^{-1}$  (-



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CH<sub>2</sub> Stretch); 1701.27 cm<sup>-1</sup> (-C=O Stretch), 1465.96cm<sup>-1</sup> (-C = C- Stretching), which are same as the characteristic absorption peaks shown by the individual compounds. Presence of any other new peaks or absence of characteristics peaks was not found. These results conform the simvastatin and the excipients compatibility.

### DSC analysis

DSC thermograms was obtained from analysis for both pure SV and physical mixture were demonstrated in Figure 2 respectively. Sharper endothermic peak at 140.4°C was displayed by the SV thermogram, which is in the melting range of SV. Whereas, the physical mixture exhibited two peaks, first peak at 75.55°C, in which the drug is dispersed in the lipids. The second peak at 140.02°C, may be due to the pure SV drug representing the absence of objectionable drug-lipid interactions [10].

### Physical compatibilities between solid and liquid lipid

When visually analyzed even after 48h, there wasn't any phase separation in the lipid mixture and GMS and OA formed a homogenous mixture. This suggests that selected solid and liquid lipid is compatible.

### Selection of S: L lipid ratio

The ratio of solid-liquid lipid selection is really significant since better drug loading capability as well as stable at room temperature should be there for an ideal Nano formulation [11]. The consistency of the formulation was found to be changeable with varying solid lipid concentration. While increasing the solid lipid concentration the formulation became turbid and creamy, whereas a substantial enhancement in size of particle was found while the liquid lipid concentration was increased above 1%.

### Optimisation of NLC by Box–Behnken design

For the determination of influence of independent variables on the factors like PS, PDI and %EE, Box–Behnken design (BBD) was used which have 17 experimental runs with five centre points, given in table 2. Based on the preliminary screening of the various factors that can affect the response, three independent variables were chosen. They are S:L ratio, concentration of surfactant and homogenization speed. The interaction plots and polynomial equations that depict the interaction between factors and its special effects were generated by means of the Design Expert software. The selection of model for the analysis of response was done by considering lack of fit value of the test, sum of squares of model, and fit summary. For analyzing the responses quadratic model was nominated, considering the values of "Prob > F", model P value <0.0001, higher R<sup>2</sup> value, lowest standard deviation and low value of predicted residual error. Basically, ANOVA validates the polynomial equation statistically and the model terms can be regarded as significant, only if the 'p values' are lesser than 0.0500. The terms of model are said to be not significant, if the P-values are more than 0.1000. 3D surface graphs for the responses observed, which illustrates the impacts on responses by the dependent variables on the responses is presented in Figure 3. The particle size of entire batches were distributed in a range of 86.19 and 286.4 nm, polydispersity index 0.199 to 0.43 and % EE 54.41 to 83.5%.

The R<sup>2</sup> value (correlation coefficient) obtained for Particle Size was 0.9816, which indicates a respectable fit and the 'adjusted R<sup>2</sup>' was 0.9580. The value of R<sup>2</sup> for polydispersity index given by model was 0.9697 which represents a decent fit and the 'predicted R<sup>2</sup>' of 0.9117 was in promise with the 'adjusted R<sup>2</sup>' of 0.9307. Lastly, the R<sup>2</sup> value of EE was 0.9945, also demonstrates a reasonable fit with the predicted R<sup>2</sup> value 0.9301 and adjusted R<sup>2</sup> value 0.9875 which were in sensible pact with each other. This recommends that the model selected for the responses was significant. Moreover, an adequate signal is indicated by the 'Adeq Precision' ratio of 22.3083, 16.7312 and 33.1971 for the responses N<sub>1</sub>, N<sub>2</sub> and N<sub>3</sub> respectively. A contour graph is a graph that you can use to understand the relationship between two factors on the response. It can be observed that at low level of solid lipid: liquid lipid ratio (-1) and high surfactant concentration (+1) minimum PDI was obtained. Low level of solid lipid: liquid lipid ratio (-1) and high surfactant concentration (+1) minimum Particle size was obtained. Low level of solid lipid: liquid lipid ratio (-1) and high surfactant concentration maximum % EE can be obtained while at high level solid lipid: liquid lipid ratio (+1) and low % EE was observed.





### Optimization of formulation

The main conditions for attaining an optimal formulation of SV-NLCs rely on obtaining least PS and PDI and highest percentage of EE using Design Expert. The composition of optimized formulation was 40mg of simvastatin, 100mg of GMS (solid lipid), 30mg of OA (liquid lipid) and 1% of tween 80 (surfactant). The experimental values for the optimized formulation was found to be particle size of 86.19nm, PDI of 0.199 and EE of 83.5 % respectively. This suggests that, the experimental values and the predicted value are in close agreement with each other. The PS of optimized formulation was 86.19nm and PDI was 0.19, which were used during the in-vitro release studies. The reports showing the PS and PDI of the optimized formulation is demonstrated in Figure 5.

### In-vitro release studies

The % release of simvastatin from the SV-NLC formulation and SV solution was plotted against time is given in the Figure 7. The release pattern was shown by in-vitro release of SV-NLCs (optimized formulation;) was biphasic. An initial sudden release of SV from the NLC formulation was observed with 12.52% in 1 hour and followed by a controlled release thereafter. The drug coated superficially onto the nanoparticles in formulations can be the cause for the surge release of SV from it. While the sustained release might be because of the drug which was entrapped in the lipid matrix. In the meantime, the SV drug solution shown an immediate release (99.3 in 6h) which may be due to its hydrophilic nature.

### Stability Study

Stability of the optimised formulation in 4°C and room temperature was evaluated for its PS (nm), PDI and %EE. NLCs highly stable and were not affected by change in storage temperature. The results are shown in Table 5 and 6.

## CONCLUSION

In the present research work, SV-NLCs were prepared effectively and assessed for its capacity to augment oral bioavailability of SV in comparison to the simvastatin drug solution. SV-NLCs of smaller particle size (86.19 nm), polydispersity index (0.199) and higher entrapment efficiency (83.5%) and sustained in-vitro release of the drug were designated for further characterizations. On the basis of results obtained, the current study can be termed as a pointer towards the fact that drugs can be effectively formulated as NLCs employing hot homogenization technique and can be optimized using DoE. The studies carried out for determining the stability of the final formulation indicated that it is stable and the release study of SV-NLCs in an in-vitro set up shown that it shows that release of SV drug for about 24 h is controlled.

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**Table 1: Variables employed along with their coded levels in BBD designed for SV-NLCs**

| Independent variables                            | Coded levels |              |            |
|--|--------------|--------------|------------|
|  | Low Level    | Medium Level | High Level |
|  | (-1)         | (0)          | (+1)       |
| M <sub>1</sub> = Solid lipid: liquid lipid conc. | 100:30       | 150:22.5     | 200:15     |
| M <sub>2</sub> = Surfactant concentration (%)    | 0.8          | 1.0          | 1.2        |
| M <sub>3</sub> = Homogenization speed(rpm)       | 5000         | 10000        | 15000      |
| Dependent responses                              | Constraints  |              |            |
| N <sub>1</sub> = Particle size (PS)              | Minimum      |              |            |
| N <sub>2</sub> = Polydispersity Index (PDI)      | Minimum      |              |            |
| N <sub>3</sub> = Entrapment Efficiency %         | Maximum      |              |            |

**Table 2: Responses obtained from Box–Behnken design for SV**

| Std | Run | Independent variables |                            |                        | Dependent variables |       |                          |
|-----|-----|-----------------------|----------------------------|------------------------|---------------------|-------|--------------------------|
|     |     | A:A                   | B:Surfactant Concentration | C:Homogenization Speed | Particle Size       | PDI   | Entrapment Efficiency(%) |
|     |     |                       |                            | rpm                    | nm                  |       |                          |
| 14  | 2   | -1                    | 1                          | 1                      | 88.57               | 0.19  | 83.5                     |
| 7   | 3   | -1                    | -1                         | 0                      | 123.8               | 0.272 | 80.41                    |
| 10  | 10  | -1                    | 0                          | -1                     | 129.1               | 0.251 | 80.1                     |
| 13  | 13  | -1                    | 0                          | 1                      | 128.7               | 0.231 | 80.77                    |
| 6   | 1   | 0                     | 1                          | -1                     | 168.5               | 0.298 | 80.74                    |
| 17  | 4   | 0                     | 0                          | 0                      | 234.5               | 0.283 | 78.54                    |
| 4   | 5   | 0                     | -1                         | 1                      | 173.7               | 0.345 | 78.35                    |
| 3   | 7   | 0                     | 0                          | 0                      | 205.4               | 0.239 | 76.89                    |





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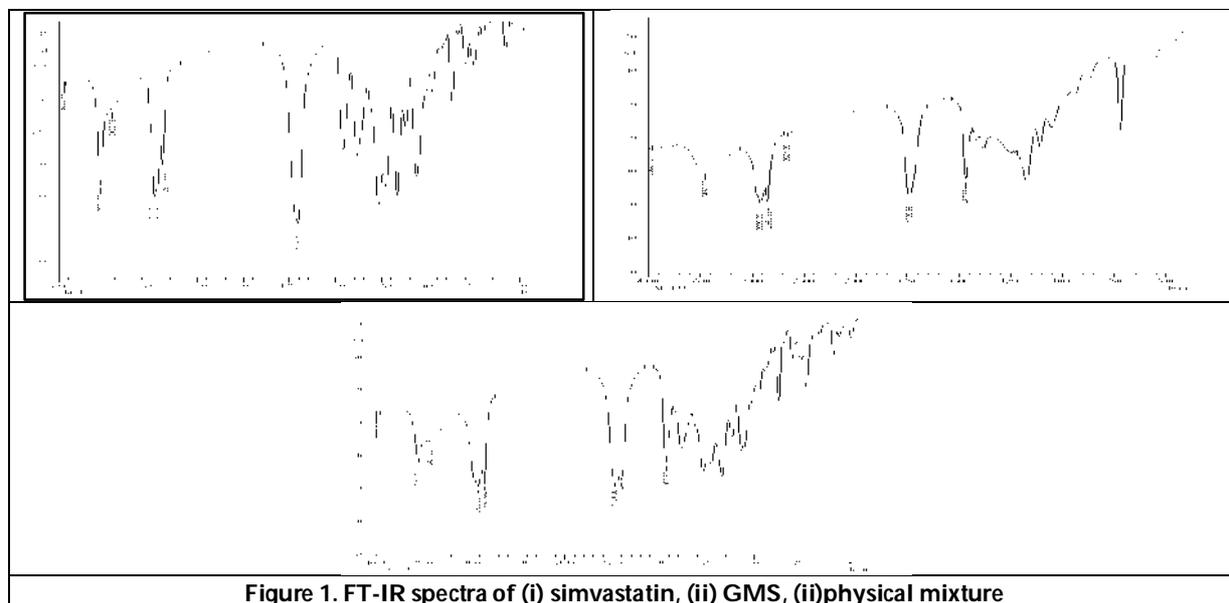
|    |    |   |    |    |        |       |       |
|----|----|---|----|----|--------|-------|-------|
| 2  | 8  | 0 | 1  | 1  | 145.3  | 0.244 | 77.11 |
| 11 | 9  | 0 | 0  | 0  | 204.9  | 0.285 | 77.21 |
| 8  | 14 | 0 | 0  | 0  | 205.8  | 0.287 | 76.22 |
| 9  | 16 | 0 | -1 | -1 | 173.6  | 0.291 | 74.35 |
| 5  | 17 | 0 | 0  | 0  | 203.1  | 0.285 | 77.54 |
| 12 | 6  | 1 | 1  | 0  | 235.25 | 0.387 | 57.32 |
| 16 | 11 | 1 | 0  | -1 | 269.5  | 0.384 | 54.41 |
| 1  | 12 | 1 | -1 | 0  | 245.6  | 0.391 | 56.22 |
| 15 | 15 | 1 | 0  | 1  | 261.8  | 0.392 | 58.56 |

**Table 3: Variations in characteristics of SV-NLCs with regards to time (4°C)**

| Formulation code | Day | Particle size(nm) | PDI   | %EE   |
|------------------|-----|-------------------|-------|-------|
| Optimized SVNLC  | 7   | 86.2              | 0.199 | 83.45 |
| Optimized SVNLC  | 15  | 86.5              | 0.205 | 83.01 |
| Optimized SVNLC  | 30  | 86.81             | 0.215 | 82.34 |

**Table 4: Variations in characteristics SV-NLCs with regards to time (25°C)**

| Formulation code (%) | Day | Particle size(nm) | PDI   | %EE   |
|----------------------|-----|-------------------|-------|-------|
| Optimized SVNLC      | 7   | 86.22             | 0.201 | 83.34 |
| Optimized SVNLC      | 15  | 86.64             | 0.212 | 82.51 |
| Optimized SVNLC      | 30  | 87.11             | 0.222 | 82.15 |



**Figure 1. FT-IR spectra of (i) simvastatin, (ii) GMS, (iii) physical mixture**





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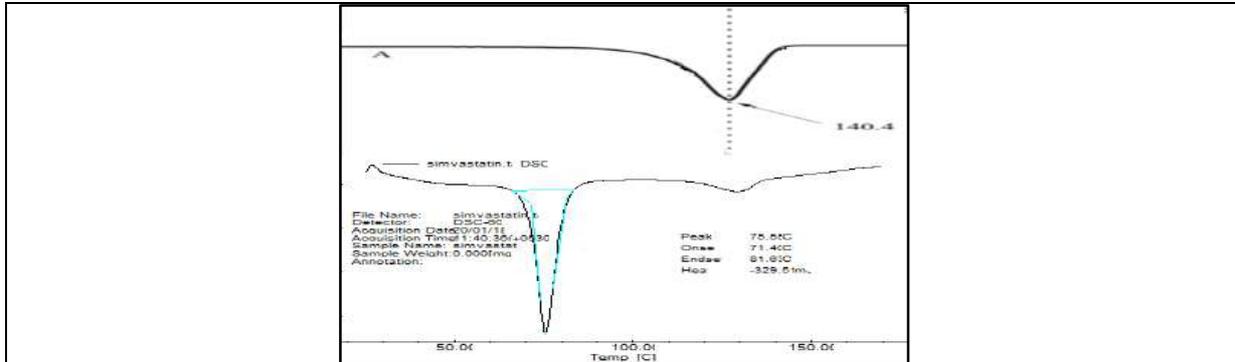


Figure 2: DSC thermogram of (A) simvastatin, (B) mixture (SV+ lipids)

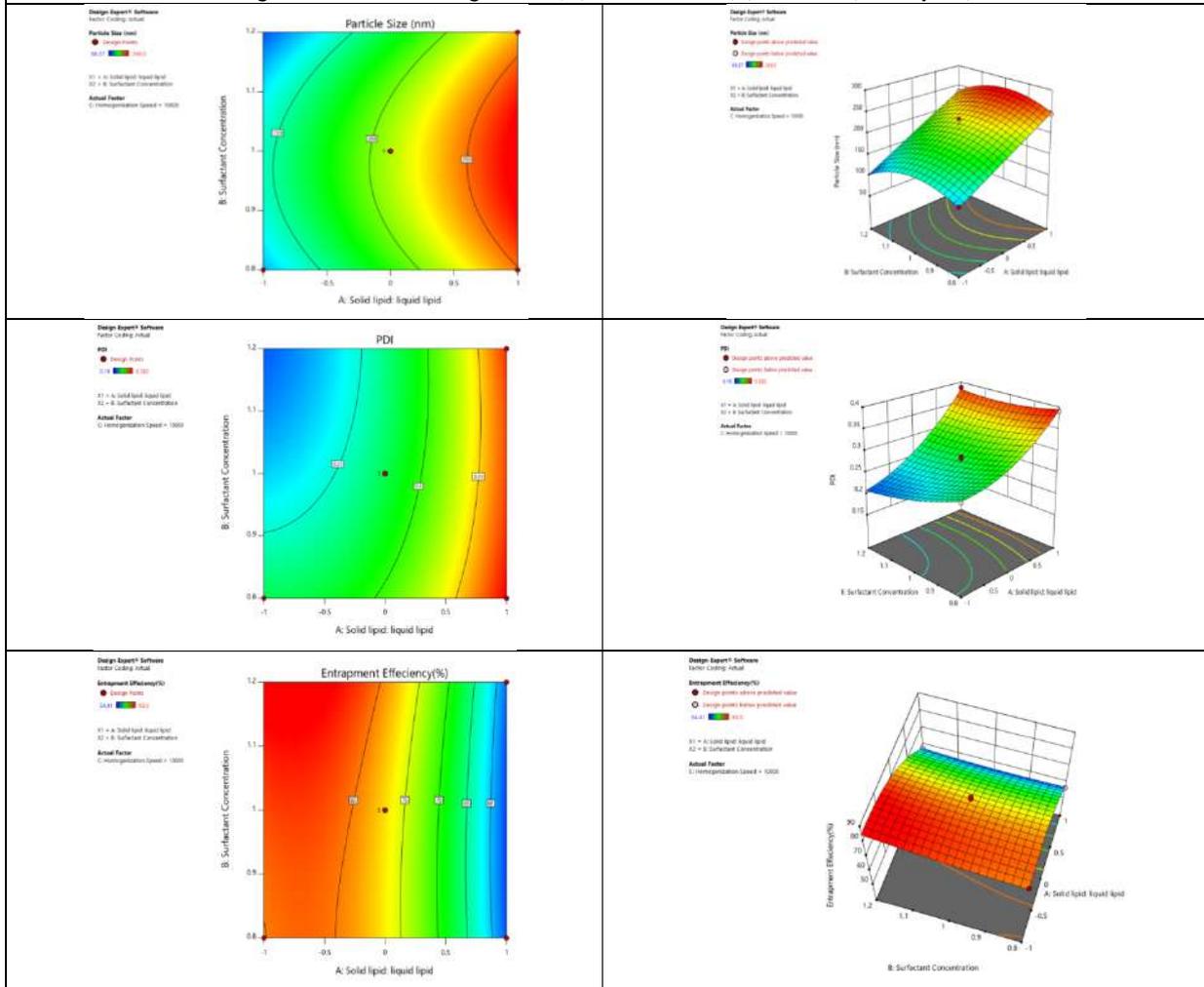


Figure 3: Contour graphs for demonstrating relationship between factors A and B on i) Particle Size nm, ii) Polydispersity Index and iii) Entrapment efficiency





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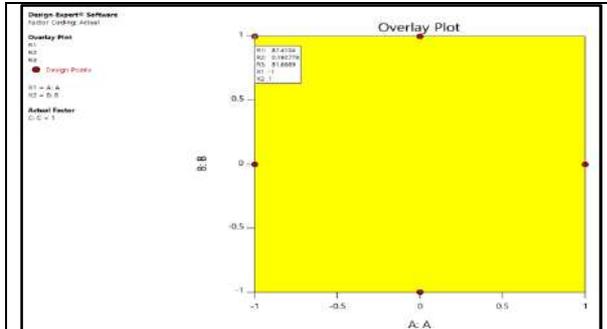


Figure 4; optimization plot

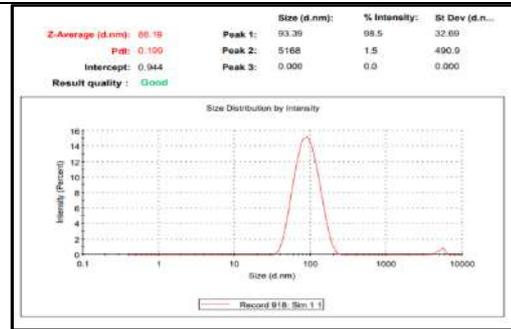


Figure 5: Distribution of PS and PDI of the optimised formulation

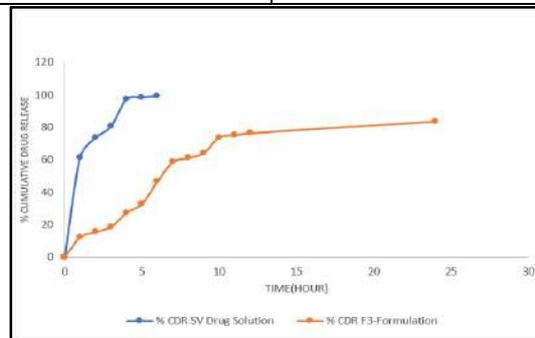


Figure 6: In-vitro release study of SV- drug solution and SV-NLC (Optimized)





## Pharmacological Evaluation of Selected Flavonoids against Multiple Targets for Ulcerative Colitis

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### ABSTRACT

Inflammatory bowel disease (IBD) is a term for two conditions (Crohn's disease and ulcerative colitis) that are characterized by chronic inflammation of the gastrointestinal (GI) tract. Studies have shown flavonoids attenuation of histamine release during the late phases of allergic reactions. Based on the methods evaluate the anti-inflammatory activity of selected flavonoids by *in-silico* method by using I GEM docking, Patch docking and Swiss docking. Evaluation of anti-inflammatory activity of selected flavonoids by *in-vitro* method by using Protein denaturation method. Docking of ligands and target enzyme by using iGem Dock, Patch Dock, Mcule and Swiss Dock. *in-vitro* anti-inflammatory activity was carried out by Protein denaturation method. Flavonoids like hesperidine, engeletin, negletin, astilbin, primuletin, cirsimartin, nobitin, norwogonin, pectolarigenin, primetin were docked against interleukin-6 by different docking software like IGEM dock, Patch Dock and Swiss dock. While comparing the flavonoids like hesperidine and primuletin with the standard drug hesperidine showed similar percentage of inhibition. *in-silico* results were correlated with the *in-vitro* results.

**Keywords:** Inflammatory bowel disease; Flavonoids; Molecular docking.



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## INTRODUCTION

Inflammatory bowel disease (IBD) is a term for two conditions (Crohn's disease and ulcerative colitis) that are characterized by chronic inflammation of the gastrointestinal (GI) tract. Prolonged inflammation results in damage to the GI tract. The exact cause of IBD is unknown, but IBD is the result of a defective immune system. A properly functioning immune system attacks foreign organisms, such as viruses and bacteria, to protect the body. In IBD, the immune system responds incorrectly to environmental triggers, which causes inflammation of the gastrointestinal tract. There also appears to be a genetic component—someone with a family history of IBD is more likely to develop this inappropriate immune response. The first stage of the mucosal immune response involves antigen uptake, processing and presentation. Antigen passes through specialized epithelial cells called M cells and is then processed and presented by both 'professional' and 'non-professional' antigen-presenting cells (APC). The former are represented by dendritic cells, macrophages A and B cells while the epithelial cell may play a role as a non-professional APC.

The major symptoms of UC include diarrhea with urgency, rectal bleeding and colicky abdominal pain. In patients with distal disease (rectosigmoid involvement), the symptoms of rectal irritation may predominate namely tenesmus (the sensation of incomplete emptying), small-volume diarrhea, proximal constipation and rectal bleeding. In contrast, in extensive colitis (beyond the splenic flexure), profuse bloody diarrhea, abdominal cramping and, in severe cases, systemic features such as weight loss, fever and tachycardia are more prominent. Symptoms tend to present insidiously but may also present acutely, mimicking an infective aetiology. In children, extensive colitis is typical at diagnosis. Flavonoids are low molecular weight phenolic compounds, secondary metabolites found in fruits, vegetables, seeds, nuts, herb, spices, stems and flowers as well as in tea and red wine [1]. Despite longstanding knowledge of the potent anti-inflammatory effect of these fascinating compounds, little is known concerning the molecular mechanisms involved in their actions [2]. In recent years, growing attention has been focused on the use of natural sources of antioxidants in the prevention of chronic diseases. Flavonoids are the examples of such substances. It is a group of bioactive compounds that are widely distributed in many plant-based foods and beverages. Flavonoid-rich products include berries, citrus fruits, grapes, cherries, arugula, onions, artichokes, soyabeans, cowpeas, blackbeans, parsley, oregano and tea. Flavonoids exhibit a wide range of positive effects, such as strong antioxidant, anti-inflammatory, and antiplatelet activities [3].

Flavonoids occur both in free State and as glycosides and exert several important pharmacological actions of potential clinical interest. Structurally flavonoids can be grouped according to the presence of different substituents on the rings and to the degree of benzo - pyrone saturation. The most common classes are the flavones, flavanones, and flavonols. Movement of B-ring to the carbon 2 of the 3- carbon chain forms the isoflavonoids. Compounds derived from the flavonol taxiflorin and coniferyl alcohol, such as silybin - the main component of the complex sylimarin, which can be extracted from the fruit of the milk thistle *Silybum marianum* are called flavanolignans[2]. Flavonones display a remarkable array of biological and pharmacological actions which are suggestive of anti-inflammatory effects and modulation of immune system. Many investigations have proven that different flavonoids molecules exhibit anti-inflammatory functions. Thus, the anti-inflammatory activities of flavonols (quercetin, rutin and morin) and flavonones (hesperidin and hesperetin) were investigated in acute and chronic inflammation animal models. Among a great variety of natural flavonoids, one of the most studied in different models of inflammation has been the genistein. The effects of this compound have been evaluated on a guinea pig model of asthma. The anti-inflammatory effect may be mediated by inhibition of tyrosine kinase signaling cascade. The anti-inflammatory activities of flavonoids have been also investigated *in vitro* models where a number of studies have been conducted to elucidate the mechanism of action [3]. The inflammation response is highly synchronized series of cell activation processes most of which are linked to prostanoid biosynthesis via arachidonic acid metabolism. Arachidonic acid is released from phospholipids by phospholipase A2 and is further oxidised to prostaglandins and thromboxanes by the action of COX and 5- LOX. Flavonoids like quercetin inhibit the cyclooxygenase pathway. Quercetin obtained from numerous dietary sources like onion, apples and tea is found to be a strong inhibitor of both COX-2 and 5-LOX



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enzymes involved in the production of eicosanoids from arachidonic acids. Studies have shown flavonoids attenuation of histamine release during the late phases of allergic reactions. Docking is a method which predicts the preferred orientation of one ligand when bound in an active site to form a stable complex. Docking is an attempt to find the best matching between two molecules. Small molecule ligand (green) to a protein target (black) producing a stable complex. Two approach esteem are particularly popular with in the molecular docking community. One approach uses matching techniques that describes the protein and the ligand as complementary surface. The second approach simulates the actual docking process in which the ligand protein pair wise interaction energies are calculated. In this case the receptor molecular surface is described in terms of its solvent accessible surface area and ligand molecular surface is described in terms of its matching surface description. The complementarity between the two surfaces amounts to the shape matching description that may help finding the complementary pose of docking the target and that ligand molecule.

Simulating the docking process is much more complicated. In this approach the protein and ligand are separated by some physical distance and the ligand find it position in to the proteins active site after a certain a number of moves in its conformation along phase. The advantage of docking simulation is that ligand flexibility is easily incorporated. To perform a docking screen, the first requirement is a structure of the protein of interest. Usually the structure has been determined using a biophysical technique such as x-ray crystallography or NMR spectroscopy, but can also derived from homology modeling construction. The protein structure and a data base of potential ligand serve as inputs to a docking program. Docking program depends on two components; search algorithm and scoring function. The search algorithm finds different confirmations for the ligand by using one of the methods. Systemic searches explore all possible binding modes between the ligand and receptor. The search space in theory consists of all possible orientations and conformations of the protein paired with the ligand. Most docking programs in use account for the whole conformation also space of the ligand (flexible ligand), and several attempt to model a flexible protein receptor. Each "snapshot" of the pair is referred to as a pose. A variety of conformation also search strategies have been applied to the ligand and to the receptor.

Scoring functions are mathematical functions used to approximately predict the affinity between two molecules after they have been docked. Docking programs generate a large number of potential ligand poses, of which some can be immediately rejected due to clashes with the protein. The remainders are evaluated using some scoring function, which takes a pose as input and returns a number indicating the likelihood that the pose represents a favorable binding interaction and ranks one ligand relative to another. Most scoring functions are physics based molecular mechanics force fields that estimate the energy of the pose within the binding site. The various contributions to binding can be written as an additive equation. Scoring functions trained with this data can dock high affinity ligands correctly, but they will also gives a large number of false positive hits, i.e., ligands predicted to bind to the protein that actually Don't when placed together in a test tube. Based on the methods evaluate the anti-inflammatory activity of selected flavonoids by *in-silico* method by using I GEM docking, Patch docking and Swiss docking. Evaluation of anti-inflammatory activity of selected flavonoids by *in-vitro* method by using Protein denaturation method.

## MATERIALS AND METHODS

### MATERIALS

All the chemicals were purchased from Hi-media labs and proteins were purchased from Sigma Aldrich. UV Spectrophotometer from Shimadzu.

### METHODS

#### Docking module

Docking of ligands and target enzyme by using iGem Dock, Patch Dock, Mcule and Swiss Dock.



**Rajinikanth et al.,****iGemDock**

iGEMDOCK is an integrated virtual screening (VS) environment from preparations through post-screening analysis with pharmacological interactions. iGEMDOCK provides interactive interfaces to prepare both the binding site of the target protein and the screening compound library. Each compound in the library is then docked into the binding site by using the in-house docking tool iGEMDOCK. Subsequently, iGEMDOCK generates protein-compound interaction profiles of electrostatic (E), hydrogen-bonding (H), and Van der Waal's (V) interactions. Based on these profiles and compound structures, iGEMDOCK infers the pharmacological interactions and clusters the screening compounds for the post-screening analysis. Finally, iGEMDOCK ranks and visualizes the screening compounds by combining the pharmacological interactions and energy-based scoring function of iGemdock [4]. PatchDock is an algorithm for molecular docking. The input is two molecules of any type: proteins, DNA, peptides, drugs. The output is a list of potential complexes sorted by shape complementarity criteria (bioinfo3d.cs/Patch dock).

**Mcule**

Mcule is your ready-to-use drug discovery platform. Mcule docking enable scientists to identify, optimize and order hits and leads faster. Therefore integrated molecular modeling tools, the highest quality compound database, IT infrastructure and compound procurement service with a very simple web interface. Use of virtual screens to identify new hits and use modeling applications to improve their affinity and other properties [5].

**SWISS DOCK**

Swiss dock, a web service to predict the molecular interaction that may occur between a target protein and a small molecule. S3DB, a database manually curated target and ligand structure. Swiss dock is based on the docking software EADock DSS, whose algorithm consist of the following steps:

- ❖ Many binding modes are generated either in a box or target cavities
- ❖ Simultaneously, their CHARMM energies are estimated on a grid
- ❖ The binding modes with the most favorable energies are evaluated with FACTS, and clustered

Swiss dock S3DB is developed by Aurelien Grosdidier, Vincent zoete and olivermichielin from molecular modeling group of Swiss institutes of bioinformatics [6].

**Consensus scoring and ranking**

Generally, docking programs have the ability to predict protein-ligand complex structures with reasonable accuracy and speed. The ability to predict the probable binding mode of a ligand to differentiate correct poses from incorrect ones is based on reliable scoring functions. However, combinations of various scoring functions would reduce the errors in single scoring schemes and improve the probability of identifying true hits. Thus, it has been demonstrated that consensus scoring is generally more effective than single scoring for molecular docking and represented an effective way in getting improved hit rates in various virtual database screening studies. In our study, we tested three different scoring functions such as iGemdock score, mcule dock score, Patch Dock score and Swiss dock score of respectively. Docking program was used to dock compounds to generate an ensemble of docked conformations and each scoring function is applied to generate classes based on the obtained dock scores followed by ranking the best conformations. During ranking, signs of scoring functions are changed to make certain that a lower score always indicates a higher affinity [7-8].

***In-vitro* Anti-Inflammatory Activity by Inhibition of Protein Denaturation Method****Procedure**

The test solution consists of 0.45 ml of bovine serum albumin and 0.05 ml of test solution. The test control consists of bovine serum albumin and 0.05 ml of distilled water. Product control consists of 0.45 ml of distilled water and 0.05 ml of test solution. Standard solution consists of 0.45 ml of Bovine serum albumin and 0.05 ml of Diclofenac sodium. All the above solutions were adjusted to pH 6.3 using 1N HCl. The samples were incubated at 37°C for 20 minutes and the temperature was increased to 57°C for 3 minutes. After cooling, added 2.5ml of phosphate buffer to the

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solutions. The absorbance was measured using UV-Visible spectrophotometer at 416nm (SL119, Systronics). Note: Stock concentration 10mg/ml

### CALCULATION

The percentage inhibition of protein denaturation can be calculated as

% inhibition =  $100 - \left[ \frac{(\text{optical density of test solution} - \text{optical density of product control})}{\text{optical density of test control}} \right] \times 100$

## RESULTS AND DISCUSSION

Flavonoids like hesperidine, engeletin, negletin, astilbin, primuletin, cirsimartin, nobitin, norwogonin, pectolinarigenin, primetin were docked against interleukin-6 by different docking software like IGEM dock, Patch Dock and Swiss dock. The ranks obtained from each of the individual scoring functions were added to give a rank-sum (Table 1). The advantage of a sum over an average is that the contribution from each individual score can more easily be split out for illustrative purposes in the former instance. Finally, from top rank-sum classes, Hesperidin is considered as potential ligands against the protein IL6 [9-13]. Similarly, the same flavonoids were docked against tumor necrosis factor- $\alpha$ . by different docking software like IGEM dock, Patch Dock and Swiss dock. The ranks obtained from each of the individual scoring functions were added to give a rank-sum (Table 2). Finally, from top rank-sum classes, Hesperidin is considered as potential ligands against the protein 1P44 as shown in fig 1-6.

### *In vitro* Protein Denaturation Method

Inhibition % of protein denaturation of these flavonoids was within the range from 8.0% to 64.0% at the concentration range of 200–500  $\mu\text{g/mL}$ . The value of  $\text{IC}_{50}$  of Hesperidine and Primuletin was 211.04 and 720.31  $\mu\text{g/mL}$ , respectively. In addition, the value of  $\text{IC}_{50}$  of Diclofenac sodium was 60.37. While comparing the flavonoids like hesperidine and primuletin with the standard drug at a 500  $\mu\text{g/mL}$  hesperidine showed similar percentage of inhibition as shown in table no 4. The results were shown in the graphical representation in fig no 7 [14-15].

## CONCLUSION

Evaluation of anti-inflammatory activity of selected flavonoids using *in-silico* and *in-vitro* methods. *in-silico* methods like IGEMDOCK, PATCH DOCK and SWISS DOCK, Hesperidine was found to have highest anti-inflammatory actions with selected proteins. *in-vitro* method done by Protein Denaturation Method, Hesperidin & Primuletin proved to possess anti-inflammatory action.

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**Table No 1: Optimized dock scores of best compounds that scored higher than respective original ligands against IL-6 proteins and their respective classes**

| S. No | Compounds        | Total Energy (Igem dock) | ACE (Patch Dock) | Estimated $\Delta G$ (Swiss Dock) | Class      |             |             | Sum |
|-------|------------------|--------------------------|------------------|-----------------------------------|------------|-------------|-------------|-----|
|       |                  |                          |                  |                                   | Igem Score | Patch Score | Swiss Score |     |
| 1     | Hesperidin       | -103.9                   | -298.27          | -7.94                             | 1          | 1           | 1           | 03  |
| 2     | Engeletin        | -95.54                   | -148.76          | -6.64                             | 1          | 4           | 3           | 08  |
| 3     | Cirsimaritin     | -91.55                   | -176.30          | -6.86                             | 1          | 3           | 3           | 07  |
| 4     | Norwogonin       | -85.29                   | -148.89          | -7.43                             | 2          | 4           | 2           | 08  |
| 5     | Primuletin       | -80.18                   | -173.09          | -6.37                             | 2          | 3           | 4           | 09  |
| 6     | Pectolinarigenin | -78.34                   | 197.99           | -6.88                             | 3          | 3           | 3           | 09  |
| 7     | Nobiletin        | -78.16                   | -277.99          | -6.89                             | 3          | 1           | 3           | 07  |
| 8     | Negletin         | -76.98                   | -176.16          | -6.86                             | 3          | 3           | 3           | 09  |
| 9     | Primetin         | -75.11                   | -199.00          | -6.68                             | 3          | 3           | 3           | 09  |
| 10    | Astilbin         | -67.77                   | -255.30          | -7.31                             | 4          | 2           | 2           | 08  |

**Table No 2: Optimized dock scores of best compounds that scored higher than respective original ligands against TNF $\alpha$  proteins and their respective classes**

| S. No | Compounds        | Total Energy (Igem dock) | ACE (Patch Dock) | Estimated $\Delta G$ (Swiss Dock) | Class      |             |             | Sum |
|-------|------------------|--------------------------|------------------|-----------------------------------|------------|-------------|-------------|-----|
|       |                  |                          |                  |                                   | Igem Score | Patch Score | Swiss Score |     |
| 1     | Hesperidin       | -115.5                   | -278.95          | -7.67                             | 1          | 1           | 1           | 03  |
| 2     | Engeletin        | -85.0                    | -187.36          | -6.72                             | 3          | 4           | 3           | 10  |
| 3     | Cirsimaritin     | -82.7                    | -177.52          | -7.34                             | 3          | 4           | 2           | 09  |
| 4     | Norwogonin       | -81.9                    | -159.08          | -6.99                             | 3          | 5           | 3           | 11  |
| 5     | Primuletin       | -78.8                    | -139.01          | -6.46                             | 4          | 6           | 4           | 14  |
| 6     | Pectolinarigenin | -78.3                    | -203.38          | -6.55                             | 4          | 3           | 3           | 10  |
| 7     | Nobiletin        | -78.2                    | -223.97          | -6.65                             | 4          | 3           | 3           | 10  |
| 8     | Negletin         | -77.8                    | -217.63          | -6.63                             | 4          | 3           | 3           | 10  |
| 9     | Primetin         | -73.8                    | -196.24          | -6.41                             | 4          | 4           | 4           | 12  |
| 10    | Astilbin         | -73.3                    | -192.55          | -6.08                             | 4          | 4           | 4           | 12  |





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Table 3. Percentage of inhibition rate of protein denaturation of flavonoids & reference drugs

| Concentration (mg/ml)    | % of Inhibition |            |                   |
|--------------------------|-----------------|------------|-------------------|
|                          | Hesperidine     | Primuletin | Diclofenac sodium |
| 200                      | 11              | 8          | 12.9              |
| 300                      | 49              | 17         | 25                |
| 400                      | 62              | 21         | 26.3              |
| 500                      | 64              | 28         | 83                |
| IC <sub>50</sub> (µg/ml) | 211.04          | 720.31     | 60.37             |

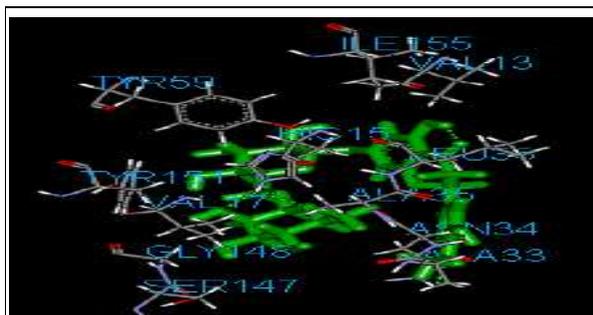


Figure 1: Docking Poses of IgemDOCK (Docking pose between Hesperidin and IL6)

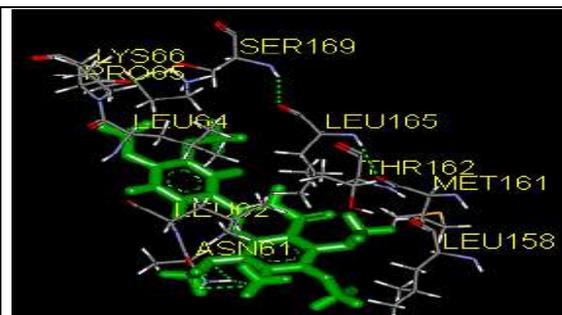


Figure 2: Docking Poses of Patch dock (Docking pose between Hesperidin and IL6)

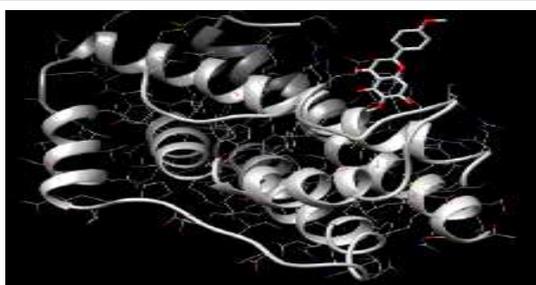


Figure 3: Docking Poses of Swiss dock (Docking pose between Hesperidin and IL6)

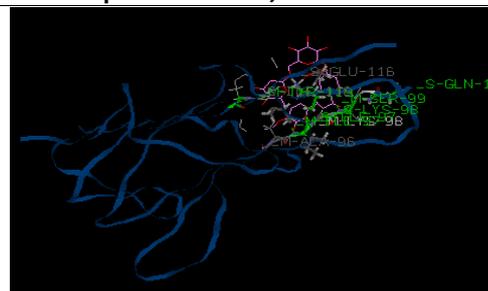


Figure 4: Docking Poses of IgemDOCK (Docking pose between Hesperidin and IL6)

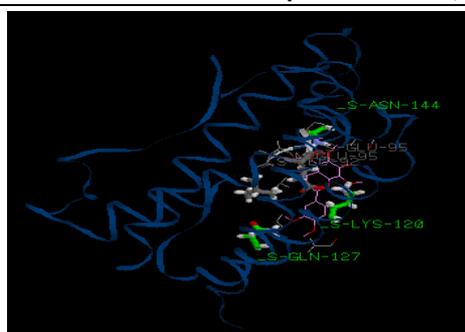


Figure 5: Docking Poses of Patch dock (Docking pose between Hesperidin and TNFα)

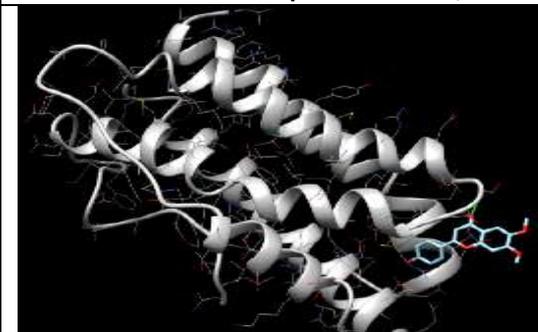


Figure 6: Docking Poses of Swiss dock (Docking pose between Hesperidin and TNFα)





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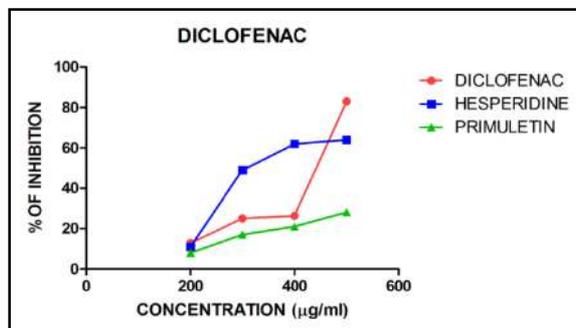


Fig. No: 7 Graphical representation of *in-vitro* protein denaturation method





## Dus Characterization Based on Seed Morphology of Some Traditional Paddy (*Oryza sativa* L.) Varieties of Tamil Nadu

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### ABSTRACT

Rice (*Oryza sativa* L.) occupies the premier place among the food crops cultivated around the world, thus its production and improvement are of interest to the Indian economy. India is the second largest rice-growing country in the world after China. It is cultivated on about 43.99 million ha area with a production of 116.42 million tones with extremely high biodiversity of plants. Tamil Nadu has been through the ages, recognized as a centre with very high biodiversity of the rice crop. There are extensive mentions of varieties of rice in various kinds of literature and technical texts. Historically, farmers have conserved and cultivated a large number of traditional paddy varieties since this serves several purposes – they are suited to the local climate and soil type, they have a high degree of resistance to pests and diseases and they are known to have specific nutritional and therapeutic properties. The essence of plant breeding lies in the creation of genetic variation which is a prerequisite for any improvement in crop. The development of one or more varieties depends on the final selection of superior plants by the plant breeder who uses several techniques to create the genetic variation and to select from within that variation. The concept of distinctness, uniformity and stability are thus fundamental to the characterization of a variety as a unique creation. In this context, an attempt was made to characterize a set of forty four traditional rice germplasm in Cauvery Delta region for different seed morphological traits and identify the variability available in the collection. The Forty-four landraces of paddy collected from Centre for Indian Knowledge Systems, Sirkali, Cauvery Delta of Tamil Nadu, India and raised. The traditional paddy seeds were characterized according seed morphological characters of the DUS guidelines of Plant Varieties Protection and Farmers' Rights Authority (PPVFRA), Ministry of

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Agriculture and Farmers Welfare, Government of India. Seven seed characters (seed length, seed breadth, decorticated seed length, decorticated seed breadth, decorticated seed color, 1000 seed weight and seed shape) were scored by visual observation and measuring scale. The study revealed that the seed morphological characteristics were found useful for varietal characterization in traditional rice varieties.

**Keywords:** Landraces, Seed characters, DUS, Characterization

## INTRODUCTION

In the globe, paddy is the second most crucial cereal crop next to maize. Paddy is cultivated in more than 100 countries and produces more than 0.7 billion tons per annum, with area of about 0.158 billion hectares (0.470 billion tons of raw rice). Asia produces almost 0.640 billion tons of paddy, which contributes for 90% of the world requirement. Paddy is the foremost staple food and the most competitive in India. Production reached to 0.120 billion tones in 2019-2020 [1]. Approximately, 425,500 accessions of paddy varieties maintain in different gene banks across the globe are possible genetic resources for crop improvement [2]. India has rich and extensive variety of heritable wealth of rice. Various investigations recommended that the India has more than 70,000 genotypes and also needs the selection and protection of a more number of wild varieties. These traditional paddy varieties also have an influence for different skin disorders and diseases such as blood fever, pressure, rheumatism, paralyzes and for improving tone of lactation in the Indian states of Karnataka, Kerala, Himachal Pradesh, Madhya Pradesh, Tamil Nadu, Uttar Pradesh and Western Ghats. Rice area production productivity in India during 2020 - 21 Area of 43662 (In ' 000 Hectare) Production 118870 (In ' 000 Tonne) Productivity 2722 (In Kg./Hectare). In Tamilnadu the area, production and productivity during 2020-21 Area of 2036 (In ' 000 Hectare) Production 6881 (In ' 000 Tonne) Productivity 3379 (In Kg./Hectare) [3]. The application of Intellectual Property Rights (IPRs) to new varieties of plants is a relatively recent phenomenon. The key objective of Plant Variety Protection (PVP), a form of IPR, is to stimulate plant variety innovations. Government of India has introduced Protection of Plant Varieties and Farmers' Rights (PPV&FR) Act in 2001, for the IP protection over crop varieties including farmers' rights over traditional varieties. DUS based morphological characterization (Distinctness, Uniformity and Stability) is the criterion for variety registration under the PPVFR Act. High seed quality can be obtained only by a thorough control of the entire seed production process, step by step from planning to final delivery. In a country like India, where certified seed production is done by registered farmers and private sector [4], monitoring genetic purity at each stage of seed production becomes necessary. In general seed genetic purity is assessed based on grow out test (GOT). So, morphological descriptors of varieties of crop species are required for verifying varietal identity and determining varietal purity [5]. Use of morphological descriptors in sequential fashion is useful and convenient to distinguish different varieties. Keeping this in view the present investigation was carried out to differentiate traditional rice varieties of Tamilnadu based on seed morphological markers. The Forty-Four rice landraces traditional rice varieties of Cauvery Delta region of Tamil Nadu, were identify the variability available based on Protection of Plant Varieties and Farmers' Rights (PPVFR) Act in 2001[6] for characterization and conservation of these traditional landraces using seven seed characters, which may prove important in future variety development programmers.

## MATERIALS AND METHODS

The experiment was conducted with Forty-four traditional paddy genotypes. The genotypes were collected from Centre for Indian Knowledge Systems, Sirkali, Cauvery Delta region of Tamil Nadu presented in Table 1. With recommended spacing of 20 cm between rows and 15 cm between plants in 3m long rows. The genotypes were raised in Randomized Block Design (RBD) with three replications with all recommended cultural practices followed. During the Samba(August to January) season in Thenpathi Village (Latitude and longitude of 10°43'30.2"N 79°27'11.6"E) of Thiruvavur District, Tamil Nadu, India. After attaining the physiological maturity stage, the seeds



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were harvested individually. Then the seven traits (seed length, seed breadth, decorticated seed length, decorticated seed breadth, decorticated seed color, 1000 seed weight and seed shape) of seed data were recorded and characterized according to the DUS guidelines of Plant Varieties Protection and Farmers' Rights Authority [7], Ministry of Agriculture and Farmers Welfare, Government of India.

**RESULTS AND DISCUSSION**

The morphological traits are used mainly for identification of genotypes and varieties. These characters form the basis for the breeder's selection of promising plant material. Accurate morphological descriptions of cultivars and varieties have been the basis of tests for DUS within worldwide PVP systems[8]. Accordingly, the plant and seed morphological characteristics listed in the crop specific DUS guideline are useful for characterizing varieties. The seed morphology has been in use since very long time [9]. Morphological descriptors can provide a unique identification of cultivated paddy varieties [10]. Qualitative seed descriptors included visual assessment of the following eight characteristics: seed length, seed breath decorticated seed length, decorticated seed breadth, colour, 1000 seed weight and decorticated seed shape.

Seed characterization qualitative traits are crucial for the characterization of plants and are primarily subjective by consumer choice, socio economic circumstances and natural selection [11]. In the present study significant differences were observed among the studied traditional rice varieties with respect to above seed morphological characters. The above Seven seed characters were observed in forty-four traditional paddy varieties to set up distinctiveness among genotypes and these are presented (Table 2 and 3). Frequency distribution for all the studied characters under study were computed (Table 4).The majority of the phenotypical traits had shown variability in different accessions. A majority of accessions recorded the short and medium seed length (68.20 and 27.30 % respectively). Two varieties possess long seed length with 4.50 % frequency distribution (Fig 1). The observations for seed breadth were recorded twenty-seven genotypes as broad (61%) followed by nine genotypes as medium state (20.50%) and the least number of genotypes in the very broad state (6.80%). (Fig 1) Decorticated seed length as medium state thirty-six recorded 81.80 percent of frequency distribution followed by long state recorded 15.90 percent and the least as short state (2.30 %) while the decorticated seed breadth was as broader state frequency distribution of 84.10 % followed by medium and narrow state (9.10 and 6.80 %) (Fig 1.).

Seed colour, which was a heritable character [12], However, the seed colour is also influenced by environmental conditions during ripening besides the genetic effect [13]. Based on the decorticated seed colour, the traditional rice genotypes were grouped into five classes viz., dark brown, white color, variegated brown, light brown and light red color. Decorticated seed color twelve genotypes recorded 27.27 percent of frequency distribution as dark brown state followed by twelve genotypes in white color (25.00%) remaining genotypes were variegated brown (seven genotypes), light brown(six genotypes) and least is light red color (five genotypes) (15.31, 13.64 and 4.55 % respectively).Weight of 1000 fully developed grains in medium state recorded in seventeen genotypes with frequency distribution of 38.64% followed by thirteen genotypes in high weight with frequency distribution of 29.55% followed by six genotypes in very high state with 13.64 % of frequency distribution. Remaining genotypes were in low and very low state (11.36 and 6.82% of frequency distribution respectively).

Seed size and shape have been used to differentiate the rice genotypes by various scientists [14]. In the present study the studied traditional rice varieties were grouped into four categories as bold, extra long, medium slender and short slender. Decorticated grain shape were in seventeen genotypes recorded in short bold with a frequency distribution of 56.82 percent followed by thirteen genotypes in extra long with frequency distribution of 29.55 percent followed by five genotypes in medium slender (11.36%) and single genotype in short slender (2.27%).The rice traditional varieties/landraces undertaken for this study registered wide range of distinctiveness for all most all the studied seed traits studied and similar findings reportedearlier by [15], [16], [17], [18], [19] and [20].





## CONCLUSION

Thus from the study it is concluded that the seed morphological characteristics were found useful for varietal characterization in traditional rice varieties. Some of the distinguishing character like seed length, seed breadth, decorticated seed length, decorticated seed breadth, colour, 1000 seed weight and decorticated seed shape were found to be more useful for identification and grouping of studied traditional rice varieties to maintain genetic purity during seed production.

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**Table 1. List of Traditional Rice Varieties Collected From Delta Regions of Tamil Nadu**

| Genotype Code | Name of the Variety | Genotype Code | Name of the Variety  |
|---------------|---------------------|---------------|----------------------|
| G 1           | Anaikomban          | G 23          | Ottadai              |
| G 2           | Ananthanoorsanna    | G 24          | Pachaiperumal        |
| G 3           | Arikiravi           | G 25          | Panakattukudaivazhai |
| G 4           | Arubatham samba     | G 26          | Pisini               |
| G 5           | Garudan samba       | G 27          | Poompalai            |
| G 6           | Iraivapondi         | G 28          | Poovan samba         |
| G 7           | Kaivari samba       | G 29          | Puzhithi samba       |
| G 8           | Kaliyan samba       | G 30          | Rasagadam            |
| G 9           | Kallurundaikaar     | G 31          | Sadakar              |
| G 10          | Kamban samba        | G 32          | Salem samba          |
| G 11          | Karunguruvai        | G 33          | Samba                |
| G 12          | Karuppukowni        | G 34          | Samba mosanam        |
| G 13          | Kattuyanam          | G 35          | Sanna samba          |
| G 14          | Kitchili samba      | G 36          | Sengini              |
| G 15          | Kollikar            | G 37          | Sivapukownii         |
| G 16          | Kottara samba       | G 38          | Sivapukurivikar      |
| G 17          | Kullakaar           | G 39          | Sivapusirumani       |
| G 18          | Kumsala             | G 40          | Soorankuruvai        |
| G 19          | Kuzhiadichan        | G 41          | Thanga samba         |
| G 20          | Mapillai samba      | G 42          | Thooyamalli          |
| G 21          | Mullan Kaiama       | G 43          | Veethivadangan       |
| G 22          | Neelan samba        | G 44          | Vellaipoonkar        |

**Table 2. Mean Performance of Seed Characters**

| GENOTYPE CODE | SEED LENGTH (mm) | SEED BREADTH (mm) | SEED L/B RATIO | DECORTICATED SEED LENGTH (mm) | DECORTICATED SEED BREADTH (mm) | DECORTICATED L/B RATIO | 1000 SEED WEIGHT (G) |
|---------------|------------------|-------------------|----------------|-------------------------------|--------------------------------|------------------------|----------------------|
| G1            | 8.10             | 3.27              | 2.48           | 5.43                          | 2.83                           | 1.92                   | 25.55                |
| G2            | 7.80             | 2.10              | 3.72           | 5.40                          | 1.77                           | 3.06                   | 13.96                |
| G3            | 8.47             | 3.30              | 2.57           | 6.00                          | 2.67                           | 2.25                   | 26.76                |
| G4            | 8.67             | 3.43              | 2.53           | 6.07                          | 2.93                           | 2.07                   | 28.87                |
| G5            | 7.80             | 3.07              | 2.55           | 5.57                          | 2.60                           | 2.14                   | 22.22                |
| G6            | 8.10             | 3.10              | 2.61           | 5.80                          | 2.60                           | 2.23                   | 24.47                |
| G7            | 8.57             | 3.37              | 2.55           | 5.90                          | 2.53                           | 2.35                   | 28.78                |
| G8            | 8.30             | 3.30              | 2.52           | 5.80                          | 2.87                           | 2.02                   | 28.86                |
| G9            | 8.53             | 3.43              | 2.48           | 5.73                          | 2.80                           | 2.05                   | 28.97                |





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|            |      |      |      |      |      |      |       |
|------------|------|------|------|------|------|------|-------|
| <b>G10</b> | 8.30 | 2.90 | 2.88 | 5.83 | 2.53 | 2.31 | 22.00 |
| <b>G11</b> | 8.20 | 3.37 | 2.43 | 5.63 | 2.80 | 2.01 | 25.59 |
| <b>G12</b> | 9.00 | 3.27 | 2.76 | 6.50 | 2.70 | 2.41 | 25.96 |
| <b>G13</b> | 8.57 | 3.10 | 2.76 | 6.13 | 2.80 | 2.19 | 28.48 |
| <b>G14</b> | 7.73 | 2.33 | 3.31 | 5.53 | 1.90 | 2.93 | 15.73 |
| <b>G15</b> | 8.27 | 3.23 | 2.56 | 6.10 | 2.73 | 2.23 | 26.59 |
| <b>G16</b> | 8.67 | 3.00 | 2.92 | 6.10 | 2.73 | 2.23 | 28.02 |
| <b>G17</b> | 7.87 | 2.73 | 2.89 | 5.27 | 2.27 | 2.33 | 20.38 |
| <b>G18</b> | 8.17 | 2.33 | 3.51 | 5.63 | 2.00 | 2.82 | 20.20 |
| <b>G19</b> | 8.87 | 3.40 | 2.62 | 6.07 | 2.63 | 2.33 | 32.20 |
| <b>G20</b> | 8.60 | 3.33 | 2.58 | 5.97 | 3.03 | 1.98 | 28.06 |
| <b>G21</b> | 7.57 | 3.07 | 2.47 | 5.60 | 2.70 | 2.07 | 22.77 |
| <b>G22</b> | 7.87 | 3.33 | 2.36 | 5.17 | 2.83 | 1.83 | 25.66 |
| <b>G23</b> | 8.60 | 3.27 | 2.64 | 5.90 | 2.73 | 2.17 | 25.32 |
| <b>G24</b> | 8.23 | 3.17 | 2.61 | 5.67 | 2.70 | 2.10 | 23.08 |
| <b>G25</b> | 8.53 | 3.57 | 2.40 | 6.07 | 3.00 | 2.02 | 28.15 |
| <b>G26</b> | 8.90 | 3.47 | 2.57 | 6.17 | 2.50 | 2.51 | 32.39 |
| <b>G27</b> | 9.00 | 3.30 | 2.73 | 6.60 | 2.83 | 2.33 | 28.19 |
| <b>G28</b> | 8.53 | 3.77 | 2.27 | 6.17 | 3.23 | 1.91 | 33.19 |
| <b>G29</b> | 8.77 | 3.40 | 2.58 | 6.07 | 2.87 | 2.12 | 28.69 |
| <b>G30</b> | 7.63 | 2.37 | 3.23 | 5.23 | 2.10 | 2.49 | 13.60 |
| <b>G31</b> | 8.10 | 3.07 | 2.64 | 5.63 | 2.60 | 2.17 | 23.58 |
| <b>G32</b> | 8.13 | 2.57 | 3.17 | 5.53 | 2.13 | 2.61 | 17.00 |
| <b>G33</b> | 8.10 | 2.87 | 2.84 | 5.90 | 2.53 | 2.33 | 24.29 |
| <b>G34</b> | 8.53 | 3.10 | 2.77 | 5.97 | 2.70 | 2.21 | 30.29 |
| <b>G35</b> | 8.50 | 3.17 | 2.68 | 5.60 | 2.63 | 2.13 | 20.38 |
| <b>G36</b> | 8.83 | 3.43 | 2.57 | 6.13 | 2.87 | 2.14 | 27.35 |
| <b>G37</b> | 8.43 | 3.10 | 2.72 | 6.10 | 2.73 | 2.23 | 33.57 |
| <b>G38</b> | 8.73 | 3.33 | 2.62 | 5.97 | 2.87 | 2.08 | 24.12 |
| <b>G39</b> | 6.80 | 3.23 | 2.10 | 4.60 | 2.80 | 1.65 | 21.27 |
| <b>G40</b> | 8.47 | 3.57 | 2.38 | 6.13 | 3.07 | 2.00 | 30.65 |
| <b>G41</b> | 8.27 | 2.87 | 2.90 | 5.83 | 2.37 | 2.47 | 21.10 |
| <b>G42</b> | 7.40 | 2.27 | 3.26 | 5.13 | 2.03 | 2.54 | 14.65 |
| <b>G43</b> | 8.03 | 3.13 | 2.57 | 5.63 | 2.70 | 2.09 | 23.86 |
| <b>G44</b> | 8.60 | 3.13 | 2.76 | 6.10 | 2.80 | 2.18 | 25.04 |





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Table 3. DUS Scoring Based on Mean Performance of Seed Characters

| Genotype code | SEED LENGTH | SEED BREADTH | DECORTICATED SEED LENGTH | DECORTICATED SEED BREADTH | DECORTICATED SEED COLOR | 1000 SEED WEIGHT | SEED SHAPE |
|---------------|-------------|--------------|--------------------------|---------------------------|-------------------------|------------------|------------|
| G1            | 3           | 7            | 1                        | 7                         | 6                       | 5                | 2          |
| G2            | 5           | 3            | 3                        | 3                         | 2                       | 1                | 1          |
| G3            | 3           | 7            | 3                        | 7                         | 6                       | 7                | 2          |
| G4            | 5           | 7            | 3                        | 7                         | 6                       | 7                | 2          |
| G5            | 3           | 5            | 2                        | 7                         | 2                       | 5                | 2          |
| G6            | 3           | 7            | 2                        | 7                         | 6                       | 5                | 2          |
| G7            | 3           | 7            | 2                        | 7                         | 6                       | 7                | 2          |
| G8            | 3           | 7            | 2                        | 7                         | 4                       | 7                | 2          |
| G9            | 3           | 7            | 2                        | 7                         | 4                       | 7                | 2          |
| G10           | 3           | 5            | 2                        | 7                         | 2                       | 5                | 2          |
| G11           | 3           | 7            | 2                        | 7                         | 4                       | 5                | 2          |
| G12           | 7           | 7            | 2                        | 7                         | 4                       | 5                | 5          |
| G13           | 3           | 7            | 2                        | 7                         | 3                       | 7                | 5          |
| G14           | 3           | 3            | 3                        | 3                         | 1                       | 3                | 3          |
| G15           | 3           | 7            | 2                        | 7                         | 3                       | 7                | 5          |
| G16           | 5           | 5            | 2                        | 7                         | 4                       | 7                | 5          |
| G17           | 3           | 5            | 2                        | 5                         | 4                       | 3                | 2          |
| G18           | 3           | 3            | 2                        | 3                         | 1                       | 3                | 3          |
| G19           | 5           | 7            | 2                        | 7                         | 4                       | 9                | 5          |
| G20           | 5           | 7            | 2                        | 7                         | 4                       | 7                | 2          |
| G21           | 3           | 5            | 2                        | 7                         | 1                       | 5                | 2          |
| G22           | 3           | 7            | 2                        | 7                         | 3                       | 5                | 2          |
| G23           | 5           | 7            | 2                        | 7                         | 1                       | 5                | 2          |
| G24           | 3           | 7            | 2                        | 7                         | 1                       | 5                | 2          |
| G25           | 3           | 9            | 2                        | 7                         | 3                       | 7                | 5          |
| G26           | 5           | 7            | 3                        | 7                         | 2                       | 9                | 3          |
| G27           | 7           | 7            | 2                        | 7                         | 4                       | 7                | 5          |
| G28           | 3           | 9            | 2                        | 7                         | 4                       | 9                | 5          |
| G29           | 5           | 7            | 2                        | 7                         | 3                       | 7                | 5          |
| G30           | 3           | 3            | 2                        | 5                         | 1                       | 1                | 2          |
| G31           | 3           | 5            | 2                        | 7                         | 2                       | 5                | 2          |
| G32           | 3           | 3            | 3                        | 5                         | 1                       | 3                | 3          |
| G33           | 3           | 5            | 2                        | 7                         | 1                       | 5                | 2          |
| G34           | 3           | 7            | 2                        | 7                         | 3                       | 9                | 2          |
| G35           | 3           | 7            | 2                        | 7                         | 5                       | 3                | 2          |
| G36           | 5           | 7            | 2                        | 7                         | 4                       | 7                | 5          |
| G37           | 3           | 7            | 2                        | 7                         | 5                       | 9                | 5          |
| G38           | 5           | 7            | 2                        | 7                         | 3                       | 5                | 2          |
| G39           | 5           | 7            | 2                        | 7                         | 1                       | 5                | 2          |





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|            |   |   |   |   |   |   |   |
|------------|---|---|---|---|---|---|---|
| <b>G40</b> | 3 | 9 | 2 | 7 | 4 | 9 | 5 |
| <b>G41</b> | 3 | 5 | 2 | 7 | 6 | 5 | 2 |
| <b>G42</b> | 3 | 5 | 3 | 5 | 1 | 1 | 3 |
| <b>G43</b> | 3 | 7 | 2 | 7 | 1 | 5 | 2 |
| <b>G44</b> | 5 | 7 | 2 | 7 | 2 | 5 | 5 |

Table 4. Frequency Distribution of Seed Characters Based On DUS Guidelines of PPV &amp; FRA

| S. No | Trait                                       | States                  | Score | No. of landraces | Frequency % |
|-------|---|-------------------------|-------|------------------|-------------|
| 1     | Seed length                                 | Very short (<6.0 mm)    | 1     | 0                | 0           |
|       |   | Short (6.1-8.5mm)       | 3     | 30               | 68.20       |
|       |   | Medium (8.6-10.5)       | 5     | 12               | 27.30       |
|       |   | Long (10.6-12.5 mm)     | 7     | 2                | 4.50        |
|       |   | Very long (>12.5 mm)    | 9     | 0                | -           |
| 2     | Seed breadth                                | Very narrow (<2.0 mm)   | 1     | 0                | -           |
|       |   | Narrow (2.1-2.5 mm)     | 3     | 5                | 11.40       |
|       |   | Medium (2.6-3.0 mm)     | 5     | 9                | 20.50       |
|       |   | Broad (3.1-3.5 mm)      | 7     | 27               | 61.40       |
|       |   | Very broad (>3.5 mm)    | 9     | 3                | 6.80        |
| 3     | Decorticated seed length                    | Short                   | 1     | 1                | 2.30        |
|       |   | Medium                  | 3     | 36               | 81.80       |
|       |   | Long                    | 5     | 7                | 15.90       |
|       |   | Long* (Basmati type)    | 7     | 0                | -           |
|       |   | Extra long              | 9     | 0                | -           |
| 4     | Decorticated seed breadth                   | Narrow (<2.0 mm)        | 3     | 3                | 6.80        |
|       |   | Medium (2.0-2.5 mm)     | 5     | 4                | 9.10        |
|       |   | Broad (>2.5 mm)         | 7     | 37               | 84.10       |
| 5     | Decorticated seed color                     | White                   | 1     | 11               | 25.00       |
|       |   | Light brown             | 2     | 6                | 13.64       |
|       |   | Variegated brown        | 3     | 7                | 15.91       |
|       |   | Dark brown              | 4     | 12               | 27.27       |
|       |   | Light red               | 5     | 2                | 4.55        |
|       |   | Red                     | 6     | 6                | 13.64       |
|       |   | Variegated purple       | 7     | 0                | -           |
|       |   | Purple                  | 8     | 0                | -           |
|       |   | Dark purple             | 9     | 0                | -           |
| 6     | Weight of 1000 fully developed grains       | Very low (<15g)         | 1     | 3                | 6.82        |
|       |   | Low (15-20 g)           | 3     | 5                | 11.36       |
|       |   | Medium (21-25 g)        | 5     | 17               | 38.64       |
|       |   | High (26-30)            | 7     | 13               | 29.55       |
|       |   | Very high (>30 g)       | 9     | 6                | 13.64       |
| 7     | Decorticated grain: Shape (in lateral view) | Short slender           | 1     | 1                | 2.27        |
|       |   | Short bold              | 2     | 25               | 56.82       |
|       |   | Medium slender          | 3     | 5                | 11.36       |
|       |   | Long bold               | 4     | 0                | -           |
|       |   | Long slender* (Basmati) | 5     | 0                | -           |
|       |   | Extra long              | 5     | 13               | 29.55       |
|       |   | Slender                 | 6     | 0                | -           |





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1.Anaikomban 2. Ananthanoorsanna, 3. Arikiravi 4. Arubatham samba, 5. Garudan samba, 6. Iraivapondi, 7. Kaivari samba, 8. Kaliyan samba, 9. Kallurundaikaar, 10. Kamban samba, 11. Karunguruvai, 12. Karuppukowni, 13. Kattuyanam, 14. Kitchili samba, 15. Kollikar, 16. Kottara samba, 17. Kullakaar, 18. Kumsala, 19. Kuzhiadichan, 20. Mapillai samba, 21. Mullan Kaiama, 22. Neelan samba, 23. Ottadai, 24. Pachaiperumal, 25. Panakattukudaivazhai, 26. Pisini, 27. Poompalai, 28. Poovan samba, 29. Puzhithi samba, 30. Rasagadam, 31. Sadakar, 32. Salem samba, 33. Samba, 34. Samba mosanam, 35. Sanna samba, 36. Sengini, 37. Sivapukownii, 38. Sivapukurivikar, 39. Sivapusirumani, 40. Soorankuruvai, 41. Thanga samba, 42. Thooyamalli, 43. Veethivadangan, 44. Vellaipoonkar.

**Fig. 1. Morphological variation in seed and decorticated seed characters of 44 traditional rice varieties.**





## Effect of Low Intensity Aerobic Exercises with Covid 19 Pandemic Handling on Children with Duchene Muscular Dystrophy

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### ABSTRACT

Muscular dystrophies are a group of diseases that induce weakness of the muscles and loss of muscle mass over time. Duchene muscular dystrophy (DMD) is a type of muscular dystrophy that primarily affects boys. Treatment for DMD is usually multidisciplinary. It includes a group of medical and paramedical teams. During this covid 19 pandemic, these children are left behind, and there are no protocols on how to handle these children. This study is conducted to identify the role of low-intensity aerobic exercises with the covid 19 pandemic management on children with DMD. Low-intensity aerobic exercises are done with regular breaks to prevent fatigue of the muscles. A home-based study with fifteen children was selected using a non-random sampling method. All the participants were selected based on selection criteria. After obtaining the consent, all the children underwent 45 minutes of low-intensity aerobic exercises for the upper limbs, lower limbs, and spine. Initially, a seven-day physiotherapist visited every child's house, demonstrated exercises, and monitored the child's movements. The outcome variables for this study are the DMD QoL questionnaire to assess the Quality of life, physical activity questionnaire for children (PAQ-C) to measure physical activity, and walking ability using the time up and go test. Statistical analysis was applied using SPSS version 26.0. A parametric test was used to compare pre-and post-intervention data. This study shows the observed effect size of the more significant variables, which indicates that the difference between the average and  $\mu_0$  is significant. The paired 't' value for DMD QoL is 15.03, PAQ-C is 1.93, and TUG is 11.06, which are higher effective when compared with the table values. In conclusion, low-intensity aerobic exercises had a statistically significant effect on Quality of life, physical activity, and walking ability in DMD children. However, further research is required.



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**Keywords:** Duchene muscular dystrophy, Covid 19, Low intensity aerobic exercises, Pandemic handling, Quality of life, Physical activity for children.

## INTRODUCTION

Duchene muscular dystrophy (DMD) is the heterogeneous group of hereditary degenerative muscle disease, characterized by progressive, symmetrical, proximal-distal weakness with hypertrophy and wasting of the muscles [1]. There is a severe loss of ambulation by 13 years, usually followed by cardiac complications, respiratory disorders, and respiratory failures [2]. DMD is estimated as 1 in every 3500 to 1 in every 5000 boys[3]. Covid 19 is a new corona virus of severe acute respiratory syndrome corona virus 2 (SARS-CoV-2), which is highly contagious and has a high rate of human-human transmission [4]. It affects the respiratory tract, which causes severe pneumonia with respiratory failure and pronouncement to death. WHO declared Covid-19 a public health emergency due to its rapid transmission[5]. There are no strong management measures available in handling such infections that cause more devastation to the people [6]. Respiratory failure in DMD children is due to the weakness of the respiratory muscles. There is severe weakness of the respiratory muscles identified in DMD, which causes restrictive respiratory disease [7]. Lung infection increase and mucus production may aid in inadequate ventilation and lead to atelectasis. Covid 19 access the respiratory tract and induce severe inflammatory and oxidative stress, which causes injury to the pulmonary alveoli, resulting in severe acute respiratory distress, pneumonia, and respiratory failure [8,9]. It also affects the skeletal muscle tissues and causes pain in the muscles (Myalgia) [10]. DMD children are more prone to lung infections, and the skeletal muscles are also weakened, and it is mandatory to take preventive steps in these children. Initially, there were no treatment options for handling the Covid 19. currently, a variety of options are available, including antiviral drugs, anti-inflammatory drugs, immunomodulatory agents [11], addition vigorous chest physiotherapy, deep breathing exercises, positioning, and proper nutritional food is also advised[12]. Prevention strategies are suggested to DMD children to prevent exposure to the infected environment. Wearing masks, washing hands, and maintaining social distance are educated to DMD children. Management of the DMD is usually a multidisciplinary one [13]. It includes maintaining muscle functions, maintaining respiratory functions, cardiovascular functions, and preventing recurrent lung infections[14]. Physiotherapy plays an essential role in maintaining muscle functions[15], but there are no clear guidelines on handling DMD children during pandemic situations. This study is a small pilot study aimed to identify the effect of low-intensity aerobic exercises with pandemic handling advice on DMD children.

## MATERIALS AND METHODOLOGY

The study is a home-based pilot study that was conducted during the covid 19 pandemic time. This study was planned during the lockdown time in Tamil Nadu, India. The study was approved by the Institutional ethical committee, Madhav University, Rajasthan, India. The experimental study involves 15 DMD children with the age group of 6—9 years. All are selected by non-probability sampling method, and the study was conducted in every children's home setting. All the children were getting treatment for the past 3-5 years with an average of 4 years. All the children were clinically diagnosed with Duchene muscular dystrophy and underwent physiotherapy, nutritional consultation, and physician visits. All the children were selected based on the criteria, male children with an age group of 6—9 years, able to walk 10 meters with or without support, able to do upper limb movements, SPO2 of 99, and can follow instructions, those who are omitted are children with wheelchair bounded, severe lung infections, poor understanding capacity, and weak stature. The parents obtained written consent before the study and a detailed explanation about the study procedure and the exercises delivered to them. Each selected child underwent 45 minutes of low-intensity aerobic exercises for the upper limbs, lower limbs, and spine. A frequent rest period was provided to every child. Initially, physiotherapist visited every day to individual house, demonstrated exercises, and monitored the child's movements. Later it was reduced to three times a week, and following one month, it was twice



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a week. A logbook is maintained, which marks the Time and duration of exercises. Clear information about the Covid 19 and SARS-CoV-2 was clearly explained to the parents and the kids. Videos about the virus spread, the symptoms, and how to manage it was also instructed. Outcome measures were taken are DMD QoL questionnaire to assess the Quality of life, physical activity questionnaire for children (PAQ-C) to measure physical activity, and walking ability using the Time up and go test (TUG). Low-intensity exercises applied with 40–50% of Maximal Heart rate (MHR). Before the beginning of the exercises, five minutes of warm-up was given to prepare the muscles. The exercise program starts with arms circling, arm curls, wand exercises to the shoulder, chest press, deltoid raise, biceps curls, triceps, hip movements, hip circling, knee bend, half squat, and toe raises [16]. These exercises were done for 30 –45 mins of duration with a frequent rest period between the exercises. Ten minutes of cool-down exercises, including mild stretching of the upper limb and lower limb muscles, were also done. Deep breathing exercises for ten repetitions, Coastal breathing exercises for ten repetitions are added with the exercise program. In addition, prone lying was encouraged for 10–15 mins for every child to improve their Oxygenation. Frequent handwashing, wearing of a mask (Surgical), and social distancing was advised and asked the children to follow it strictly. Statistical analysis was applied using SPSS version 26.0. A parametric test was used to compare pre-and post-intervention data. An  $\alpha < 0.05$  is the level of significance in all analyses.

## RESULTS

Data was collected on the first visit and then at regular intervals. This study uses first-day and 3rd-month data for the statistical analysis. These data were analyzed using SPSS 26.0. The primary outcomes are Quality of life, physical activity, and ability to walk. Since this study tries to identify the difference between the sets of observations, this study uses the paired 't' test. All the test was set with the  $p=0.05\%$ . The demographical analysis and the outcome analysis are described in Table I and Table II. The table shows that the p-value is small, which means the chance of the type I error is very small, and the smaller p-value supports the H1. Since the  $p\text{-value} < \alpha$ , H0 is rejected. The table shows the observed effect size of the three more significant variables, which indicates that the difference between the average and  $\mu_0$  is substantial. The interpretation of the table shows a significant difference was obtained on comparing the pre-test and post-test variables. This signifies that the application of low-intensity aerobic exercises produces a substantial improvement in DMD children. A survey was conducted to all the parents about the child's health and the pandemic handling, and descriptive statics was used to measure the values. Few questions were raised to the parents, including their adherence to the exercises, infection rate, hospitalization, etc... which are in Table III. Infection was found in 7 children out of 15. The conditions are related to the urinary tract and skin infections. Hospitalization of the participants was noted in 4 children with infections (UTI) but recovered within three days. All the participants have highly complied with the prescribed exercises. All the children have done hand washing frequently; the mean of 7.73 times a day was noted, and the satisfaction rate of the prescribed exercises was 88% since two of the parents were not highly satisfied by these exercises.

## DISCUSSION

The study aims to determine the effect of low-intensity aerobic exercises with pandemic handling advice on DMD children. Standard management of the DMD includes vigorous physical exercises. The choice of activities depends on the individual therapist. This study aimed to identify the role of low-intensity aerobic exercises on DMD. Aerobic exercises are usually prescribed to improve aerobic capacity, cardiovascular function and to regulate metabolic regulations. Muscle strength or muscle function also improved following aerobic exercises proved in various literature[17,18]. Low-intensity aerobic exercise on how it opposes the deterioration of the muscles is unclear. Still, aerobic exercises are vastly prescribed. Hypothetically, it was described as low-stress exercises may significantly affect the myofiber's contractility and energy efficiency [19]. Researches identified that aerobic exercises increase protein synthesis and stimulate mitochondrial biogenesis, favouring the muscles and myofibrils to activate and grow [20,21]. The animal studies revealed that low-intensity exercise has no detrimental effects [22]. So, the application of low-intensity exercise would help to improve the quality of life and physical functions. Animal studies also exposed



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that a decrease in the oxidative stress markers causes a rapid shift of muscle fibers from fast twitching to slow-twitch [22]. Slow-twitch fibers resist muscle degeneration in the DMD [23]. Covid 19 precautions and application of aerobic exercises positively impact lung functions and prevent lung infections. Multiple researchers have supported that aerobic workouts positively influence lung capacities like FVC and FEV1 values [24,25]. The mechanism of the exercises is unclear how it affects FVC and FEV1. Some hypothesis says there is a strong relationship between the abdominal muscle force. DMD [26]. Limitations of this study are, there is no lung function measurement done due to the covid 19 pandemic and the lockdown rules the sample size was small in number. There is no blinding between the patient and the therapist. In conclusion, low-intensity aerobic exercises had a statistically significant effect on DMD children's quality of life, physical activity, and walking ability. However, further research is required to determine whether this is clinically worthwhile or could be increased by sample size and modified exercise protocols.

## COMPETING INTERESTS

None declared.

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Table 1. Demographic analysis

| Variables            | Mean | S. D |
|----------------------|------|------|
| Age group            | 7.53 | 1.87 |
| Duration of symptoms | 4.60 | 1.31 |
| First child          | 7.51 | 0.94 |
| Second child         | 7.60 | 1.52 |





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**Table 2. Outcome Measure Analysis**

| Outcome measures | Pre test (Mean ± SD) | Post- test (Mean ± SD) | Percentage of change | Paired 't' value | Effect size | P value |
|------------------|----------------------|------------------------|----------------------|------------------|-------------|---------|
| DMD QoL          | 45.80 ±2.21          | 27.87 ± 5.19           | 40%                  | 15.03            | 3.88        | 0.0079  |
| PAQ-C            | 2.07 ±0.26           | 2.87 ±0.35             | 39%                  | 7.48             | 1.93        | 0.0000  |
| TUG              | 19.53 ± 0.99         | 16.93 ± 1.10           | 15%                  | 11.06            | 2.86        | 0.049   |

**Table 3. Questionnaire analysis**

| Variables                         | Percentage of involvement |
|-----------------------------------|---------------------------|
| Rate of Infection                 | 48%                       |
| Rate of Hospitalisation           | 26%                       |
| Compliance to exercises           | 100%                      |
| Compliance of Hand washing        | 100%                      |
| Rate of Satisfaction to exercises | 88%                       |





## A Study on the Positive Impact of the Merging of Public Sector Banks on the Indian Economy

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### ABSTRACT

The Indian government announced in August 2019 its decision to consolidate ten public sector banks into four for business growth and organizational efficiency. The decision taken by the government is for the betterment of our society's welfare by increasing lending efficiency to the public. The objective of merging public sector banks is to prevent weaker banks from getting wiped out of the market. This paper aims to discuss how RBI Rules and regulations will govern business entities and individuals' everyday business transactions. Merging of public sector banks will result in the efficient usage of resources very effectively. One of the positive aspects of this consolidation will lead to the banking sector may be able to fund big projects very quickly and easily.

**Keywords:** Assets, Bank, Merger, Non-Performing Assets, Shares.

### INTRODUCTION

Public sector banks mean the significant shareholding that is more than 50% of shares lies with the central and state government. The financial disparity in the banking sector is one of the major causes of the emergence of public sector banks in 1969. In 1969, the state bank of India was the only public sector bank nationalized in 1955. Nationalization means consolidating privately owned business entities' assets pooled and organized by the government. Nationalization usually occurs in developing countries and can reflect a nation's desire to control assets. Currently, in India, there are 12 banks in number that are nationalized, and their names are PNB, Bank of Baroda, Bank of India, Central Bank of India, Canara Bank, Union Bank of India, Indian Overseas Bank, Punjab and Sind Bank, Indian Bank, UCO Bank, and Bank of Maharashtra, State Bank of India. One of the main objectives of nationalization is to diversify the flow of credit towards the primary sectors such as agricultural industries and to provide the best guidance to the banking authorities. Despite the many advantages in the banking sector, the increasing defaults,



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frauds, and non-performing businesses forced the adoption of the policy of merging. The main aim of merging is to increase the efficiency of the banking sector. A merger is an agreement between two business entities where they can pool their assets and liabilities and bring them into one business entity. Today, India has 12 public sector banks, including Bank of Baroda and State bank of India.

**REVIEW OF LITERATURE**

The effects of bank mergers and acquisitions in India were studied by Sonia Singh et al. (2018). Three of India's largest banks have been selected for an in-depth analysis of the effects of mergers and acquisitions. In this research, we compare the performance of the Indian banking sector before and after six years of merger and acquisition activity. The report used financial metrics such as net profit margin, operating profit margin, return on capital used, return on equity, earnings per share, capital adequacy ratio, dividend per share, etc., to examine the merged banks' post-merger financial performance. In light of these findings, it is clear that tactics and policies in procedural, physical, and socio-cultural contexts have a significant role in the post-merger and acquisition period. Some critical concerns about the consolidation of government-owned banks were examined by Benazir Banu.T (2021). The study relied on a descriptive approach to research. The primary research topic was the effect of a merger on key performance indicators for financial institutions. Existing problems with bank mergers were examined. The effects of the consolidation of India's public sector banks were studied by Yasmin K. et al. (2021). The period from the 1990s to 2020 was marked by the dominance of new-generation private banks, the availability of a wide range of products and services delivered via several different channels, coordinated marketing efforts within financial institutions, widespread adoption of cutting-edge technological advancements, etc. The Central Government gave this issue some serious thought in response to rising NPAs (Non-Performing Assets), frequent re-capitalization in State Sector Banks, poor earnings, a lack of competition in the global banking market, and subpar customer service at public banks. The country's problem was solved by consolidating its public sector banks to streamline the financial system.

**OBJECTIVES**

- To understand the concept of merging public sector banking institutions.
- To identify the positive impact of merging public sector banks on society.
- To analyze the advantages of public sector banks towards the bankers.
- To study the benefits of public sector banks to the customers.

**RESEARCH METHODOLOGY**

- This study is based on secondary data, and it's a descriptive study.
- This fact is extracted from various journals, articles, websites, and bulletins of RBI.

**POST-MERGER PUBLIC SECTOR BANKS**

There is an improvement in PSBs, the profitability in the year ended March21, despite the corona virus pandemic disruptions. The key reason for attaining a profit of 31.817 crores is to lower the cost of frauds, reduce operating expenses, and raise gains in bond portfolios amid declining bond yields. The benefits of a merger could be highlighted in figures related to profitability, the employees of the big Bank merger are tremendous, and it cannot be measured in financial numbers both to bankers and customers. The positive impact on the bankers is as follows:

- There is an improvement in the reported gross non - performing assets(NPA) (9.4% as on Mar2021 from 10.7% as of March 2020) and net NPA (3.1% VS 3.8%) in FY21, overdue loan book across the bank remains high.





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- PSB started improving its lending capabilities and turnaround time by digitally sanctioning the loans by enhancing its customers through online tools.
- Merger leads to the possibility of maximizing the utilization of infrastructure and workforce efficiency.
- A merger of public sector banks creates a better platform to expand its operations widely.
- Where one bank has a broad customer base with other banks.
- Increased geographical locations
- Merger creates excellent control and also reduces the burden on the government.
- A merger facilitates better Risk management with a more extensive capital base.
- Merger helps abolish redundant posts and designation in the banks, increasing savings.
- Larger banks can finance big projects for companies which leads to increased returns.
- It helps to prevent the closure of unprofitable businesses.
- Merger creates to increase the market share.
- Mergers may improve the service quality, which ultimately benefits the customers.
- The merged banking sector could achieve price cuts by operating more efficiently, reducing redundancies in staffing.
- Merged banks will lead to higher customer safety as the government of India possesses verifiable aspects.
- Customers' loans can be sanctioned very fast.
- Lower-income groups also can be benefitted more and more.
- Loans with lower interest rates would be more beneficial to the customers.
- Bank employees could attain job security.
- Better service facility to the rural customers
- Bank employees are also eligible for pension after Retirement

### SUGGESTIONS

- Merger facilitates scope for more extensive scale operations for the public, but the employees' position is questionable, and the government should also take necessary steps for employees' job security.
- The size of the board committee can be increased to increase the accountability aspects.
- A separate ethical committee has to be formed to assess the risk in the market.
- Government should take adequate steps to prevent the dominance of the acquired bank by the acquiring bank and monitor the usage of resources.
- Employees can be provided better training programs to adapt themselves for efficient management.
- Government should also allocate an adequate budget for the welfare of the merged bank to serve the nation better.

### CONCLUSION

Though the above study concludes that merging was done to save the interest of bankers and customers from the weaker banks, in the later stage, the critical objective is to build a strong image over the public sector bank to facilitate a better economy and to increase the standard of living for the better economy. Merging helped most of the time to protect the weaker bank and met its societal expectations. After the merger, SBI increased its turnover to 52.05 lakh crores, PNB Stood second largest public sector bank with 17.94 crores, and the bank of Baroda achieved its business target of 16.13 crore. To increase financial services to society, we need government support just like a steering wheel in the form of public sector banks.





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## The Effect of Otago Exercise versus Chair Based Exercise to Reduce Risk of fall in Older Population

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### ABSTRACT

Aging, a progressive physiological decline in multiple body systems, marked by loss of function, loss of physiological reserve and increased vulnerability to disease and death. During postural control mainly three systems plays important role to maintain balance: vision, somatosensory, and vestibular. As with advancing age, there are degenerative changes occurring, the loss of any one of these systems affects balance which may result in falls and increased morbidity. The study focuses on the effectiveness of OTAGO exercise versus CHAIR based exercise to reduce risk of fall in older population. 60 normal older individuals with age >60 years were included. They were randomly allocated in 2 groups. Group A received Otago exercise program and Group B received Chair based exercise program. In this study balance was measured by Berg balance scale and Time Up and Go test before and after 6 weeks of intervention. Result was statistically analyzed using t test using SPSS 25. There was a significant improvement at  $p < 0.05$  in group A and group B. In between Group analysis there was more significant improvement in BBS and TUG at  $p < 0.001$  in Group A than Group B. This study showed a significant difference in efficacy of Group A on balance in older population as compared to Group B. This study concluded that Otago exercise program is more effective than Chair based exercise program to reduce risk of fall in older population.

**Keywords:** Older Population, Balance, Otago, Chair, BBS, TUG.

### INTRODUCTION

Aging is the process through which healthy humans become old, with diminishing reserves in most physiological systems and an exponentially growing vulnerability to most illnesses and mortality.[1]. Aging is the state in which he changes takes place, compared to other stage. They are normally decremented and maintained throughout time

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and usually lacking in clearly definitive points of transformation.[2]It is characterized by the continuous breakdown of organ system and tissues, which is an anticipated and exceptionally involved diverse process.[3] Changes in the structure and activity of tissues, major organs, and biological system throughout the time can influence human health, behavior, functional capacity, and survival.[4] However not all of the changes experienced by old people are caused by physiological aging, while many people go through comparable physiological changes during their lives, not all of them are unavoidable.[4] Falls are the 7th major cause of mortality in people above age of 75 years.[5]48% of adults over 75 years who had an injurious fall acquire a fear of falling and 26% of these people begin avoiding situations that require refined balance skills, thus leading to further declines in walking and balance skills.[6] People aged 65 and more fall approximately 28% to 35% each year, according to a World Health Organization (WHO) worldwide study on preventing falls, and this proportion rises as age and frailty levels rise.[7]Similarly to the research of balance control, it is critical to distinguish between age-related changes in mobility that impact all older persons and pathology-related changes that affect just a subset of them [6]. Many studies now indicate that balance control is a major factor in steady walking.[6]Decreased balance control is a crucial factor contributing to the loss of independent movement in many elderly people [6].

High risk of falling is mostly due to older individual's difficulty in maintenance of postural control during ADL. Postural control rely upon the capacity to coordinate many systems in a continuing cycle: sensory systems (vestibular, visual, and somatosensory), cognitive system (central nervous system), and musculoskeletal system.[8]Physiological changes occur in one's visual, vestibular, and somatosensory inputs, as well as the central processing and muscle effectors, during normal aging.[9] The primary weakness related to falls among older persons appears to be a diminished capacity to recognize low contrast dangers, evaluate distances, and understand spatial connections in the visual system [10]. Changes in the vestibular system are manifested by a decrease in the number of hair cells in the semicircular canals, saccule and utricle maculae, and primary and secondary vestibular neurons [11]. Reduced ability to find position and direction of movement, as well as decreased lower-limb strength and sensitivity, are thought to be major determinants of fall risk in older persons.[12]Furthermore, inter-joint synchronization and optimal muscle activation time during ADL, such as walking, are compromised.; as a result, older people's ability to adopt to fall prevention measures by young people is diminished [8].

The Otago exercise program was developed and tested in four controlled trials by Professor John Campbell a and his research team at the University of Otago Medical School in New Zealand. This regimen vastly used with main target to enhance strengthening, balance and gait among community dwelling seniors with reduction of fall to 35%. The interplay of the musculoskeletal and neurological systems is required for postural regulation.[13] Other programs have universally accepted to focus on chair based exercise as it is done only with a less equipment. Chair-based exercise is a sitting, systematic, and progressive exercise program that employs a chair for support and is suitable for older persons and those who are frail or deconditioned [45]. In elderly persons, chair-based exercise has been demonstrated to help them retain or improve their independence and mobility[14] There are so many techniques that have been stated to be effective for reducing falls in older individuals and moreover there is a huge data conforming promising effect of physical training activity.[8] Literature shows that to preserved to functionally independent and also for preventing or postponing frailty aerobic as well as resisted exercise protocol can be given[15].

Exercise in form of aerobic found to be effective for maintenance of cardiovascular function as well as restoring mitochondrial activity and motor unit recruitment in muscle which improved quality of life by preventing atrophy of muscle.[16] Resisted exercises result to improved strength of muscle and neural activity with enhanced synthesis of protein and muscular hypertrophy which can be consider as adaptation in form of neurological and morphological basis.[17]Combined effect of different types of training improved physical function and composition of the body and also emotional, cognitive aspect in older people.[18] It is remembered that most aerobic and strength activities need a high level of mobility from the participants. Because of their restricted motor capacity, older persons with limited mobility may find it difficult to benefit from this activities.[8] The purpose of the study is to compare the effectiveness of OTAGO exercise versus CHAIR based exercise to reduce risk of fall in older population.





## METHODS AND MATERIALS

An experimental study was conducted at Sainath hospital and Shreemati Maniben Tribhivandas Matru Ghruh, ahmedabad. 60 normal older individuals were taken in the study according to inclusion criteria. They were divided into 2 groups 30 in each group. Group A received Otago exercise program and Group B received Chair based exercise program. The inclusion criteria are (a) Both genders male and female (b)Age:  $\geq 60$  years (c)Able to follow command (d)Moderate fall risk 21 to 40(BBS) (e)Able to walk at least 3 meter (f)Stable vital signs (g)Subject willingly participate. Exclusion criteria are (a) History of neurological condition which could possible impair balance (CVA, Parkinsonism, vestibular disorder) (b)History of recent fracture or surgeries.

Outcome measures of the study are the Berg balance scale and Time up and go test. This outcomes helps to determine fall risk and measure the progress of balance, sit to stand and walking. Outcome measures were taken before and after the intervention. Duration of intervention was 5 days a week for 6 weeks (30 minutes). Group A was received Otago exercise program consists of lower limb strengthening exercise, balance training exercise and endurance. Progression of exercises will be done by increasing the duration and then intensity. In strengthening training 10 RM will be done with intensity of weights for strengthening program for quadriceps, hamstrings and hip abductors. 50% of 10 RM will be taken for training and will gradually progress. The starting level is determined by the amount of ankle cuff weight the person can use to perform 8 to 10 good quality repetitions before fatigue. This needs to be assessed for each muscle group on each leg. Balance exercises progress from holding on to a stable structure to performing the exercise independent of support. Once the level is achieved, progress to next level. Subjects are advised to carry walking for at least 30 minutes 2 times a week. Group B was received Chair based exercises which includes Marching, Single knee raise, Knee lift, V-step, Half jack, Criss cross, Sit to stand, Heel slide, Ankle circle. This protocol was conducted for 5 days in a week with 20 repetitions for 6 weeks.

## RESULT

An experimental study was done with 60 normal individuals age  $>60$  years, who fulfill the inclusion criteria. These subjects were randomly divided into 2 groups and intervention was given in the form of Otago exercise and chair based exercise. The parametric test was used in statistical analysis because the distribution was normal. Paired t-test was used to see the pre and post-treatment effects. Unpaired t-test was used for to do comparison between the both groups. Table 1 shows the mean age of both groups. Table 2 shows paired t-test of Group A pre and post mean of outcome measures. Table 3 shows paired t-test of Group B pre and post mean of outcome measures. Table 4 shows unpaired t-test between Group A and Group B. Result showed significant improvement in all the outcome measures in Group A as p-value being  $<0.001$ .

## DISCUSSION

The impact of Otago exercise versus Chair-based exercise on the risk of falling in older persons is examined in this study. Ms. Nancy N. Patel, et al. (2015) had done a study to assess the impact of the Otago exercise program on older people's fall prevention. Thirty community dwellers, 60 years aged female and male with moderate risk of fall were taken. Protocol was given for 6 weeks, with one hr duration for 5 days per week. The intervention consists of mainly strength and balance training. They used Tinetti Performance Oriented Mobility Assessment and Chair stand test as outcome measurement. This study showed significant improvement in both outcome measures and it provided evidence to support the Otago exercise [13].

Shreeya dilip berde et al. (2020) has conducted research on the impact of chair-based exercise on the quality of life of fragile old people. According to inclusion exclusion criteria they select 42 older individual and age group from 60-80 years. Regime of chair based exercise for 6 weeks with 4 days in a week. They used quality of life and 6 minutes walk



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test as outcome measure. This interventional study showed significant improvement in both outcome measure and it provided evidence to support the chair based exercise [14]. Result of this study showed that Otago exercise and Chair based exercise both the group individually statistically significant to decreases the fall risk in older population but Otago exercise(Group A) showed more improved effect when compared to Chair based exercise(Group B). Otago exercise program showed more improvement because there are more exercise with more number of repetition and also strengthening training compared to chair based exercise.

**CONCLUSION**

This study showed that there is a positive effect of Otago exercise program and Chair based exercise program to reduce risk of fall in older population. But Group A showed greater significant difference as compared to Group B. Otago exercise program is more favorable when compared to chair based exercise program to improved balance in older individuals and also decrease the fall risk.

**FURTHER RECOMMENDATIONS**

1.This study can be done in Osteoporosis women. 2. More subjects can be taken for study. 3. Interpretation can be done for long periods

**CONFLICT OF INTEREST: Nil****REFERENCES**

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**Table 1: shows mean age and gender of both groups.**

|              | GROUP A(n=30) | GROUP B(n=30) |
|--------------|---------------|---------------|
| AGE          | 74.06±8.50    | 75.03±10.92   |
| GENDER (M/F) | 19/11         | 12/18         |

**Table 2: Comparison Of Pre And Post Mean In Otago Exercise Program (Group-A)**

|                        | OUTCOMES | MEAN  | STD.DEVIATION | t value | P Value |
|------------------------|----------|-------|---------------|---------|---------|
| OTAGO EXERCISE PROGRAM | PRE- BBS | 28.70 | 4.96          | -18.89  | <0.001  |
|                        | POST-BBS | 37.53 | 5.90          |         |         |
|                        | PRE-TUG  | 11.84 | 2.20          | 20.36   | <0.001  |
|                        | POST-TUG | 8.19  | 1.76          |         |         |

**Table 3: Comparison of Pre And Post Mean In Chair Based Exercise Program (Group-B)**

|                              | OUTCOMES | MEAN  | STD.DEVIATION | t value | P Value |
|------------------------------|----------|-------|---------------|---------|---------|
| CHAIR BASED EXERCISE PROGRAM | PRE-BBS  | 29.86 | 5.09          | -11.11  | <0.001  |
|                              | POST-BBS | 31.66 | 5.30          |         |         |
|                              | PRE-TUG  | 11.07 | 2.24          | 12.06   | <0.001  |
|                              | POST-TUG | 10.10 | 2.356         |         |         |

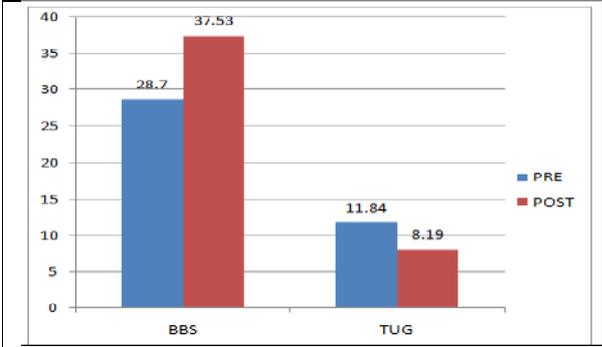
**Table 4: Between Group Comparison**

|          | OUTCOMES             | MEAN  | STD.DEVIATION | t VALUE | P VALUE |
|----------|----------------------|-------|---------------|---------|---------|
| POST BBS | OTAGO EXERCISE       | 37.53 | 5.78          | 4.04    | <0.001  |
|          | CHAIR BASED EXERCISE | 31.66 | 5.90          | 4.04    |         |
| POST TUG | OTAGO EXERCISE       | 8.19  | 1.76          | -3.54   | <0.001  |
|          | CHAIR BASED EXERCISE | 10.10 | 2.35          | -3.54   |         |

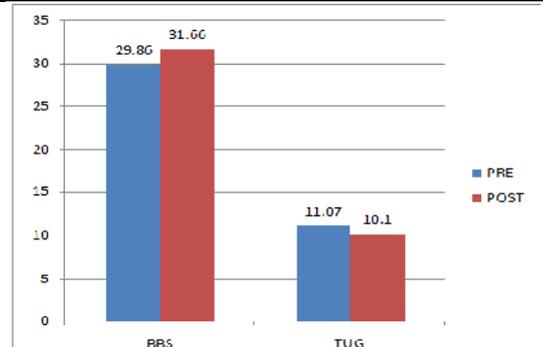




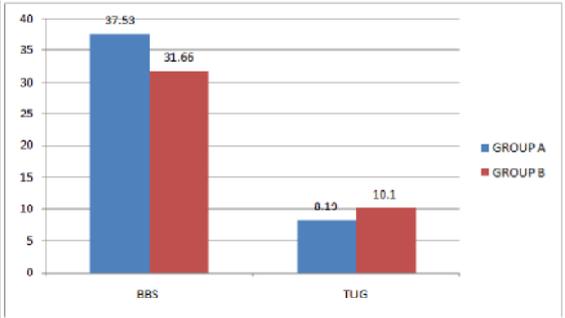
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**GRAPH 1: GROUP A PRE AND POST MEAN OF BBS AND TUG**



**GRAPH 2: GROUP B PRE AND POST MEAN OF BBS AND TUG**



**GRAPH 3. COMPARISON OF BBS AND TUG IN BOTH GROUPS**





## Green Banking - A Tool for Sustainable Development

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### ABSTRACT

Natural environment is getting depleted day by day. Global warming has become a major threat and the government is taking necessary steps to save our planet. Banking industry is the primary source of economic development and has taken responsibility to contribute for sustainable development through Green Banking. Green Banking is the new buzz word that is making a name for itself in the financial world. It is the process of minimizing internal carbon foot prints as well as external carbon emissions with a concern over exploitation natural resources. This paper highlights the green initiatives adopted by different banks in India and creates awareness about the environment.

**Keywords:** Global Warming, Green Banking, Sustainable Development, Carbon Footprints, Carbon Emissions.

## INTRODUCTION

Green Bank, also known as ethical bank or sustainable bank or social bank or responsible bank is an innovative financial technique and a market development tool to gear up the stationing of clean energy technologies. Green banking utilizes public funds to leverage private investment in clean proposals that struggles to establish a widespread presence in consumer markets. It reduces the negative impact on the environment. Green banking promoted online banking by reducing usage of papers, conservation of electricity, saving water and other related resources. Green banking is also like an ordinary banking but the objective is to protect the environment and natural resources.



**Vikram****OBJECTIVES**

- To explore the concept of 'Green Banking'
- To study the green initiatives adopted by various banks in India.
- To create awareness among all stakeholders.

**RESEARCH METHODOLOGY**

The current study is based on secondary data which is collected from various published sources such as annual reports of RBI, annual reports of individual bank websites, books, magazines, journals, articles, research papers, news papers and websites. Each and every data were thoroughly studied, properly scrutinized and only the relevant information required for this paper is taken.

**REVIEW OF LITERATURE**

Neevitha (2017) conducted a green bank survey in Mauritius on customer feedback to raise awareness about Green Banking by selecting 200 respondents. Most customers are aware of Green Banking services but do not have the knowledge of how banks use to train their customers to use Green Banking services.

Shobha, et al(2018) learnt about customer feedback on green banking systems by gathering data on organized schedules and published sources. The selected sample is 30 customers from each SBI bank, Canara Bank and Syndicate Bank. The tools used to process oata are descriptive statistics such as percentage method, mode method and Anova-t-Chi-square test. It was concluded that green banking methods are used but not that customers are killed because they were not taught how to use green banks.

Khairunnessa et al., (2021) has conducted his research in Bangladesh and the purpose of this study is to investigate the growth of "Green Banking" in Bangladesh with a strong focus on the role of financial law in making the Bangladeshi financial sector green. It also examines the role of financial and non-financial institutions in promoting green financial transformation. Secondary data collected from various sources including websites of Bangladesh's central bank and other commercial banks were used. Descriptive statistics were used to analyze the data. The findings revealed that the bank of Bangladesh has played a key role in promoting the country's green financial system by introducing a number of environmental policies and regulatory measures. Bangladesh has made great strides in establishing and expanding green banking systems, developing infrastructure and promoting green growth over the years, but it lags behind rich countries in terms of environmental efficiency.

**GREEN BANKING PRODUCTS AND SERVICES**

- Green Loans - Green loans are loans meant for sustainable proposals and deriving benefits out of them.
- Green Mortgage – Green Mortgage specifies green buildings that are constructed as eco friendly. The banks would offer either a low interest rate or an increased loan amount.
- Mobile Banking-It is an online banking service provided to the customers to transact anywhere and anytime using their smart phones and tablets.
- Automated Teller Machine (ATM)- A unique and peculiar machine installed by banks either adjacent, inside or away from banks to withdraw and deposit money with or without using debit cards.
- NEFT/RTGS- National Electronic Fund Transfer promotes one-to-one transfer of funds nationally. RTGS is nothing but Real Time Gross Settlement and it is an immediate money transfer than NEFT. The transfer limit under both methods varies according to the banks.
- Point of Sale (POS) –It is a card payment processing system at retail locations. The customers must enter their PIN set by them or given by banks to complete the payment.





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- Online Bill Payments – Bills of all kinds can be paid electronically. This is a massive effort for paperless transactions.
- Electronic Clearing Service (ECS) – Transactions of repetitive and periodic nature are categorized under this. Bulk receipts and payments opt for this service.
- BHIM/UPI – BHarat Interface for Money/Unified Payment Interface is a recently developed instant payment/collection app by National Payments Corporation of India (NPCI) for day to day transactions from a minimum of 1 rupee to maximum amount whatever using the mobile number or Virtual Payment Address (UPI ID).

### SIGNIFICANCE OF GREEN BANKING

Green banking optimizes costs, reduces the risk, enhance banks reputations and contribute to the common good of environmental sustainability. So it serves both the commercial objective of the bank as well as its social responsibility. Indian Banks can adopt green banking as business model for sustainable banking.

### OPPORTUNITIES AVAILABLE FOR GREEN BANKING

- 1) Supply Chain Management (SCM) – Flow of goods and services are well managed by supply chain management.
  - Techniques and Plans are adopted to reduce stock and wasted freight.
  - Carbon footprints are controlled through adopted network design.
- 2) Enterprise Resource Planning (ERP) –Daily business activities are managed through this advanced and improved software.
  - Promotion of e transactions
  - Technology adoption of intelligent device management.
- 3) Customer Relationship Management (CRM)- A technology for managing all the potential customers simultaneously and maintaining a smooth relationship with them.
  - It facilitates online collection of customers data through various media.
  - All the needs and wants of the customers are fulfilled instantly.
- 4) Sourcing and Procurement-**Sourcing** is the process of screening and choosing efficient suppliers who provide inputs for running the organization successfully.Procurement involves appropriation of products and services essential for the organization.
  - Vendors Selection for sustainability rating
  - Finds,evaluates & engages suppliers for acquiring goods and services for sustainable development.
- 5) Product Life Cycle Management(PLC)-PLC is the management of all phases of the product's life cycle from new idea through to commercialization and decline
  - Minimizes carbon footprint by providing their own design of banking products and services.
  - Implementation of efficient and effective systems for goods end-of-life management that have low impact on environment.

### CHALLENGES FACED BY GREEN BANKING

- Credit Risk: Global warming affects the economic assets financed by the banks, thus leading to high credit risk.When there are changes due to environmental rules,credit risk arises.
- Legal risk: When banks do not adhere to environmental rules and regulations,legal risk comes into existence.When loans are sanctioned on projects that are against environment,severe penalties and stringent action will be taken.
- Reputational Risk: If a bank's action and activity directly or indirectly affects the environment,reputational risk pops up.
- Diversification Problem-Green banks restrains their transactions to the entities qualified for screening process done by banks.Hence they have only limited number of customers.
- Pioneer phase-Many green banks are still at their pioneer stage.It takes about a duration of atleast five years to get monetary benefits.Hence banks are helpless during recession period.





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- High operating cost-Green Banking requires potential human capital to serve customers.Experienced officers are required to deal with green business and its customers which results in high operating cost.

#### GREEN INITIATIVES ADOPTED BY DIFFERENT BANKS IN INDIA

- State Bank of India (SBI) (2010) has become the first bank in India to generate green power through windmill installation for various purposes.
- Canara Bank (2013) has introduced several online banking facilities through various media and initiated solar power Automated Teller Machines.
- Punjab National Bank (2021) constructed rainwater harvesting in existing buildings and motivated new environmental friendly constructions and started a new mission called “Catch the Rain” as an awareness measure.
- Bank of Baroda (2013) becomes the first to record digitization and paperless banking over 33 crore papers scanned at more than 5000 branches.
- ICICI bank (2014) waived half percentage on total loan amount of automobile loans on car models which uses renewable sources of energy.
- HDFC bank (2021) launched “green and sustainable” deposits programme for retail clients, funds from which will be used to finance sustainable housing credit solutions and services.
- Axis Bank (2020) installed solar-based devices for Automated Teller Machines for Uninterrupted Power Supply.
- Kotak Mahindra Bank’s (2021) “Think-Green” plan motivates customers for e-statements and makes them to plant a tree for every e-statement.
- IndusInd Bank(2021) launched “Green Fixed Deposits” to support proposals that aims for sustainable development.
- Yes Bank(2018) launched Green Good Deeds campaign on Climate Awareness Workshops, Tree plantation drives, Energy Conservation drive, Book donation drive.
- HSBC Bank(2020) launched its “Green Deposit Programme” to finance and support more of environmentally beneficial projects. The purpose is to reduce carbon footprints.
- IDBI Bank(2016) has planned to fund for many clean projects for the development of environment.

#### FINDINGS

- Green Banking takes efforts to reduce paper work which in turn controls deforestation.
- Bill payments of all kinds have been made online which saves paper,time and facilitates convenience to customers.
- Loans are provided at concessional rates for green projects to encourage customers as well as protect the environment.
- Green Banking started consuming more of solar and wind energy for ATMs to operate which is a renewable resource.
- Awareness can be created among budding and established entrepreneurs who have environmental and social responsibility enabling them to do environmental friendly business practices.
- It provides cash back facilities to the customers having “green” accounts.
- Green Banking tends to protect the environment through plantation of saplings, rainwater harvesting, electricity and water conservation.

#### SUGGESTIONS AND RECOMMENDATIONS

##### To Banks

- More awareness about green banking can be created among customers through their websites.
- Banks can actively participate in environmental protection events.
- Numerous Outlets can be setup by banks to promote green business.





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- Regular communication through press can make customers and public know more about green banking.
- Annual Environment report can be prepared to keep the track record of environmental programs conducted and participated.
- Carbon foot print can be reduced by energy consciousness and mass transportation to their employees.
- Banks can provide environmentally positive rewards to customers.
- Green Banks can aim on greening information technology infrastructure for the betterment of the environment.

#### To Customers

- Customers can avail the facilities of online banking instead of branch banking to reduce paper work from their side.
- They can continuously learn and update their knowledge about green banking through various media.
- Entrepreneurs can avail loans for environmental friendly projects alone.
- Customers can participate in sustainable development events along with the green banks they are related with.
- Investments and savings can be made by the customers in green banks which results in environmental benefits such that a small portion of amount is provided for environmental cause.

#### To Government

- Proper and sufficient support can be provided to the green banks when required.
- Mass campaign and Awareness programs can be conducted frequently all over the country so that green banking becomes famous.
- Clear policies can be framed to incorporate sustainability issues.
- Legal provisions can be made stringent so that exhaustion of natural resources can be avoided.

## CONCLUSIONS

Green has become a chanting mantra. Green Banking is like a reform in the banking sector. Green Banking has been pioneered to enhance the environment and promote economic development. In India, this concept is still in its infancy. Before its complete implementation, awareness must be created among all stakeholders. Green Banking is essential for world market entry. Therefore, proper training is necessary for successful green banking.

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## Effectiveness of Acute Bout of Resistance Exercise on Cognitive Performance in Young Adults with Sleep Deprivation

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### ABSTRACT

Sleep deprivation has been becoming an epidemic nearly young adults require a sleep of 8-7 hours but this has decreased due to increased workloads to achieve better grades in academics or due to occupational stress studies have proven that this affects cognitive performance of young adults moreover evidence suggesting a positive role of resisted exercise to improve cognitive performance has been implicated so purpose is to evaluate effectiveness of acute bout of resistance exercise on cognitive performance in young adults with sleep deprivation 60 sleep deprived subjects meeting inclusion criteria were taken and divided into two groups one experimental group were given resistance exercise for 75% RM 12 repetition, 2 session with 10 minutes warm up and cool down and other control group were given seated rest for 30 minutes and pre post outcomes in form of stroop test, Trail making test, Ruler drop test were taken. calculated using SPSS version 25.0 were paired t test was done for within group analysis and unpaired t test for between group analysis at  $p < 0.05$  and  $0.1$  where there was significant improvement in stroop and ruler drop test in inter group comparison. Thus we conclude that there is an effect of resisted exercise on cognitive performance of sleep deprived young adults in form of selective attention and reaction time

**Keywords:** sleep, trail making test, stroop test, ruler drop test, cognition, acute bout, resistance, exercise.

### INTRODUCTION

Sleep plays a pivotal role in human's physiological process and cognitive function that has an influence on routine activity and health [1]. Lack of sleep results into pernicious effect on its characteristic and quantity. In this current era it is primarily related to stress and increased workload.[2] Sleep deprivation states that of procuring inadequate sleep for supporting an adequate daytime alertness. According to national sleep



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foundation sleep deprivation referred to as not getting adequate amount of sleep [3]. Sleep deprivation has emerged as an evolving pandemic [4], according to national sleep foundation adults require a suggestive sleep of 7-9 hours but since past 40 years this has been reduced to eight and half to seven hours [5]. Schoen born and Adams in their study reported that in 2010, 3/10 adults slept for less than 7 hours per day while in early 20<sup>th</sup> century it was reported as an average of 9 hours.[6]Prevalence among daytime sleepiness is 9-24%, according to American thoracic society during a day 35% adults in US sleep for less than 7 hours [7]. Daytime sleepiness commonest among sleep deprived individual [5] and is evaluated using EPWORTH SLEEPINESS SCALE [8]. having a reliability 0.88[9], Various researches and experiments have shown that it also has a negative impact on cardiovascular system, respiratory, immune system, excretory system, gastrointestinal system and nervous as well as psychosomatic.[6]Physiology of acute sleep deprivation shows that inferior parietal gyrus, middle prefrontal gyrus, anterior cingulate gyrus are hypo activated [10].

**Various reasons for sleep deprivation**

Trying to achieve better marks, Poor sleep habit [7] Jet lags, Night shifts, Neurological disorders, Breathing disorders, For better achievements, Unhealthy lifestyle, Intake of caffeine ,Alcohol consumption, Using stimulants[10], Extreme usage of technology and media[11].

**Signs and symptoms accordingly include**

Daytime sleepiness [7], Mood changes, Cognition altered, Lack of concentration on task, Gaining weight, Excessive yawning [12], Irritability, Difficulty doing conceptual task. Physiologically during sleep there is an increase in volume of interstitial space, that allows high lymphatic clearance of waste in brain, so during sleep deprivation there is an accumulation of amyloid plaques that results to impaired cognition. Cognition is a process includes knowing, memory, judgment, reasoning and awareness [13] Cognitive function is defined as brain's activity that leads to knowledge, and mechanism of acquiring it.<sup>3</sup> Includes execution functional aspects which comprises of planning, manipulation, initiation, and termination of task further problem solving, abstract thinking, error recognition are integral part of its function [13].

Cognitive aspects are linked to frontal lobe which is susceptible to sleep deprivation that lowers wakefulness. Working memory and execution are linked to anterior cingulate cortex, and prefrontal cortex [10]. Areas in brain for cognition includes attention, memory, executive function [14]. Attention in brain linked to parietal lobe that includes sustained, selective, divided, alternating forms. Memory function includes short and long term memory and its retrieval and storage. Execution function consists of planning, purposeful act, performance, volition of task. Resisted exercises are considered as strength training that consist of voluntary activation of muscles that increase muscle mass, strength, power and also is associated to decrease risk factors related to ageing moreover Yuk kai chang et.al asserted that kimura et al. Failed to find positive effect of resisted exercise on cognitive function improvement [8].

Jarod Christopher vance (2018) shows that intensity of a single bout of resistance exercise is an essential component that impact between resistance exercise and cognitive performance. Improved performance followed by an acute bout of resisted exercise could be due to insulin growth factor that accelerate brain derived neurotrophic [15]. So to evaluate cognition test form of stroop color word test, trail making test, ruler drop test are used. Thus the purpose of this study is to see effectiveness of acute bout of resisted exercise on cognitive performance in young adults with sleep deprivation.



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## MATERIALS AND METHODS

An Experimental study was conducted by screening sleep deprived subjects by use of recall method and daytime sleepiness scale, 60 subjects fulfilling criteria were taken and randomized into two groups Group A experimental, Group B Control group. Inclusion criteria were Age 18-25 years normal healthy young adults, Both males and females, Sleep less than 7hrs day on basis of last week (recall), Epworth score 11-24. Exclusion criteria are, People under medications or having any medical history, Taking caffeine more 200mg per day, Mental incapacity to provide form consent, People on sedatives, hypnotics, nicotine, People with Color blindness will be excluded, Night shift workers. Intervention pre post outcomes for cognition in form of stroop color word test<sup>16</sup> measures selective attention which consist of three sheets sheet 1 we have to say names written, sheet 2 saying color name of rectangles, sheet 3 we have to say color of ink of word written (red say blue), Trail making test<sup>17</sup> executive and task switching function part A join 1-2-3, part B JOIN 1-a-2-b-3-c..., Ruler drop test<sup>18</sup> measures reaction time ruler held by therapist and subject has to catch falling ruler in all the test one has to measure time taken in seconds. For group A allocated with resisted exercises 75% 1 R.M 2 sessions 12 repetition 7 exercises biceps curls, leg press, triceps extension, plank, shoulder press, squats, calf raise with warm up and cool down phase while group B was only given seated rest while staying awake for 30 minutes.

## RESULT

An experimental study with 60 sleep deprived young adults was done with three test stroop, trail making, ruler drop test with group A resisted exercise and group B seated rest in which parametric test using paired t test for within group analysis and unpaired t test for between group analysis was taken at  $p < 0.05$  moderate significant and  $p < 0.1$  weak significant. Table 1 shows intra group comparison for group A found to be significant, Table 2 shows intra group comparison of group B found to be significant only for stroop and trail test, Table 3 shows intergroup comparison for both groups found to be significant except trail test in group A.

## DISCUSSION

Present study, group A experimental were given 30 minutes resisted exercise with warm up and cool down session for 75% 1 RM and pre post cognitive measures were evaluated using stroop test, ruler drop, trail making test where within group mean time taken, pre and post stroop, pre and post trail, pre and post ruler drop test and in between stroop, trail, ruler drop which shows reduction of time taken complete test. Shilpakhullar (2019) randomized study on 60 young subjects divided two groups where one group with less sleep hours less than 7 and other group normal sleep hours, assessed by stroop test for their cognitive performance and concluded that cognitive performance were hampered in sleep deprived group, they asserted that sleep deprivation affects processing dorsolateral prefrontal cortex which responsible for cognitive performance by stroop task hence stroop test measures selective attention affected due to sleep deprivation, so our findings were similar to them. Paula Alhola (2017)[13] stated in their article that cognitive aspects are linked to frontal lobe which is susceptible to sleep deprivation.

A study done by Andrew T Harveson [19] et.al (2016) study asserted that increased measures of cognition with improvement in stroop test while no significant improved scores of trail making test over seated rest group so reason behind improvement of task was that neuromuscular activity increases the brain activity that increases speed of processing and also neurotrophic factors hence this support our finding. Chang and etiner et.al(2009) and alves et.al (2012)[20] done study regarding there is no significant improvement in trail making test following resisted exercise where they affirmed that this is due to task dependency that can be relatable in our study. In present study ruler drop test found to be significantly effective following acute bout of resisted exercise, study done by bindeshpatel et.al (2019)[21] where they found that there was positive effect of exercise on visual reaction time evaluated by



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ruler drop test stated that exercise leads to arousal which in turn increase alertness [45]. that Can be correlated in our study. Jarod C Vance(2018)[15]did a crossover experimental study 30 subjects, with age group of 18-25 ,resistance exercise showed accelerated level in brain derived neurotrophic factor and that increases the neurogenesis and shows promising effect on cognitive function. result for outcome showed significant improvement in scores of stroop test and ruler test so from finding for improvement of cognitive performance can be relatable to mechanism stated in study done by jarodvance. In present study group B control group were given 30 minutes of seated rest while

staying awake and pre post outcomes for stroop, trail, ruler drop test taken where mean time for within group showed pre stroop and post stroop, pre trail, post trail, pre ruler, post ruler shows decrease in time. Jungyunhwang (2016)[22] did a study with 58 subjects divided two group where one group high intensity acute exercise control group was given seated rest and cognition in form of stroop test and trail making test were analysed where they conclude that control group shows less improvement in scores compared to experimental group that can be considered as response of exercise to brain derived neurotrophic factor This supported present study on less improved scores in seated rest group. Harveson et.al in their study with 140 subjects divided three groups where one group was given seated rest and other two resisted and aerobic exercise while cognition was evaluated using color dot test and trail making test where they found that more improved scores following resisted and aerobic exercise were there compared to non-exercise control group.

So when we compared both groups experimental group showed more improvement in selective attention and visual reaction time then control group, as group A were given resisted exercise in which it enhances the serum levels and brain derived neurotropic factors ,insulin growth factors responsible for neurogenesis and angiogenesis that eventually improves cognitive components[20]while control group were given only seated rest. Experimental group showed improved timing for stroop and ruler drop test that respectively measures selective attention and visual reaction time while improved selective attention due to changes in arousal mechanism leads to increase brain derived factors, catecholamine's activity [18] while visual reaction time decreased due to resisted exercise induced arousal leads to alertness [45].

**CONCLUSION**

Thus we conclude that there is an effect of resisted exercise on cognitive performance of sleep deprived young adults in form of selective attention and visual reaction time. Limitation: No follow up was taken, Males were less in this study, Individual Epworth scores sleep duration and weight according repetition maximum data has not been mentioned. Future scope: Long term effect for this study, Continue with this study by assessing other cognitive components, Can compare this study with other exercise, Can measure change in vitals before and after treatment.

**CONFLICT OF INTEREST:** Nil

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**Table 1: Mean Age of Sleep Deprived Subjects Based on Gender**

|             | Group A     | Group B    |
|-------------|-------------|------------|
| AGE         | 22.23±1.406 | 22.3±1.557 |
| Gender(m/f) | 8/22        | 7/23       |

**Table 2: Effect Of Experimental Group On Stroop, Trail Making, Ruler Drop Test: (Significant \*, not significant \*\*)**

| Group        | TEST        | Mean      | Std. deviation | t value  | p value |
|--------------|-------------|-----------|----------------|----------|---------|
| Experimental | PRE STROOP  | 115.50230 | 24.120237      | 6.166455 | < 0.05* |
|              | POST STROOP | 88.03053  | 18.978941      |          |         |





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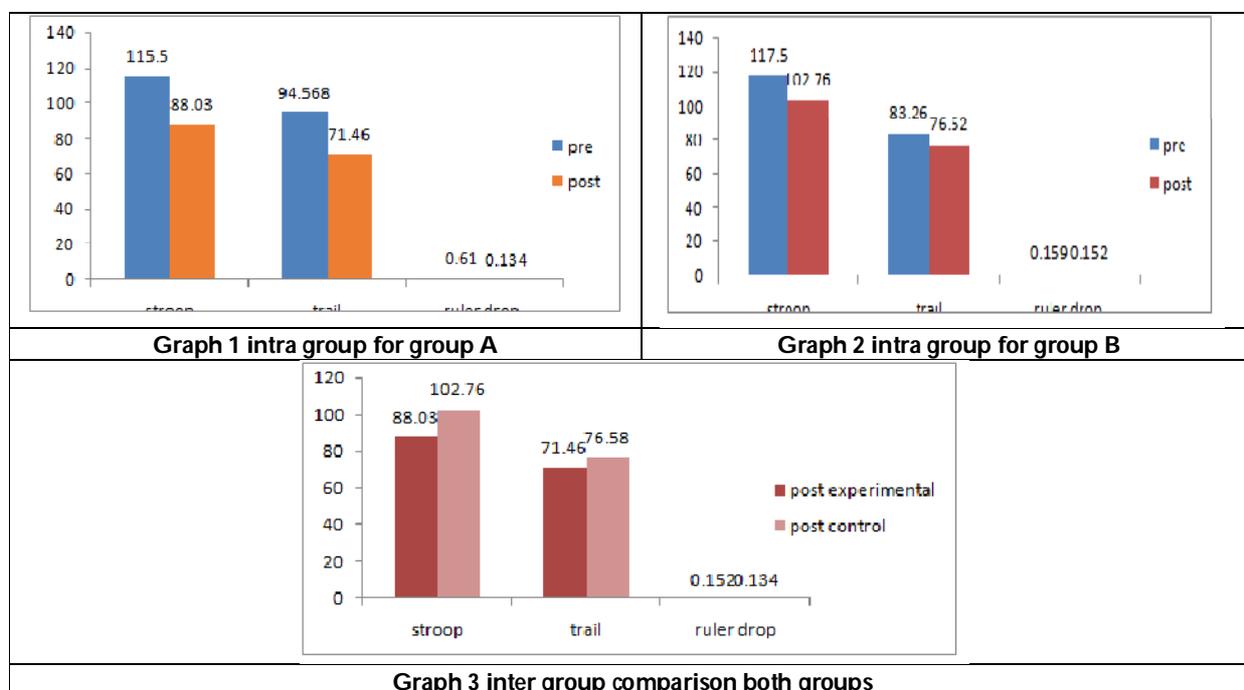
|  |            |          |           |          |         |
|--|------------|----------|-----------|----------|---------|
|  | PRE TRAIL  | 94.56883 | 28.376061 | 7.569182 | < 0.05* |
|  | POST TRAIL | 71.46110 | 19.803239 |          |         |
|  | PRE RULER  | 0.1603   | 0.03399   | 6.408575 | < 0.05* |
|  | POST RULER | 0.1343   | 0.03350   |          |         |

**Table 3: Effect Of Control Group on Stroop, Trail, Ruler Test**

|         | Group       | Mean      | Std. Deviation | T value | p value |
|---------|-------------|-----------|----------------|---------|---------|
| Control | PRE STROOP  | 117.50613 | 23.850454      | 7.214   | < 0.05* |
|         | POST STROOP | 102.76073 | 19.580271      |         |         |
|         | PRE TRAIL   | 83.26747  | 19.371088      | 4.795   | < 0.05* |
|         | POST TRAIL  | 76.52820  | 20.001981      |         |         |
|         | PRE RULER   | 0.1590    | 0.04105        | 1.585   | <0.05** |
|         | POST RULER  | 0.1527    | 0.04051        |         |         |

**Table 4: Post Outcomes of Both Groups Comparison**

| TEST        |              | Mean      | Std. Deviation | t VALUE  | p VALUE  |
|-------------|--------------|-----------|----------------|----------|----------|
| POST STROOP | Control      | 102.76073 | 19.580271      | 2.958716 | < 0.05*  |
|             | Experimental | 88.03053  | 18.978941      |          |          |
| POST TRAIL  | Control      | 76.52820  | 20.001981      | 0.986029 | < 0.05** |
|             | Experimental | 71.46110  | 19.803239      |          |          |
| POST RULER  | Control      | 0.1527    | 0.04051        | 1.910388 | < 0.1*   |
|             | Experimental | 0.1343    | 0.03350        |          |          |





## Securing Cloud Computing Environment using Various Preservation Techniques

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### ABSTRACT

Due to its on-demand services, fast processing power, minimal service cost, excellent performance, reliability, scalability, convenience, and accessibility, cloud computing has grown to be one of the most talked-about topics in today's society. In general, it's a novel idea for giving consumers access to virtualized resources. Customers can use the cloud to store a lot more information from various locations and request services, applications, and solutions. But as cloud computing's popularity grows, there is a growing threat that security will overtake other concerns as the primary one. The use of cloud services has security issues despite its many benefits. In the current social and business environment, if a little bit of information is lost, the attacker has a direct path to interfere with your security. Therefore, maintaining information from online media is currently a crucial issue. Security of cloud data is the main topic of this article. In addition, a thorough discussion of a number of crucial issues relating to cloud security protocols, cloud architecture, data retention, security problems in cloud computing, and mitigation methods. This paper also considers and investigates the various strategies and procedures used by analysts for the preservation of online long-distance informal communication data. Additionally, it illustrates the various drawbacks of these techniques and offers a suitable replacement.

**Keywords:** Cloud Computing, Data Security, Privacy Threats, Counter measures





## INTRODUCTION

The security of computers, networks, and information more generally can all be thought of as sub-domains of cloud computing. A collection of regulations, tools, software, data, services, and infrastructure for cloud computing make up the concept of cloud data security[1]. To protect against information loss and loss of resources that belong to a cloud service provider's or a customer, a set of controls can be put into place. A driving factor of cloud computing development is the improvement of security as well as privacy[2]. The user's data is secure in cloud storage. Data leaks from cloud storage systems also happened frequently, and malicious attacks on those systems increased. Cloud data is exposed to a wide range of security risks. The types of cloud computing and network/security issues that are related to them are covered in detail in the current paper. Denial-of-service attacks, man-in-the-middle attacks, network sniffing, port scanning, SQL injection attacks, and cross-site scripting are some of the common attacks which networks face. XML signature element wrapping, browser security, cloud malware injection attacks, flooding attacks, data protection, insecure or incomplete information deletion, and locks-in are security issues that can arise with cloud computing.

### Cloud Computing

The term "cloud computing" refers to a method for effective, on-demand remote access to a reservoir of shared reconfigurable computing resources, including networks, servers, storage, apps, and services. With this model, provisioning and releasing these resources can be done quickly and with little involvement from the service provider [3]. The core of cloud computing is bridging disparate environments. Infrastructure services are provided as required for the client. It is a crucial subject in information technology. Cloud computing's core tenet is the idea of accessing or storing data and programmes online rather than on a computer's hard drive[4]. A model of on-demand service is cloud computing, based mainly on distributed computing and virtualization technologies. With all of the storage available online, Google Drive can be used as a computing service. Additionally, online backup, synchronisation, and storage of mail, contacts, calendars, and other data are the main uses of Apple's cloud service[5]. Cloud computing is a system in which remote servers that users connect to over a secure Internet connection manage computing resources and storage. These servers' access points have developed to include a pc or laptop, a cell phone, a tablet device, and other connected things. These access points can be used to manage applications and display data[6].

### Specifications of Cloud Computing

Regardless of their location or device, users can access the system using a search engine from anywhere in the world (such as a PC or mobile phone). No requirement for each user's PC to be installed with a cloud computing app. These have multiple points of access[7]. A lot of user's share resources. As cloud computing becomes more widespread, security concerns like identity verification, access control, backup, storage security, and virtualization are given more weight. One of the key requirements of cloud computing is secure user authentication in order to protect cloud service providers from loss and to offer secure service to legitimate users[8]. Cloud frameworks utilise a metering capability at the appropriate abstraction level for the type of administration to automatically control and upgrade the use of cloud resources. Resource utilisation can also be monitored, managed, and disclosed, providing suppliers and customers with transparency[9].

### Cloud Computing Service Models

Instead of offering a single product, cloud computing offers a variety of services. These services offered the platform-as-a-service, infrastructure-as-a-service, and software-as-a-service models[10].

**1. SAAS:SAAS** is a cloud service that is mostly used by organizations and is managed by cloud providers. Users can access it via the internet.



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**2.PAAS:**Developers use this programme (readily accessible for Windows and Linux) to create websites without having to install any computer software. It can also be used even by those without administrative experience.

**3.IAAS:**It is managed, controlled, and governed by cloud service providers, who offer a variety of services such as computer networks, application server, hardware, and storage.

**Types of Cloud Computing**

According to NIST (2009), there are four different kinds of cloud computing models: community cloud, hybrid cloud, private cloud and public cloud.

**Public Cloud**

This type of cloud is available to everyone and offers resources, web applications, and web services via the internet. Public organisations provide some of the infrastructure required to run the public cloud.

**Private Cloud**

The above kind of cloud is only used by one organisation and is used internally. Users within the company can access the cloud's details, services offered, and web applications, but users outside the organisation cannot. The organisation itself manages all aspects of the private cloud infrastructure and takes full responsibility for the maintenance of business data.

**Hybrid Cloud**

The Hybrid cloud is made up of two or more different clouds such as public, private and community. Mostly, it refers to a situation where a number of internal or external cloud service providers are being used.

**Community Cloud**

In general, a cloud is made up of one or more public, private, or hybrid clouds which are used by several organizations for the same purpose (mainly security). Several organisations within a particular community will share infrastructure with the same goals for compliance and security. It is either internally managed or managed by a third party. It costs more than private cloud, but less than public cloud.

**Related Work**

This section reviews several publications that looked at security parameters for cloud computing. In cloud computing, a user's email address and credit card information are required for both initial registration and subsequent logins. Therefore, both the growth of the Service Providers and users require the usage of considerably more secure authentication methods. In situations where a given cloud service provider (SP) offers many services, G. Jaspheer et al. recommended to use a safe biometric-based authentication mechanism that addresses proxy and session key issues. For secure key creation and exchange, cryptographic algorithms like elliptic curve cryptography are employed. However, biometric authentication methods are not always accurate. In a conventional biometric system, faults might come in two different forms. A false reject (FR) issue occurs when a legitimate user tries to enter the system but is denied. The acceptance of someone who is not who they claim to be constitutes a false accept (FA) error. To protect user logins and data transmission over the cloud, Shefali et al. presented an authentication method based on AES and MD5. The authors of this work suggest current methods of data encryption and decryption at the moment of login, but they do not include any authentication. Security is not offered because it is based solely on trust value[7]. In her solution, Neha and her colleagues suggested using a privacy-preserving protocol in cloud computing enabling protected access. In order to enable privacy-preserving access authority sharing, a new privacy barrier is found during information access in cloud computing in this work employing the SAPA protocol. In order to re-encrypt files for file sharing with a large number of user's while maintaining confidentiality, the ECC algorithm and numerous keys are employed. A safe system for encrypted transactions is created and put to the test for



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vulnerability[12]. For cloud-based services, Slawomir Grzonkowski and Peter M. Corcoran introduced an innovative authentication technique. This protocol has several advantages over other authentication methods like Kerberos, including the lack of physical tokens, resistance to replay attacks, and the absence of a password that the user and the authentication service both shares. Only the previously created zero-knowledge proof-based password method is used in this portion of the protocol[13]. P. Tobin et al. examined the creation and use of a one-time pad encryption method in a study that was presented to examine how to protect data stored in the cloud. Information is protected against hacks, side-channel attacks, and backdoors in commonly used encryption algorithms when security is customised at the client side using a one-time pad generator. One-time pad binary sequences were used to encrypt local client data. They were produced by analogue chaos oscillators which had been modified and triggered by noise. K. N. Prasetyo and colleagues advised using symmetric encryption algorithms[14]. As a result, they suggested implementing the Blowfish encryption method on an FPGA device and programming it in VHDL. The proposed solution was assessed using performance criteria like privacy, encryption time, avalanche effect, & throughput, and it was discovered to deliver better performance. S. Aljawarneh et al. suggested an encryption method for multimedia data[15]. The algorithm is a multi-level encryption system that uses the evolutionary algorithm, the Fiestel encryption technique, and AES with S-box. Because there is no way to swap the keys, this approach does not maintain confidentiality when different senders use it. There seems to be no key generation because the key is produced from the plain text.

**Network issues with Cloud Computing**

The privacy of users is maintained in the cloud, but it is essential to enable multi-domain policy integration and safe service composition in environments with many domains and a service-oriented architecture. The main privacy issues include a lack of user control, possibly illegal secondary use, data proliferation, and dynamic provisioning. [16]. A few of the network issues that can arise in cloud computing are addressed here.

**Denial of Service Attack:**

When hackers repeatedly bombard a local network or web server with service requests in an effort to damage the networks, denial of service is unable to keep up with them, preventing the server from handling regular client requests. A web server might no longer be able to offer the services, for example, if a hacker takes control of it. In cloud computing, a hacker attack on the server entails sending a huge number of requests, which overwhelms the server and prevents it from serving the regular clients. Reducing the user's privileges after connecting to a server is a defence against this attack. This will lessen the impact of the DOS assault.

**Man in the middle Attack**

One more problem with network safety is the Man in the Middle Attack, which can occur if the secure socket layer (SSL) isn't set up correctly. For instance, every data connection between two organizations could be hacked by the intermediary party if SSL is not executed correctly and two parties are corresponding with each other. SSL should be correctly installed and tested before contact with other authorised parties as a countermeasure against this attack[17].

**Network Sniffing**

one more sort of assault is known as a network sniffer, and it poses a more serious threat to network security because it allows for the hacking of unencrypted data through a network, such as passwords which are not securely encrypted during communication. The data can be intercepted during transmission if the communication parties do not utilise encryption mechanisms to protect the data. To defend against this attack, parties should secure their data using encryption techniques.

**Port scanning**

There may be issues with port scanning that could be exploited by an attacker because Port 80 (HTTP), that is used to deliver online services to users, is always open. Until the server software is properly installed, other ports, like FTP,



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should be protected by encryption because they are only opened when necessary. In order to defend against this assault, firewalls are employed to protect data against port attacks.

**Cross-site scripting:**

In a cross-site scripting attack, the hacker on the other site sends the target to their own website and takes their login credentials when they key in the proper URL for a website. For instance, when a user enters a URL into their browser's address bar, an attacker may reroute them to a hacker website where he can then steal their sensitive information. Buffer overflows, denial-of-service attacks, and the introduction of malicious software into web browsers in order to violate user credentials are all possible through cross-site scripting attacks.

**CONCLUSION**

A new concept called "cloud computing" has entered the business world, allowing users to communicate directly with virtualized resources while saving customers money. This paper discusses a few security concerns and solutions to them. There is a need for effective authentication techniques, as evidenced by the different attacks and their effects on the crucial data kept in the network. This overview demonstrates the extensive research that has been done on authentication techniques, despite the fact that their application in other situations has not received as much attention. Additionally, the paper discusses potential attacks that have already been noted.

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**Table 1. Cloud Computing Security threats along with their Countermeasures [18]**

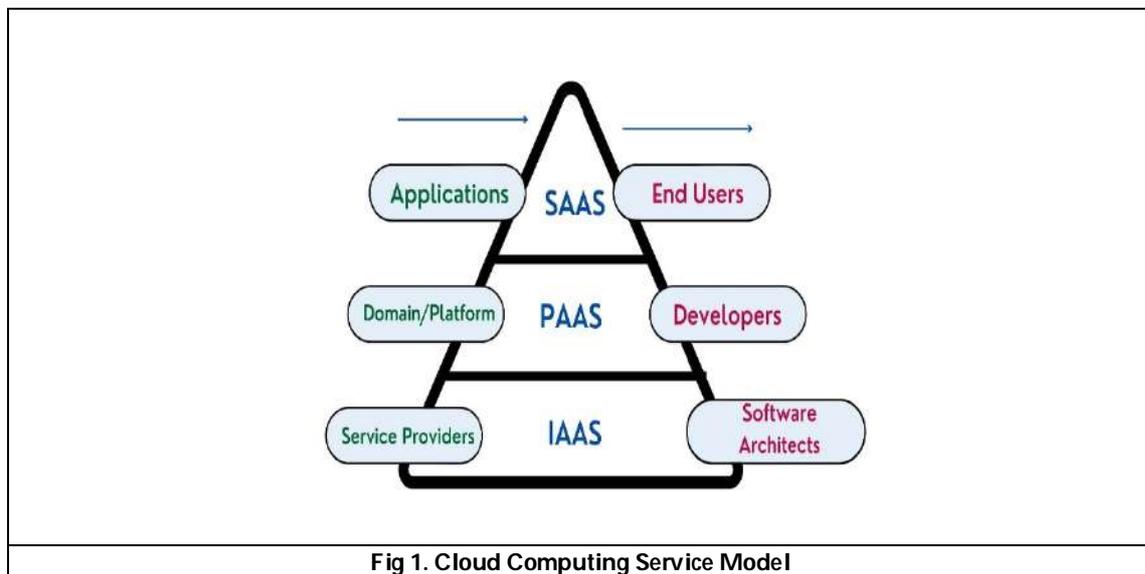
| S.No. | Types of Security Threats | Affected Cloud Services | Countermeasures   |
|-------|---------------------------|-------------------------|---|
| 1.    | Data Loss                 | SaaS, IaaS, PaaS        | <ul style="list-style-type: none"> <li>• periodic backups.</li> <li>• By utilising appropriate encryption methods.</li> <li>• By guarding transmissions of data.</li> <li>• The use of reliable key generation, administration, and storage.</li> </ul>   |
| 2.    | Data Breaches             | SaaS, IaaS, PaaS        | <ul style="list-style-type: none"> <li>• implementation of secure key creation, administration, and storage.</li> <li>• Legally stating supplier maintenance and reinforcing methods[19].</li> </ul>  |
| 3.    | Service Hijacking         | PaaS, IaaS, SaaS        | <ul style="list-style-type: none"> <li>• knowledge of security rules and service level agreements (SLA).</li> <li>• Using techniques for multi-factor authentication.</li> <li>• Strict surveillance to find illegal activity</li> <li>• Prevent consumers and services from exchanging login information.</li> </ul> |
| 4.    | Abuse of Cloud Services   | IaaS, SaaS              | <ul style="list-style-type: none"> <li>• implementing strong authentication and permission.</li> <li>• Proper network traffic auditing</li> <li>• Improved monitoring of credit card fraud.</li> </ul>  |





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|    |                             |                  |  |
|----|-----------------------------|------------------|--|
| 5. | Insecure APIs               | SaaS, PaaS, IaaS | <ul style="list-style-type: none"> <li>• strong access control and authentication procedures.</li> <li>• Data transmission via encryption [20].</li> <li>• Examination of cloud service provider interfaces.</li> <li>• A thorough understanding of the API dependency chain.</li> </ul> |
| 6. | Lock-In                     | IaaS, SaaS, PaaS | <ul style="list-style-type: none"> <li>• Implementing the firewall and using the Intrusion Prevention System, Intrusion Detection System, and other monitoring tools</li> </ul>  |
| 7. | Misconfigured Cloud Storage | PaaS, IaaS, SaaS | <ul style="list-style-type: none"> <li>• Use specialized tools to check privacy configuration like CloudSploit and Dome9.</li> </ul>   |
| 8. | Biometric Template Privacy  | SaaS             | <ul style="list-style-type: none"> <li>• Threats can be reduced by decentralising the template storage[21].</li> </ul>   |



**Fig 1. Cloud Computing Service Model**





## The Metaverse and the World's Digital Future: an Exploration

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### ABSTRACT

The Metaverse is based on the fusion of virtual reality (VR) and augmented reality (AR) technologies with the aid of Web 3 and AI, which allow for multimodal interactions with people, virtual surroundings, and digital objects. As a result, the Metaverse is a web of permanent multiuser social platforms and interconnected immersive experiences. Although the concept of metaverse was developed primitively before 2020, the term became more popular in October 2021 when the American tech giant Facebook Inc. announced that its name would be changed to Meta Inc. This article aims to provide an understanding of the uses of the metaverse in various industries, as well as familiarity with global users, consumer awareness, and global market position. The secondary data was collected from various sources, such as published articles, blog pages, and reports. It was found that metaverse was used in the leading 12 sectors and was highly popular with developed and developing countries. In a short span of time, consumer awareness of the metaverse is limited, and the study suggests that more popularity is required for consumer use of their digital businesses.

**Keywords:** Metaverse, History, Familiarity, Uses, Consumer Awareness

## INTRODUCTION

Metaverse is a three-dimensional, immersive virtual platform where users can interact with each other using AI-powered avatars in a highly realistic virtual environment with the help of highly advanced extended reality (XR) devices. The term 'metaverse' was first coined by American writer Neal Stephenson, who used the term in his novel Snow Crash which was published in 1992. The word is the blend of 'meta' i.e., 'more comprehensive' and 'universe'. Metaverse involves social interaction of human-based avatars in a virtual platform and dealing with virtual properties. This can be done using specially constructed software's and hardware's that enables XR. Also, digital



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conferences, webinars, classroom lectures and social gatherings are also expected to be conducted using the technology.

**WHICH IDEAS MAKE METAVERSE STRONGER?**

The concept of metaverse is actually closely connected to the ideas of Extended Reality (XR) and Web 3.0. Basically, Extended Reality is the mix of both Augmented Reality (AR) and Virtual Reality (VR) which allow its user to experience a specific simulated environment through specially designed software's and hardware's. The idea of XR is usually connected with the rise of Artificial Intelligence which helps to make the experience of the users more authentic. Usage of XR plays a crucial role in the metaverse as the platform can be experienced only with the help of XR. Web 3.0 is generally defined as the generation of the internet technologies which primarily focuses on decentralization, blockchain technology, AI and machine learning. It is the successor of Web 2.0, which focuses on social connectivity and user-generated contents and Web 1.0, that looks at basic web development. Decentralization involves the process of replacing the system where a central authority exists whose permission and authority is required while using the system. Decentralization has its major implication on blockchain technology, where a database is maintained in the form of groups of blocks. This blockchain technology is used in crypto currencies and non-fungible tokens (NFTs). Web 3.0 helps the users of metaverse in a more useful way by protecting and enabling them to control their data from being stolen and inappropriately used. In other words, Web 3.0 is crucial for data sovereignty in metaverse

**WHO MADE METAVERSE POPULAR?**

Although the concept of metaverse was developed primitively before 2020, the term became more popular in October 2021 when the American tech giant Facebook Inc. announced that its name would be changed to Meta Inc., to 'reflect its focus on building the metaverse' using its subsidiaries that produce hardware's (Oculus VR) and software's (Facebook, Messenger, WhatsApp and Instagram apps). This step can be viewed in the continuity of its acquisition of Oculus VR in 2014 and the launch of VR based game named Facebook Horizon (later Horizon World in 2021) in 2019. Also, other big tech companies like Google and Microsoft are developing VR technologies in the goal of metaverse. Since then, many small-scale companies and start-ups started to focus on metaverse with XR and Web 3.0 technologies. It has become normal for tech companies to hire Chief Metaverse Officer (CMO).

**HISTORY OF METAVERSE****BASIC STAGES OF METAVERSE HISTORY**

The history of metaverse can be traced back to 1838 when the idea was roughly fictionalized. Later, in 1950s, new technologies were invented which facilitated AR and VR. Then, in 1978, first software that enables virtual world with real people was designed.

Broadly, the history of metaverse can be categorized into 6 phrases:

- i. Early stage or fictional stage, where the concept of metaverse was only imagined
- ii. Intermediate or intentional stage, where the basic inventions required for metaverse were made
- iii. Software developmental stage, where software's based on metaverse were designed
- iv. Hardware developmental stage, where advanced hardware's for metaverse were created
- v. Investment and Preparatory stage, where the investments and preparations for full-fledged metaverse are made ready

Future or Complete Developmental stage, where advanced metaverse is expected to be achieved

**EARLY OR FICTIONAL STAGE (1832 – 1999)**

The conceptual history of metaverse can be looked back to 1832, when Sir Charles Wheatstone, an English inventor thought about binocular vision that helps to view an image in 3D by displaying the same image to left and right eyes separately. He is also known as the pioneer of stereoscope, which was invented using his idea by R. Murray in 1832. Later, in 1935, American science-fiction novelist Stanley Weinbaum published a book named 'Pymalion's



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Spectacles', where the protagonist can enter a fictional world by wearing a pair of goggles, with sensing sight, smell, sound, taste, and touch. Then, a movie named Tron was released in 1982 based on the idea of virtual reality. The major milestone in the history of metaverse was the book Snow Crash by Neal Stephenson, in which the word was first used. In this book, a metaverse with the usual characteristics is mentioned. He is often considered as the father of metaverse.

**INTERMEDIATE OR INVENTIONAL STAGE (1832– 1889)**

We need to remember that metaverse is only possible with the technologies like AI, XR and Internet. Stereoscope, which helped to enable 'binocular vision', was invented by R. Murray with the help of Sir. Charles Wheatstone in 1832. This idea was further developed to Lenticular stereoscope in 1849 by David Brewster and to View-master in 1939 by William Gruber. Later, in 1962, American cinematographer Morton Heilig invented Sensorama, that helped the audience to feel a complete VR experience by enabling to sense all happenings. He is often regarded as pioneer of Virtual Reality. Meanwhile, first AI-powered software was developed in 1955 by Herbert Simon and Allen Newell. It was named as 'Logic Theorist' and the software could prove mathematical theorems independently. Further, John McCarthy created LISP – a programming language that facilitates AI and thus became the father of AI. Then, Tim Berners-Lee invented World Wide Web (WWW) in 1989, which led to the development of Internet of Things in future.

**SOFTWARE DEVELOPMENTAL STAGE (SINCE 1978)**

In 1978, MUD (Multi-User Dungeon) was created by Roy Trubshaw and Richard Bartle. This is considered as the first software that created a real time virtual world. Here, the users can interact among themselves using storyboards and chats. Later, in 2003, Linden Labs developed a metaverse based video game named Second Life, where the users can interact in the forms of digital avatars that represent them. This is considered as the dirt game that resembled metaverse. Then, similar games like Roblox (2006), Minecraft (2011), The Sandbox (2012), Decentraland (2020), Party Island (2022) were developed.

**HARDWARE DEVELOPMENTAL STAGE (SINCE 1962)**

This stage has started in 1962 when Morton Heilig invented Sensorama. This is the first device that gave VR experience to people. This led to further innovations in devices for VR. These include Ivan Sutherland's Sword of Damocles (1968), Krueger's VIDEOPLACE (1975), The McDonnell-Douglas HMD (1979), etc. Later, many tech companies ventured into the field of VR technology. These companies include SEGA (1993), Meta – formerly Facebook through Oculus (2014), Sony (2014), Google (2016) and Microsoft (2016). Further, many other accessories like gloves and mics that help to give authentic VR experience are developed. In the field of AI, that can improve metaverse, computers, robots and machines are developed in the manner of taking own decisions. AIoPs and Inclusive User Interfaces which facilitates well-structured metaverse are invented by the programmers to support development of metaverse.

**INVESTMENT AND PREPARATORY STAGE (SINCE 2021)**

It is necessary to know the fact that although metaverse concept was existed, it was not known by the common people until 2021. The breakthrough in the history of metaverse happened in 2021, when the Facebook Inc. – the holding company of Facebook, Messenger, WhatsApp, Instagram and Oculus, renamed into Meta Inc., with the motive to develop a full-fledged metaverse. Marc Zuckerberg, CEO of the company, declared that the technology of metaverse will rule the future in the company's renaming ceremony. Also, the company has invested an amount of \$10 billion in Meta Reality Labs, its XR and metaverse division. Moreover, the division's revenue has surged from \$ 1.83 billion in Q1 2021 to \$ 2.96 billion in 2022 and its operating cost has raised up from \$ 534 million in Q1 2021 to \$ 695 million in Q1 2022. Zuckerberg remarked on this data that the company is making losses meaningfully. Since the renaming of Facebook into Meta, many people became aware about metaverse. Also, with the emergence of Web 3.0, many aspirant entrepreneurs and industrialist became interested to start a business based on metaverse. Such start-ups include Inworld AI, Improbable, AllSeated, H2L, Somnium Space, etc.





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**FUTURE AND COMPLETE DEVELOPMENTAL STAGE (IN FUTURE)**

This stage is expected to get started in 2030s when completely developed and united metaverses is designated to be prepared. These metaverses are to be accompanied with AI, XR and Web 3.0 through which they provide true experience to the users. Also, with advanced VR devices, hi-tech software's, strongly linked blockchains'and government support, the industry of metaverse is set to achieve the market capitalization of trillion dollars in future. It can revolutionaries the sectors of education, entertainment, healthcare, social interacting, and e-commerce.

**USES OF METAVERSE TECHNOLOGIES AROUND THE WORLD  
SECTORS WHERE THE METAVERSE IS USED**

Metaverse has its implications in various sectors. These sectors can use metaverse to get developed to the next generation. Many companies have already started to use metaverse in their business to be unique and innovative. Some of these sectors include

1. Information Technology (IT)
2. Education
3. Manufacturing and Production
4. Healthcare
5. Military
6. Commerce
7. Tourism
8. Marketing
9. Entertainment
10. Gaming
11. Real Estate
12. Social networking

**INFORMATION TECHNOLOGY**

Nowadays, many IT sector companies are showing their interest on learning and implementing metaverse technologies in their business. Metaverse is expected to create a separate division in IT that deals with data of users in metaverse. These data will be grouped in the forms of blockchains using Web 3.0 technologies to protect from stealers. Infosys, who is known for innovating the IT industry, has ventured into the field of metaverse, by introducing Infosys Metaverse Foundry. This platform is launched with the objective of navigating the holding company in the concepts of XR, AI and Web 3.0. This platform is also open to enterprises using which they can create their own metaverse environments to adapt the market trends

**EDUCATION**

Many schools, colleges and universities are exploring the opportunities in using the metaverse in teaching and demonstrating the concepts to the students innovatively. Students can experience and understand real-life scenarios through XR without harms that can exist in original. Meta Inc. has set up Meta Immersive Learning by investing \$ 150 million for the purpose of providing training to ed-tech companies like Coursera, Byju's to develop them to use metaverse and XR to teach children

**MANUFACTURING AND PRODUCTION**

Manufacturing sector can get benefitted from metaverse through the concept of digital twins. Basically, digital twin is the process of replicating a real person or object into the metaverse in the digital form. This can be used for comparing the real product with the virtual prototype and thus can help to increase the quality of product and efficiency of organization. BMW, the leading car producer, has used the digital twin technology for 6 months in its Joytopia factory, for the same purpose. This has yielded them the result of self-evaluation and helped to improve their bike models.





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**HEALTHCARE**

Many healthcare companies and organisations are venturing into metaverse currently. Metaverse also has its applications in healthcare industry. People who are constrained due to geographical limitations or because of some pandemics can consult doctors using VR without reaching hospitals physically. Apollo Hospitals, a healthcare major, has collaborated with California based 8chili Inc. to implicate metaverse in its services. This enables the organisation to reach its patients through XR to provide consultations.

**MILITARY**

Some people think that wars can happen in metaverse in future as life is going to be lived there. Warfare using metaverse provides many advantages to the soldiers like controlling the opponent's using technology. Also, pilots can get trained to fly planes using simulation in metaverse. US military, one of the most powerful militaries in the world, is using metaverse-based programs like Project Blue Shark and Project Avenger to train and support its personnel's.

**MANUFACTURING AND PRODUCTION**

Metaverse technologies help to make the shopping experience of consumers more immersive, social, and personal. This also provides more security to transactions and helps the firms to promote their brands. Moreover, a hybrid mode of shopping with more authenticity can also be successful. Apparel giants like Nike and Adidas are working on metaverse-based shopping. Nike uses Roblox, constructed Nikeland in Sandbox and acquired digital apparel site RTFKT. Adidas also bought BARC NFT and land in Sandbox to build Adiverse.

**TOURISM**

Travelling can be done by people easily using metaverse by making use of VR and AR. They can visit their favorable destinations instantly as they wish at zero cost with XR. Many tourism companies can have software's to provide realistic experience via metaverse to its consumers. Walt Disney Co., who holds the major theme park chain Disneyland, has announced to virtualize Disneyland soon via metaverse through Web 3.0 technologies.

**MARKETING**

Metaverse provides many opportunities to the companies to promote and market their products and brands. The technology facilitates them an easy deal of promotion and selling. Also, with metaverse in commerce, customers can directly express their needs to the firms, even the shopping is done in online. Many corporates like Coco-Cola, Samsung and Volkswagen have entered advertising in metaverses. Also, companies like Gucci are selling their products in metaverse. Companies can also provide VR and AR experiences and market via NFTs like Obsess and Twitter

**ENTERTAINMENT**

Entertainment sector can get influenced by metaverse by livestreaming events in metaverse. Also, popular entertainers can increase their fame by doing shows in metaverse. Singers like Ariana Grande, Justin Bieber and Marshmello have conducted shows in various metaverse platforms.

**GAMING**

Already, metaverse has affected the authenticity of gaming sector. Moreover, with advanced technologies in metaverse, gaming can become a good revenue generating sector. Roblox, Second Life, Minecraft and Sandbox have proved their success in metaverse gaming. In future, metaverse games on Web 3.0 technologies are expected to rise. This can be predicted with the coming up of games like Decentraland.

**REAL ESTATE**

Nowadays, it has become a habit for many to buy properties in 'virtual estate' as like real estate. Many metaverse platforms offer the properties for sale to public. The payments can be made in regular currencies, platform tokens or



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in cryptocurrencies. Roblox, Sandbox and Decentraland have emerged as leading platforms in the field of 'virtual estate'.

**SOCIAL NETWORKING**

Many metaverse platforms can become the places for social interaction and gatherings, they can also host some public gatherings and meetings. Many leading tech companies are working out to create exclusive social networking metaverses. As of now, Decentraland, Roblox, Sandbox, Axie Infinity and Bloktopia leads the segment of being used by users for social networking

**FAMILIARITY OF METAVERSE IN MAJOR COUNTRIES**

Since 2021, many people across the globe are becoming aware about metaverse. Also, many of them are interested to experience true metaverse technologies. They are interested to test the applications of metaverse in various sectors

From the above data, we can initially assume that every major country has a reasonable familiarity about metaverse. Turkey has the most percentage of 86% and Japan has the lowest with 46%. We also need to note that developing countries like India, Turkey is more familiar to metaverse as compared to developed nations like France, Germany, USA, on the other hand, the pioneer of metaverse technologies, is lagging the other countries with 59%. While considering about regions, Asia has the most countries with higher values such as India, Turkey, and China. But Europe and North America are comparatively lower than other regions. Latin America and Africa are reasonably good in their ratings.

The reasons for these results are seen as the development of intellectual and technically strong population in developing nations as they are interested to know and learn every new technology. This also can be compared with the results of AI and Web 3.0. Whereas, developed nations are trying to improve their awareness in older technologies. But this cannot be the final observation as still these types of innovative technologies are invented in only developed nations and not in developing countries

The above data is obtained from the survey conducted on January 2022 in USA by Gartner Inc. The findings of the survey show that nearly 6% of US citizens know well about the term 'metaverse' and 21% are familiar about the concept partially. But 38% of them are unaware about the meaning of metaverse and 35% have not heard the word ever. The reason behind this can be identified as the magnitude of reach of metaverse among the people as the concept has become popular only before 3 months from the survey. Experts expect that these results will turn in reverse as many big-tech companies are working out to enhance the experience of people in metaverse.

**CONSUMER MARKET OF METAVERSE**

Market of metaverse is expanding day-by-day with new inventions every day. Also, VR market is in its peak with nearly 40 million customers. Moreover, AI is also being boosted regularly. Web 3.0 ideas like NFTs and cryptocurrencies are already in the high with increased awareness among people. The above graph is exerted from the Omdia's Consumer VR Headset and Content Revenue Forecast 2021-2026 conducted in December 2021. This data shows that the VR market size is increasing gradually. This gradual increase can be traced from 2020 before which the number of headsets were decreasing. It was 20 million in 2017 and decreased to 17 million in 2019. But since then, it was increasing in straight to 19 million in 2020 and 26 million in 2021. It is also forecasted that it will increase in 2022 to 35 million and finally in 2026 to 70 million.

But revenue earned in VR market follows a hiking trend from around \$ 600 million in 2017 to \$ 2.3 billion in 2021. The same is expected to rise to nearly \$ 7.5 billion in 2026. While considering about the trends in VR headset types, Standalone Headsets are expected to occupy 90% of total number of headsets. It was only around 1 million in 2017, but it has surged to 17 million in 2021. It is also expected to reach 63 million in 2026. This trend can be evidenced with the consumer preference of Standalone VR sets as they don't require much add-on cost and operating skills.



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However, on the other hand, Smartphone Headsets are declining from 15 million in 2017 to 3 million in 2021. It is also predicted to the decline of Smartphone based VR sets below 1 million. This is because most of the users don't prefer them due to their dependence on smartphones. In between, Tethered headsets have slightly increased from 4 million to 6 million. In future, the number is designated to remain constant as many think that these headsets are uncomfortable as they require wired connection with devices every time.

**MARKET SIZE OF METAVERSE**

Since the upsurge of VR and AR products, the market size of metaverse is set to rise in a great speed. Moreover, when Facebook was renamed as Meta, the market is expanding more rapidly with upcoming of a greater number of established companies and also new start-ups. This report was published by PWC in 2019. The report talks about the metaverse market size based on the boost given by AR and VR based companies to the world GDP every year. According to the data, the metaverse market values to \$ 46.4 billion in 2019. This figure is expected to rise to \$148.5 billion in 2021, \$273.2 billion in 2023 and \$476.4 billion in 2025. The trend continues to rise till 2030 when it will reach \$1.5 trillion. This report can be interpreted that the size of XR market won't stop increasing in future. But the predictions may not be true since 2021 due to the sudden rise in popularity of metaverse

**COMPANIES IN METAVERSE SECTOR****MAJOR COMPANIES**

There are many key players in the sector of metaverse. The list includes

- Meta
- Google
- Microsoft
- Roblox
- Linden Labs
- Nvidia
- Tencent

**META**

Meta Inc., formerly Facebook Inc., is considered as the major company in the integrated metaverse industry. It is also regarded as the catalyst for upsurge in the popularity of metaverse since its decision to change its name. It has a separate subsidiary named Meta Reality Labs (formerly Oculus) in specifying its focus on metaverse. It produces VR and AR devices like Meta Quest, and Ray-Ban Stories. They have also built a simulative metaverse named Meta Horizons in 2021 that allows the users to experience metaverse using VR devices.

**GOOGLE**

Google, who leads the 'dot-com' companies in a whole by providing extra-ordinary services to people, has also entered the fantasy of metaverse. It has historically produced VR products like Google Cardboard (2015-2021) and Google Daydream (2016-2019) with a vision of providing VR experience to people in low cost and good quality respectively. But these products are no longer available as they were discontinued.

**MICROSOFT**

Microsoft, a leading tech corporation, always leads the metaverse market. It has started its operations in 2016 with the launch of VR headsets Microsoft HoloLens. This step is succeeded with acquisition of Mojang that owns metaverse-based game platform Minecraft in 2014 at a deal of \$ 2.5 billion and prominent gaming studio Activision Blizzard for \$ 68.7 billion in 2022. Along with Microsoft's Customer Innovation Labs, still it tries to make its metaverse market domination larger. This dream is set to be achieved the launch of Microsoft Metaverse in Microsoft Teams which can be expected in late 2022



**Krishna Moorthy and Vinoth****ROBLOX AND LINDENLAB**

These are the major game-based metaverse platforms. Roblox is the metaverse based that was launched in 2006. Linden Labs owns game named Second Life which is often considered as first metaverse video game that was launched in 2003. These companies provide authentic 2D based metaverse services to their users. There are also other similar firms like Sandbox (2012), Fortnite (2017), Axie Infinity (2018) and Decentraland (2020).

**NVIDIA AND TENCENT**

These are the some of the names which are often heard in the market of metaverse. Nvidia is an American company formed in 1993 by Jensen Huang that produces GPUs for Web 3.0, AI and metaverse technologies. Tencent is a Chinese corporation that was found by Ma Huateng in the year 1998. This involves in producing and selling various video games like Call of Duty, League of Legends and PUBG. The above data shows about the ranking of major metaverse based software's. Axie Infinity leads the chart with fully diluted market cap of \$ 41.7 billion. The reason is because of services provided by the platform which are mostly liked by users.

The above graph shows the investments made by major players in metaverse industry on the projects on metaverse. Microsoft has recently bought gaming studio Activision Blizzard for a huge amount of \$ 68.7 billion. This is considered as the company's largest acquisition deal in its history. The studio owns many famous games like Call of Duty, Candy Crush Saga, etc. These games can be developed by Microsoft into the next stage as they are expected to enter Xbox Platforms. This move is also considered as its strategy to develop a full-fledged metaverse. Meta, formerly Facebook, announced its plan to invest nearly \$ 10 billion in its subsidiary Reality Labs in the process of developing devices for VR and AR technologies. Google, who had formerly involved in the business of VR headsets and then quitted due to losses, has revealed its plans to re-

enter the sector with earmarking nearly \$ 37.5 million in a private equity firm to get used to finance metaverse based projects. Tencent, who leads the market in China, has acquired 10 gaming companies in its lifetime for nearly \$ 2 billion. These games are used the firm to build a metaverse. Also, it has bought VR based company Pico for \$ 771 million (¥ 500 million) as providing a neck-to-neck stance with Meta.

**CHALLENGES TO BE FACED BY METAVERSE**

Every technology has two sides – pros and cons. It is evident that every invention also has a dark side. As same the metaverse too. It is also affected by a list of short comes.

**METAVERSE TECHNOLOGIES ARE HIGHLY EXPENSIVE**

A person, who wishes to enjoy a true metaverse experience, must spend thousands of dollars. This situation is because of the technical feasibility and intellectual rights of the technologies. For example, a Meta Quest costs nearly \$ 1000 along with accessories required, Ray-Ban stories cost \$ 300 and HoloLens 2 cost \$ 3500. Such products cannot be afforded by customers in low-income and middle-income countries. But prices of these products are expected to get lowered due to future development of newer, better and more feasible technologies

**METAVERSE CAN LEAD TO INTERNET ADDICTION DISORDER AND OTHER DISORDERS.**

We also need to note that metaverse affects people mentally, psychologically, and physically. Long usage of metaverse can lead to eye-based disorders, mental problems like stress, hypertension., and Internet Addiction Disorder.

**METAVERSE IS PRONE TO PRIVACY ISSUES**

As metaverse is the successor of Internet, it too suffers same problems as Internet. One of the most dangerous problems is Lack of Privacy. Hackers and data-stealers can use different tricks can tracking eye-lenses, etc. to get data from the users.



**Krishna Moorthy and Vinoth****METAVEVERSE IS UNREGULATED**

Although there are various companies promoting metaverse, there is no one who has framed rules for metaverse. This serves as a major challenge for development of metaverse. Also, laws which are applicable in real world are not the same in metaverse. Crimes committed in metaverse cannot be challenged and convicted.

**CONCLUSION**

In this thoughtful piece, we discussed the possibilities of recent advancements in virtual worlds for providing fresh value propositions for the digital transformation of society and business. We focus on the Metaverse function as a bridge between technological trends and social and commercial applications. A Metaverse is considered a globally accessible 3D virtual space and computer infrastructure. It acts as a unifying platform and a design environment for apps with high added value. In this paper, we present a conception for such a design environment. This study found that due to the special characteristics of metaverse technologies, they were employed in a variety of industries, including IT, education, healthcare, the military, business, tourism, entertainment, and so on. People in nations like Turkey, India, China, and South Korea are quite accustomed to it. Only 6% of Americans, according to a poll, are aware of the Metaverse completely. From \$148.5 billion in 2021 to \$476.4 billion in 2026, it is predicted that the size of the Metaverse will increase. The main participants in the global metaverse market include organizations like Meta, Google, and Microsoft. For example, in 2022, Microsoft spent \$68.7 billion to invest in and buy a game studio. There were a number of difficulties with deploying and utilizing the device, including its high cost, internet problems, privacy concerns, and unregulated practices.

In our opinion, the Metaverse presents a significant opportunity to develop high-value applications for a new generation of cyber-physical systems using human-centered design principles. The use of some of the technological aspects of the metaverse, such as virtual reality, augmented reality, simulation technology, and block chain technology, by gaming, entertainment, marketing, and higher education institutions is undoubtedly seen as advantageous at this moment. It is obvious that this technology will soon have more functions added to it, and that individuals from a variety of industries will use it.

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**Table 1 – Familiarity of Metaverse Among Selected 29 Countries (In %)**

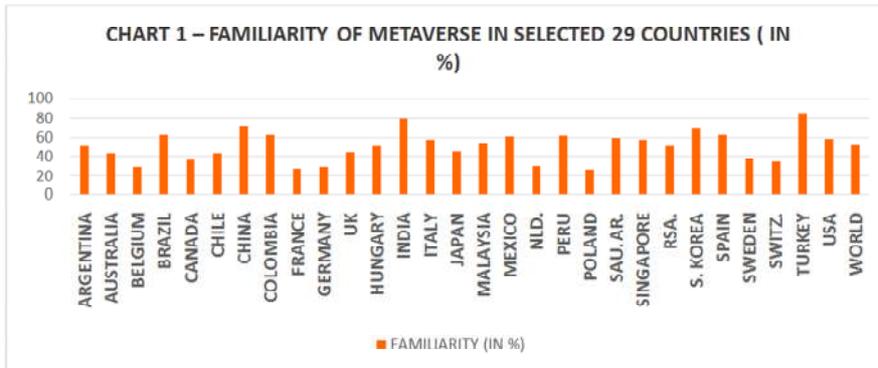
| COUNTRY NAME  | FAMILIARITY OF METaverse AMONG PEOPLE (in %) |
|---------------|--|
| ARGENTINA     | 51   |
| AUSTRALIA     | 44   |
| BELGIUM       | 30   |
| BRAZIL        | 63   |
| CANADA        | 37   |
| CHILE         | 44   |
| CHINA         | 73   |
| COLOMBIA      | 63   |
| FRANCE        | 28   |
| GERMANY       | 30   |
| GREAT BRITAIN | 45   |
| HUNGARY       | 51   |
| INDIA         | 80   |
| ITALY         | 58   |
| JAPAN         | 46   |

| COUNTRY NAME          | FAMILIARITY OF METaverse AMONG PEOPLE (in %) |
|-----------------------|--|
| MALAYSIA              | 54   |
| MEXICO                | 61   |
| NETHERLANDS           | 31   |
| PERU                  | 62   |
| POLAND                | 27   |
| SAUDI ARABIA          | 60   |
| SINGAPORE             | 58   |
| SOUTH AFRICA          | 51   |
| SOUTH KOREA           | 71   |
| SPAIN                 | 63   |
| SWEDEN                | 38   |
| SWITZERLAND           | 35   |
| TURKEY                | 86   |
| UNITED STATES         | 59   |
| <b>GLOBAL AVERAGE</b> | <b>52</b>                                    |

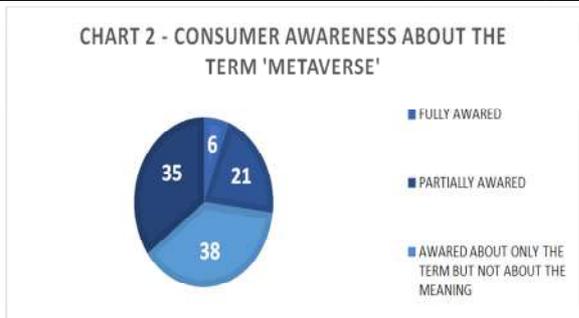




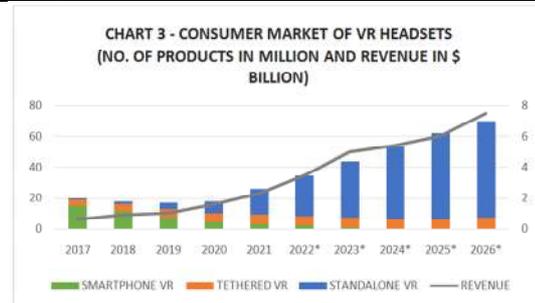
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Source - How The World Sees The Metaverse And Extended Reality, A 29-Country Global Advisor Survey By Ipsos in May 2022, www.ipsos.com

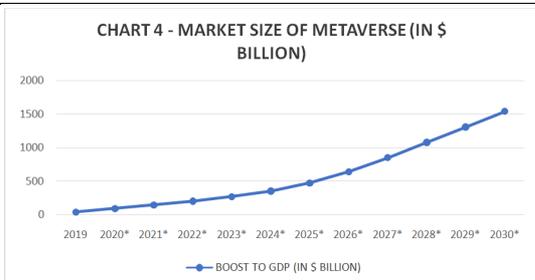


Source - www.gartner.com



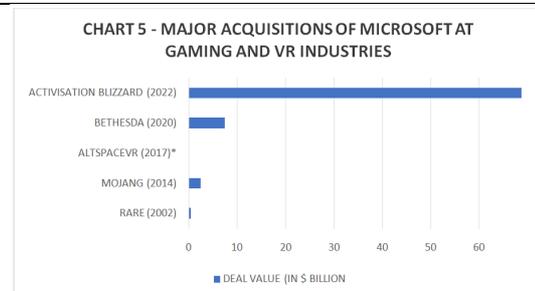
Note - \* Means Expected

Source – www.omdia.tech.informa.com



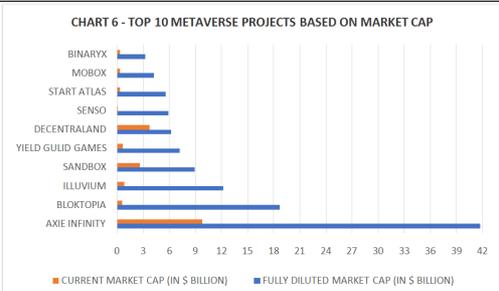
Note - \* refers to estimation

Source - pwc “seeing is believing” report, 2019, www.pwc.com

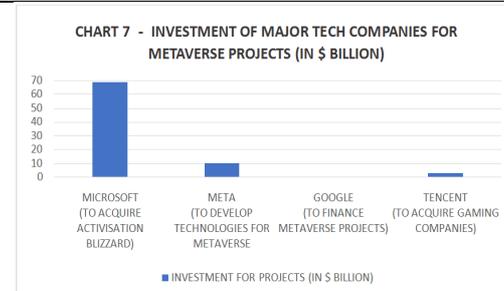


Note - \* refers that deal value wasn't disclosed

Source - www.visualcapitalist.com,, www.wikipedia.org



Source – News. Cryptorank. Io

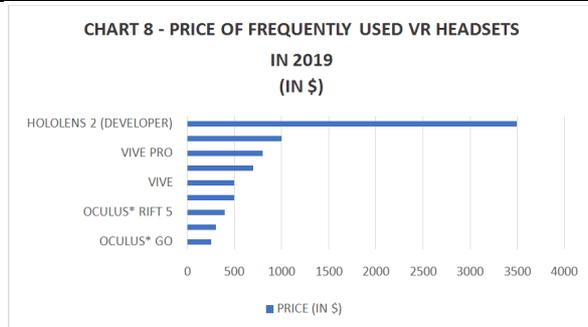


Source - www.spglobal.com, www.samco.in





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**Note - \* - oculus is renamed as reality labs and the products are prefixed with 'meta'**

**Source - www.statista.com, www.firstpost.com**





## Immediate Effect of Nordic Hamstring Curls and Neurodynamic Tensioner to Improve Hamstring Flexibility in Young Adults - Pilot Study

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### ABSTRACT

With increased sedentary lifestyle seen among young adults, focusing on their physical capability and health is important. Flexibility is foremost essential component for individual's fitness to escalate physical performance and activity. Studies have shown that hamstring tightness one of its commonest kind to focus on as it can lead to musculoskeletal injuries in form of strain, plantar fasciitis, altered lumbo pelvic rhythm, patello femoral pain syndrome. Study shows a prevalence of hamstring tightness among 18-25 age groups. To evaluate comparison of immediate effect on Nordic hamstring curls and neurodynamic tensioner to improve hamstring flexibility among young adults 20 subjects hamstring tightness meeting inclusion criteria are taken and randomized into two groups group A Nordic hamstring curls and group B neurodynamic tensioner. Pre and post outcome for immediate effect was taken for flexibility in form of active knee extension test and finger to floor distance test. Calculated using MS Excel windows 10 using unpaired, paired t test showed significant difference on hamstring flexibility after intervention. Thus we conclude that immediate effect of Nordic hamstring curls shows increase in hamstring flexibility compared to neurodynamic tensioner technique.

**Keywords:** hamstring flexibility, neurodynamic tensioner, Nordic hamstring curls, active knee extension test, finger to floor distance test.

### INTRODUCTION

Hamstring is a two-joint muscle which is located at the back aspect of the thigh and consists of semimembranosus, semitendinosus and two heads of biceps femoris, it helps for maintenance of posture, lumbo pelvic rhythm maintenance and plays



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pivotal role for other activities of daily living stair descent, sit to stand, and also it serves during jumping ,running activities.[1] Due to increased sedentary lifestyle seen among youths that includes prolonged sitting hours due to academics or job requirements hamstring are more vulnerable to tightness[2] Further focusing on their health and fitness plays a crucial part, a prevalence shows that is common at age group 18-25 years.[3]Moreover study determined 82% and common females than males [4]. Flexibility is ability of muscle for movement to occur at joint [5] most essential component that will escalate performance of an individual researches have shown that it is commonest kind to focus as it can results to altered lumbo pelvic rhythm, back pain, plantarfasciitis,patellofemoral pain syndrome and most commonest hamstring strain.[3]With poor flexibility results less torque of knee angle when compared to normal[5] Physiology behind states that muscle tightness is considered as decreased ability of muscle to deform which leads to reduced range available at the joint.[6]Hamstring tightness results to altered alignment of posture as it causes disturbed alignment in hip and knee also results to decreased length of muscle that can lead to posterior pelvic tilting increased lordotic curve that can result to low back pain [7].

There exist a connection between flexibility and risk of strains.[8]Hamstrings are more prone to develop injury during activities such as stair descending, jumping, running activity , among them biceps femoris commonest to get injured with fast running[9]eccentric training provides force more than concentric and also produces lengthening moreover eccentric training will result lengthening contraction phase and also during lengthening there will be less energy required by muscle thus it is considered to be efficient.[1] Nordic hamstring curls are eccentric type of exercises that helps to improve flexibility also reduce risk of injury. this is performed with subjects standing on his bent knees upright posture, arms crossed at chest and are asked to bent forward in the same position and therapist holds them at ankle [1].

Nordic curls there is generation of torque due slump trunk posture that leads to muscle length activity.[10] Tension in nerves, tightness, immobile structures are chief cause of reduced flexibility as well as injury to muscle[11],due to tightness lacking to perform straight leg raising involves nerves such as sciatic as results creates altered nerve dynamics and perception to stretch[12], Neurodynamic tensioner is one of contributor to hamstring flexibility, it has been reported that adhesions of sciatic nerve contribute to alter neurodynamic and mechano-sensitivity that limits length of hamstring muscle can also influence hamstring tightness [7]. Neurodynamic tensioner produces tension of nerve tissue as an adjunct to abnormal mechano-sensitivity. The subject is seated with a thoracic slump and head neck flexed and instructed to straighten his legs with head neck in extended. Active knee extension test by use of popliteal angle use to evaluate hamstring tightness by measuring lag with supine position and hip knee 90-90[13]Reliability of test 0.94[14]. Finger to floor distance test measure the flexibility of hamstring where subject in standing position is asking to touch floor without bending his knees. The reliability for test is 0.98.[14].

**MATERIALS AND METHODS**

This study was a comparative pilot study,24 subjects from Ahmedabad physiotherapy college were assessed for hamstring tightness and were recruited and divided into two groups where 4 subjects excluded from study as not able to perform the intervention . Group a Nordic hamstring curls group B: neurodynamic tensioner. With 10 subjects in each group. Inclusion criteria are Both male and females included age group 18-25, Individuals with popliteal angle lag of more than 20 degree, Individuals with b/l hamstring tightness. Exclusion criteria are recent fractures, injuries, surgeries, Spinal conditions acute listhesis, deformities, acute back pain, psychologically ill or non-cooperative patients. Outcome measures were active knee extension test that is Measurement for hamstring tightness in form of active knee extension test using popliteal angle (180°) where subjects were supine position hip knee 90-90 position were ask to straighten their knee up to feeling of discomfort or stretch and lag was measured by goniometer. Other outcome include finger to floor distance in which subjects were standing on stool of 20 cm and were ask to try to touch floor up to feeling of stretch and without bending their knees and distance is measured by help of measurement tape. Intervention group A: Nordic hamstring curls 3 session 7 rep where individuals have to be in kneeling position with body upright and place their hands cross pattern on their chest and therapist will hold their





ankles ask them to lower trunk towards floor without bending their hip joint and pre and post outcome in form of active knee extension test and finger to floor distance measured, group B: were given neurodynamic tensioner, individuals are in high sitting position, cervical spine extension, flexion of both knees and ask to maintain thoracic slump therapist passively extend spine with knee extended foot dorsiflexion hold for 60 secs, 10 sec rest 5 rep and pre and post outcomes for active knee extension test and finger floor distance measured.

## RESULT

A pilot study with 20 young adults meeting inclusion criteria were taken and were divided randomly in 2 groups by giving intervention in form of Nordic hamstring curls and neurodynamic tensioner parametric test in form of paired t test for intra group and unpaired t test in form of inter group comparison were given at  $p < 0.05$  moderate significant,  $p < 0.1$  as weak significant. Table 1 shows mean age and gender both groups, Table 2 paired t test for active knee extension test, Table 3 shows paired t test for both groups for finger floor distance test, Table 4 unpaired t test for active knee extension test, Table 5 shows unpaired t test for both groups for finger floor distance test.

## DISCUSSION

Purpose of this study was to see immediate effect of Nordic hamstring curls on young adults to improve hamstring flexibility and to compare immediate effect of Nordic hamstring curls and neurodynamic tensioner to improve hamstring flexibility in young adults. Results of study showed that In both groups intra group comparison by paired t test, showed a significant difference pre post outcome While during intergroup comparison of post outcomes active knee extension test on right leg and finger floor distance test showed significance. Group A were given Nordic curls where intra group shows right leg 63.7, 55.4 and 62.4, 54 for active knee extension test and finger floor distance for pre and post 41.05, 34.45 Seethalet.al(2018) taken 40 subjects, and were randomized into group a Nordic hamstring curls 5 weeks, group b conventional treatment, outcomes were seat reach test, modified sphygmomanometer test, sit stand test where they concluded that there was significant difference in flexibility, endurance, strength in this they stated that due to repetition of hamstring curls it results to eccentric contraction, which leads to changes optimal length muscle fibres[1]. So in our study findings for Nordic curls to improve hamstring flexibility were similar as of seethalet.al difference was that we have evaluated immediate effect for flexibility and also outcome measures were also different. In group B neurodynamic tensioner pre post right leg 67, 63.7 and left 64.7, 60.1 for active knee extension test and finger floor distance for pre and post 43.74, 41.1. Jin yong lim et.al(2021) in their study on immediate effect taken 20 males and randomized into two groups where group A were given sliding and group B was given tensioner technique, outcome taken was active knee test and they concluded that sliders were more effective compared tensioner during forward bending they stated that tensioner technique cause an increase in mechanosensitivity which results to protective contraction of hamstring while sliders decrease mechanosensitivity leads lengthening and improve hamstring flexibility [15] So findings in our study was similar for tensioner technique as of jin yon glim et.al study . Thus in this study when both groups were compared A and B more improved scores for AKE, FFD test was found in group A as Nordic hamstring curl are eccentric exercise helps to lengthen muscle.

## CONCLUSION

Thus we conclude that immediate effect of Nordic hamstring curls more effective than neurodynamic tensioner to improve hamstring flexibility in young adults. This study had little limitation as there was no follow-up of subjects, no warm-up session was given, and Males were less in this study. Future recommendation for this study can be by taking more subjects and can go with same study; also one can compare long term effect of these groups.

## CONFLICT OF INTEREST: Nil





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**Table 1 Mean age and gender**

|              | GROUP A    | GROUP B   |
|--------------|------------|-----------|
| AGE          | 22.2±1.751 | 22.7±1.49 |
| GENDER (M/F) | 3/10       | 2/10      |

**Table 2: active knee extension test of group A and group B**

| GROUP A NORDIC HAMS CURLS | ACTIVE KNEE EXTENSION TEST | MEAN±SD    | T VALUE | P VALUE |
|---------------------------|----------------------------|------------|---------|---------|
|                           | PRE RIGHT LEG              | 63.7±8.642 | 14.85   | <0.05*  |
|                           | POST RIGHT LEG             | 55.4±8.592 |         |         |





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|                                       |                |             |       |         |
|---------------------------------------|----------------|-------------|-------|---------|
|                                       | PRE LEFT LEG   | 62.4±7.412  | 6.77  | < 0.05* |
|                                       | POST LEFT LEG  | 54±9.967    |       |         |
| GROUP B<br>NEURODYANMI<br>C TENSIONER | PRE RIGHT LEG  | 67±11.146   | 12.67 | < 0.05* |
|                                       | POST RIGHT LEG | 63.7±11.334 |       |         |
|                                       | PRE LEFT LEG   | 64.7±11.176 | 10.77 | <0.05*  |
|                                       | POST LEFT LEG  | 60.1±10.939 |       |         |

Table 3 Intragroup comparisons of both groups for finger floor distance test

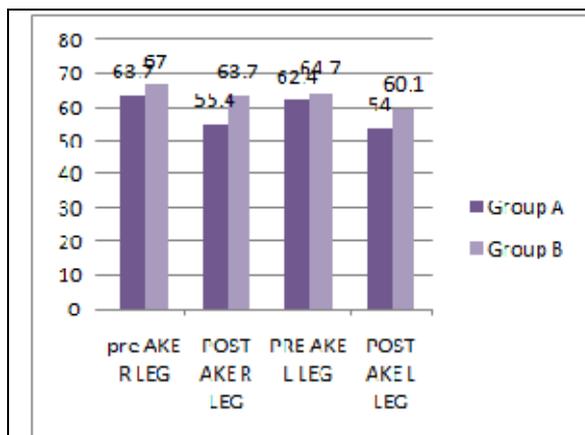
| GROUP A NORDIC<br>HAMS CURLS         | FINGER FLOOR<br>DISTANCE TEST | MEAN±SD    | T VALUE | P VALUE |
|--------------------------------------|-------------------------------|------------|---------|---------|
|                                      | PRE                           | 41.05±7.30 | 8.937   | < 0.05* |
|                                      | POST                          | 34.45±6.81 |         |         |
| GROUP B<br>NEURODYNAMIC<br>TENSIONER | PRE                           | 43.74±6.33 | 8.421   | < 0.05* |
|                                      | POST                          | 41.1±6.21  |         |         |

Table 4 comparing both groups for active knee extension test

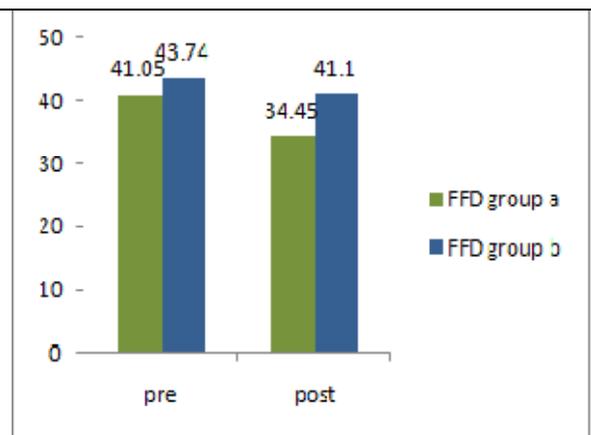
| ACTIVE KNEE<br>EXTENSION TEST |                   | MEAN ±SD   | T VALUE | P VALUE  |
|-------------------------------|-------------------|------------|---------|----------|
|                               | RIGHT LEG GROUP A | 55.4±8.642 | -1.845  | < 0.05*  |
|                               | RIGHT LEG GROUP B | 63.7±11.33 |         |          |
|                               | LEFT LEG GROUP A  | 54±9.96    | -1.303  | < 0.05** |
|                               | LEFT LEG GROUP B  | 60.1±10.93 |         |          |

Table 5. comparing both groups for finger floor distance test

| FINGER FLOOR<br>DISTANCE TEST |         | MEAN±SD    | T VALUE | P VALUE |
|-------------------------------|---------|------------|---------|---------|
|                               | GROUP A | 34.45±6.81 | -2.200  | < 0.1*  |
|                               | GROUP B | 41.1±6.21  |         |         |



Graph 1. intra group for both groups for AKE test

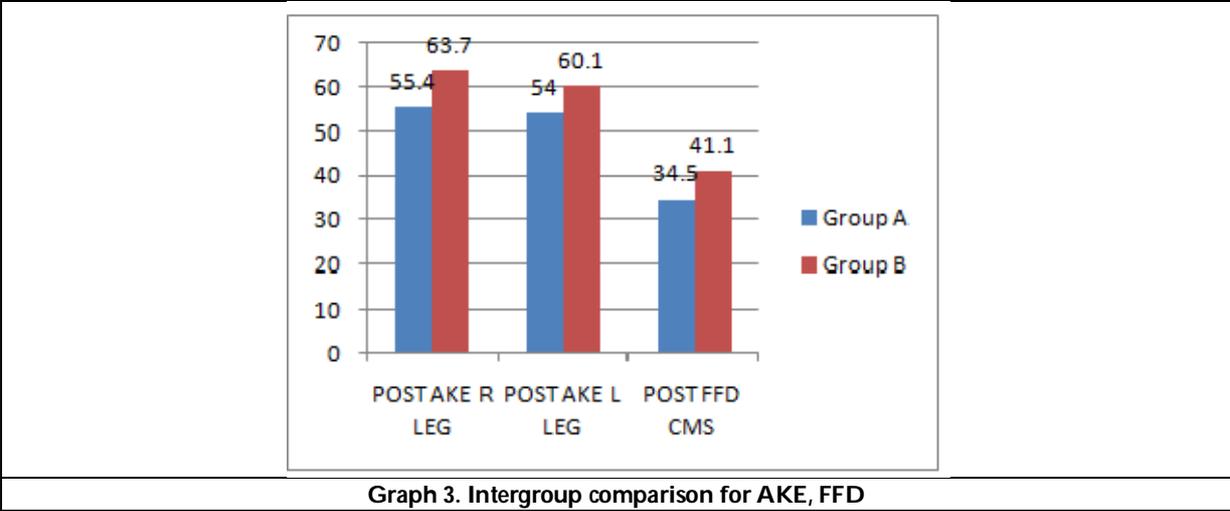


Graph 2. intra group for both groups for FFD test





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## A Study on the Impact of Digital Nudging on Investment Behaviour of It Professionals

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### ABSTRACT

The article throws light on the nudging behavior of IT professionals on Investment. IT people have the choice of choosing their investment option. They may choose on various bases and also environment have major impact on the Investment Decision. The various advantage and disadvantages are discussed in the basis of questionnaire collected from 140 IT professionals in and around Chennai. The collected questionnaire is analysed through various statistical tools and conclusion is also derived.

**Keywords :** Digital, Nudging, Investment, Behavioral Economics, Return and Risk

## INTRODUCTION

The main study is to concentrate and explore about the investment choices and their options for choosing the best option. A decade back investment option given to salaried people was very less and their need for investment also was very minimal. But at the current situations, we have numerous number of options and also the reason for investing varies from individual to individual. Before going to explore the behavior, first let us understand the concept of Nudging. It is a famous term in Behavioural Economics. Though we have an intention to do certain things, some situation or option make us to or force us to change the perspective of doing the planned thing. This may result in the positive outcome or negative outcome also. When we have less option or no option we make the decision much faster and also very effective. When the options are more and we have more choices then automatically we are forced with the impact, suggestion, decision making and so many issues. The same nudging behavior relating to Investment of IT professional is taken as the crux of the article





## Kolammal and Nanthiga

### OBJECTIVES OF THE STUDY

- Choosing the better option from all the alternatives available
- Best return policy with the investment options and the return of investment.
- Minimal risk with the return and amount of return.
- Empower the types of investment for better outcome

### NEED OF THE STUDY

- To understand the market position and Economic pulse of Investment
- It helps to make proper decision on choosing the best choice
- It helps in privacy of the information and other personal details
- It also helps others to decide for their betterment.

### SCOPE OF THE STUDY

- The study is limited to IT Professionals in Chennai it can be extended for a better studies and result.
- The research is applied to 140 respondents, it can be expanded for more respondents in future

### RESEARCH METHODOLOGY

The sample is chosen from IT Professionals in and around Chennai. The sample method adopted is random sampling and the numbers of respondents are 140 samples. The statistical tools applied for the research:

- Fried man Test
- Chi – Square Test
- One Way Anova

### DATA ANALYSIS AND INTERPRETATION FRIEDMAN TEST

**Null hypothesis (H<sub>0</sub>):** There is no significant difference between the various factors for choosing the Investment Option.

**Alternatives hypothesis (H<sub>1</sub>):** There is significant difference between the various factors for choosing the Investment Option

**Inference:** There is a significant difference between the various factors for choosing the Investment Option

**Interpretation:** Economic Growth is ranked has the most important factor which as (mean rank of 2.44) and Finance from other banks is ranked has the least factor which as (mean rank as 5.35) choosing the various factors for Investment Option

### CHI SQUARE TEST-1 – Employee Motivation v/s Decision Making

**Null hypothesis (H<sub>0</sub>):** There is no significant association between Employee Motivation and Decision Making.

**Alternatives hypothesis (H<sub>1</sub>):** There is significant association between Employee Motivation and Decision Making.

#### Interpretation

There is moderate association between Employee Motivation and Decision Making.

### ONE WAY ANOVA TEST-1 - Investment choice and IT Professionals

**Null hypothesis (H<sub>0</sub>):** There is no significant difference between Investment choice and IT Professionals

**Alternatives hypothesis (H<sub>1</sub>):** There is significant difference between Investment choice and IT Professionals

#### Inference

There is significant difference between Investment choice and IT Professionals





### Kolammal and Nanthiga

#### ONE WAY ANOVA TEST-2 – Digital Nudging and IT Professionals

**Null hypothesis (H<sub>0</sub>):** There is no significant difference Digital Nudging and IT Professionals

**Alternatives hypothesis (H<sub>1</sub>):** There is significant difference between Digital Nudging and IT Professionals

**Inference**

There is significant difference between Digital Nudging and IT Professionals

#### INDEPENDENT SAMPLE T TEST- Digital Investment and Nudging

**Null hypothesis (H<sub>0</sub>):** There is no significant difference between Digital Investment and Nudging

**Alternatives hypothesis (H<sub>1</sub>):** There is significant difference between Digital Investment and Nudging

**Inference**

There is significant difference between Digital Investment and Nudging

### CONCLUSION

From the research we are able to conclude that due to more options and choices available the choice of selection should be made apt and also after proper scrutiny. The environment and the situation of investment pave way for the Nudging behavior. The article also made us to understand that not only individual behavior but also economic condition and peer group thought provoke the investment pattern, choices and process.

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**Table 1 Ranks**

| RANKS                              |          |
|------------------------------------|----------|
| FACTORS                            | MeanRank |
| Interest Rate                      | 2.69     |
| Economic Growth                    | 2.44     |
| Confidence / Trust                 | 4.28     |
| Technological Development          | 2.75     |
| Availability of Finance from banks | 5.35     |
| Others                             | 3.49     |





**Kolammal and Nanthiga**

**Table 2. Test Statistics<sup>a</sup>**

| Test Statistics <sup>a</sup> |         |
|------------------------------|---------|
| N                            | 134     |
| Chi-Square                   | 245.244 |
| df                           | 5       |
| Asymp.Sig.                   | .000    |

Pvalue =0.000

Since

pvalue is < 0.05 Since Reje

ct null hypothesis

**Table 3. Employee Motivation and Decision Making.**

| Employee Motivation and Decision Making. |                     |                         |         |      |       |
|--|---------------------|-------------------------|---------|------|-------|
| Cross tabulation                         |                     |                         |         |      |       |
| Count                                    |                     | Type of Decision Making |         |      | Total |
|  |                     | Interest                | Secured | Safe |       |
| Type of Employee Motivation              | Core group          | 24                      | 18      | 0    | 42    |
|  | Known Investors     | 16                      | 18      | 0    | 34    |
|  | Known Company       | 28                      | 2       | 7    | 37    |
|  | Collaborative group | 10                      | 8       | 0    | 18    |
|  | others              | 5                       | 0       | 4    | 9     |
| Total                                    |                     | 83                      | 46      | 11   | 140   |

**Table 4. Chi-Square Tests**

| Chi-Square Tests             |                     |    |                                   |
|------------------------------|---------------------|----|-----------------------------------|
|                              | Value               | Df | Asymptotic Significance (2-sided) |
| Pearson Chi-Square           | 48.742 <sup>a</sup> | 8  | .000                              |
| Likelihood Ratio             | 53.078              | 8  | .000                              |
| Linear-by-Linear Association | 1.133               | 1  | .287                              |
| No of Valid Cases            | 140                 |    |                                   |

**Table 5. Symmetric Measures**

| Symmetric Measures |                         |       |                          |
|--------------------|-------------------------|-------|--------------------------|
|                    |                         | Value | Approximate Significance |
| Nominal by Nominal | Phi                     | .590  | .000                     |
|                    | Cramer's V              | .417  | .000                     |
|                    | Contingency Coefficient | .508  | .000                     |
| No of Valid Cases  |                         | 140   |                          |

P value=.000

Since p value is < 0.05 Null hypothesis is rejected.

Cramer's V=.417





**Kolammal and Nanthiga**

**Table 6. ANOVA**

| ANOVA                      |                |     |             |       |      |
|----------------------------|----------------|-----|-------------|-------|------|
| Type of Investment Choices |                |     |             |       |      |
|                            | Sum of Squares | df  | Mean Square | F     | Sig. |
| Between Groups             | 8.517          | 11  | .774        | 2.011 | .033 |
| Within Groups              | 46.983         | 122 | .385        |       |      |
| Total                      | 55.500         | 133 |             |       |      |

P value = 0.042 Since P value < 0.05

Null hypothesis is rejected.

**Table 7. ANOVA**

| ANOVA                                    |                |     |             |       |      |
|--|----------------|-----|-------------|-------|------|
| How long are you planning for Investment |                |     |             |       |      |
|  | Sum of Squares | df  | Mean Square | F     | Sig. |
| Between Groups                           | 24.032         | 10  | 2.403       | 8.493 | .000 |
| Within Groups                            | 36.503         | 129 | .283        |       |      |
| Total                                    | 60.536         | 139 |             |       |      |

P value = 0.000 Since P value < 0.05

Null hypothesis is rejected

**Table 8. Independent Samples Test**

| Independent Samples Test |                             |   |      |                              |        |                |                 |                       |   |        |
|--------------------------|-----------------------------|---|------|------------------------------|--------|----------------|-----------------|-----------------------|---|--------|
|                          |                             | Levene's Test for Equality of Variances |      | t-test for Equality of Means |        |                |                 |                       |   |        |
|                          |                             | F                                       | Sig. | t                            | df     | Sig.(2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference |        |
|                          |                             |   |      |                              |        |                |                 |                       | Lower                                     | Upper  |
| <b>Nudging</b>           | Equal variances assumed     | 1.059                                   | .305 | -5.139                       | 132    | .000           | -1.760          | .343                  | -2.438                                    | -1.083 |
|                          | Equal variances not assumed |   |      | -4.939                       | 81.996 | .000           | -1.760          | .356                  | -2.469                                    | -1.051 |

P value = 0.000

Since P value < 0.05

Null hypothesis is rejected





## Energy Storage Devices for Renewable Solar Energy: An Overview

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### ABSTRACT

The invention and technology development should always friendly adhere to the society and the environment. As we are at the end of the fossil fuel era, world technologies are focusing on energy security to avoid an energy crisis. Since solar energy originates in about 1970 much research about the main conversion technologies and not much about storage methods, if very few. Energy storage systems (ESS) are essential in the case of solar energy because of its intermittent and stochastic nature. Moreover, the self-dependency of a standalone system mainly depends on its energy storage device, also the energy storage improves the energy autonomy at the distribution side. Many storage devices are here: In this review article, we summarize the state of the art of EME, Fly Wheel Energy Solar System, Electrochemical Storage devices, Batteries, Lead acid storage devices, Capacitors, Super Capacitors. Nevertheless, of availability and steady of solar radiations, storage methods will become significant research technologies in solar energy processing. Whether it is a standalone system or a grid-connected one, the quality of continuous power supply for sensitive loads mainly depends on the types and rating of the storage systems. Each storage method consists of its merits and demerits.

**Key words:** Conservation of energy, Energy autonomy, Energy storage device, Standalone system, Super capacitor, Renewable energy.





## INTRODUCTION

In the topic as renewable energy sources, solar and wind energy consumptions a larger portion of energy production next to hydrothermal. Batteries are energy storage materials known for its Stand – alone power system for providing electricity in remote areas too. In general, whenever the solar energy system generates more power than the actual requirements, it must be stored or convey to the grid [1]. Based on its usage it may be classified into stand alone or grid connected solar system. The energy storage systems are so much important as it affording backup, save economic expenditure by eliminating peak demand tariffs and extend capacity of the grid. Commercially available with long half – cycle storage such as backup grid power and appropriate functionalities [2-7]. Similar to a coin, the fossil fuel energy conversion has two big issues, one is rapid depletion rate and the other is harmful environmental impacts. Whereas the promising alternatives are non-polluting renewable energy sources. At present, Globally India reached fifth position in renewable energy installed capacity with renewable installed capacity increased unbelievably 226%. Among all other renewable resources solar energy is one of the most important sources easily and plentifully available in the earth. The revolution taking place in the semiconductor industry gives so many useful devices like solar cells which are the basic building block of solar panels. It can convert photonic energy of the sunlight into electricity through a process called the photovoltaic effect. In this review article, each storage devices, its chemistry components, applications and recent developments with its challenges are well explained.

### Types of Solar Power System

To meet the higher amount of energy requirements, more number of solar panels are connected together and hence a solar array is formed. Based on the usage, the solar system is classified into three main categories. Solar photovoltaic system(PV), Solar thermal system(T), Hybrid system(PV/T). Solar energy may be directly converted into electricity through the photovoltaic process and known as solar photovoltaic system (PV). At some places, based on the need where the solar energy is directly converted into required heat energy and known as solar thermal system (T). It is possible to convert the solar energy into heat energy and further converted into electricity using an integrated system which is popularly known as hybrid (PV/T) system [8].

### Parts of PV system

In general, the important components of solar PV system are solar panels, inverters and energy storage systems are major research areas.

### Energy storage System

The important storage methods used in conjunction with solar energy systems are as follows;

- ✚ Electromechanical electrical energy
- ✚ Flywheel energy storage systems
- ✚ Electrochemical energy
- ✚ Battery energy storage system
- ✚ Lead Acid storage batteries
- ✚ Capacitor and super capacitor storage system
- ✚ Electromagnetic super conductor magnetic energy storage (SMES).

The study includes the efficiency, initial costs, advantages, and disadvantages of the storage systems as listed above. In addition to safeguard the environment, life cycle assessments (LCA) are required in developing new methods of storage of solar energy. IEA's renewable global market report forecasts that the world's total renewable-based power capacity will grow by 50% between 2019 and 2024. This increase of 1,200 gig watts – equivalent to the current total power capacity of the United States – is driven by cost reductions and concerted government policy efforts. Solar PV accounts for 60% of the rise. The share of renewable in global power generation is set to rise from 26% today to 30% in 2024. Uninterrupted power supply to critical consumers, Stable operation of substations weakly connected to the



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power supply system, Smoothing of abruptly variable (impulse) load on the power system, Frequency control in the power system. Such an energy storage unit may be either a static or an electromechanical device [9].

**Electromechanical electrical energy**

Energy storage system (ESS) can be integrated in to conventional generators and solar power system. In the first case ESS provides peak load handling capacity of the grid where as in the second case it is used to meet out the base load during night and seasonal day times where sun light is not sufficient to produce the required electricity. Hence ESS is very much important for the solar power system as a standalone independent grid freedom power system. Among all ESS the electromechanical energy storage system (EMES) is versatile and controllable one. This EMES consists of two types of power storage as given bellow; Pumped water storage (PWS), Compressed air energy storage (CAES)

**Pumped water storage (PWS)**

The excess energy is used to pump the water from lower level to higher level and hence stored in the form of potential energy. During high demand periods, this stored potential energy is converted into required electrical energy through hydro electric generators. Hence this system of storage requires two water reservoirs probably one at higher altitude known as upper reservoirs, and another at lower altitude known as lower reservoirs. In addition to this two reservoirs reversible pump-turbine, motor-generator set are also required. Where the natural falls and stored water bodies are available in surplus, this technology gives 65-80% efficiency. But the cycle efficiency is limited one whereas it is the ratio of output energy to input energy during one round trip that is successive charging and discharging. The pumped water storage system further classified into two types based on the natural water flow of the reservoirs. viz. Open loop pumped water storage, Closed loop pumped water storage

**Compressed air energy storage (CAES)**

In this method of energy storage system, the off-peak power is used to save in the underground reservoirs as a pressurized air which can be converted into useful electricity during peak hours through turbine-generator set. The energy density and efficiency of the system is 12 kWh/m<sup>3</sup> and 70 % respectively. In 1978 the first operating unit of 290 MW is developed at Huntorf, Germany. The second unit of 110 MW unit constructed at McIntosh, Alabama in 1991. Nowadays small-scale compressed air energy storage (SCCAES) systems are attractive to overcome the large area problems. Further researches are going on storage of compressed air at high pressure in a cylinder instead of underground reservoirs to meet small scale applications.

**Flywheel energy storage systems**

Fly wheel energy storage can cope up with transient voltage drop and be an effective system of energy storage. It is used super conductor and hence its life time is increased with higher efficiency and high energy density. High energy density means ratio of energy generation to space required. Hence this system is suitable for space satellite and hybrid electric vehicles [10]. The important components of EMES are as follows; 1. Flywheel 2. Electromechanical network adapter 3. Electrical machine 4. Frequency converter. When generation of energy is more than the actual demand, the excess energy is stored in the flywheel as in the form of kinetic energy. An electromechanical network adapter is used to extract and convert the flywheel energy. The main functions of network adapter are given as to ensure the starting and regenerative braking, to variable speed operation of the flywheel for felicitating different mode of operations, to transport active power in dual directions, to adequate generation and /or consumption of required reactive power, to ensure minimum amount of distortions in voltage and current through proper damping, to ensure stable operation of the EMES even during disturbances either from supply side or from the load side, to maintain the rated voltage at the connection unit.

The electrical machine used in flywheel energy storage system (FESS) is basically a motor generator set that too single rotor sandwiched between two stators. Each stator consists of three phase distributed copper winding. The structure of FESS is shown in Figure. Eight pairs of electromagnets embedded over the circumference and allow rotor to rotate in the hollow center. The motions of rotor in this case consist of both spinning as well as axial





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displacement. This should be properly balanced by incorporating a synchronizing controller and also the external disturbances nullified [11].

#### Electrochemical energy storage device

Electricity generated from solar power can be efficiently stored in and released from rechargeable batteries and electrochemical capacitors.

a) The major electrochemical reaction completes by the two electrodes, electrolyzers and the electrolyte transport the ions. The stored electric power can be converted into fuels by electrozyers and further generated by fuelcells. In general, two electrochemical principles are followed stored energy. Physical Method: Conduction of electricity through electrons or ions. Electro chemical method: Conduction of electricity through redox reactions and catalytic activity. Many activated materials can be used as energy storage device to enhance the energy storage. Carbon materials, Porous materials, Graphite materials, Active nanoparticles, Green materials, Active electrolyte material, (KOH Ac) [12,13] The activated porous materials and nanoparticles also enhance the surface area. Super capacitors and batteries have also been proven, with all these types. [14]

#### Carbon Materials

##### Graphite

Carbon is the most versatile material for synthesizing surface activated nanomaterials. All the allotropes of carbon acts as surface modified materials to act as energy storage materials. Naming some, 1. Crystalline carbon 2. Graphite & diamond 3. Polyacrylonitrile – Carbonfibres (polycrystalline Carbon) 4. Activated carbon & carbon black (amorphous carbon) [15]. From the precursor, manufacturing methods, to the end of life, the whole life cycle of carbon renders a successful reinforcement agent to the energy storage applications.

Graphite serves as best energy storage devices for portable electronic and electric vehicles. It is the widely used anode material for commercial lithium – ion batteries. The drawbacks of lithium ion batteries such as poor energy storage capacity to run electrical vehicles, responsibility in grid energy storage, poor power density, poor energy density are directly addressed by the intrusion of Graphite as anode in the lithium ion batteries.

#### Intrusion of Natural fibres into carbon:

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**Saraswathi and Kanimozhi****Electromechanical electrical energy**

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**Carbon as a source from waste materials banana peels.**

Due to the possession of multilayered porous structure banana peels exhibit superior electrochemical performance. These porous structured materials are further subjected to sulfur activation and used in the production of Lithium-Sulfur batteries. Like this many bio waste materials are used in the construction package of energy storage vehicles. They are listed as i) Agricultural crops- Rice, Wheat, Sugarcane, Millets, Groundnut, Coconut, Maize, Cloves and their respective shells and husks (residues) ii) Woods and wood wastes iii) municipal wastes & animal wastes iv) Aquatic plants and algae contribute theirrole in the storedevices [20 -24].

**Bio Waste Materials**

Photosynthesis process taking place naturally is the basic idea for this articles and research ideas that solar energy is stored as chemical energy in the plants and during the process it released in the required amounts. Keeping this in mind, all the bio-waste materials / bio sourced materials are used as electrochemical conversion or energy storage devices. Second advantage, undergoing heat treatment / pyrolysis treatment of biomaterials, the inbuilt nature of high specific area and rich porosity widely used for gas separation, water purification, catalyst supports electrodes for super capacitor and fuel cells [8,24].

**The basic source of idea bloom:**

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#### Carbon as a source from waste materials banana peels.

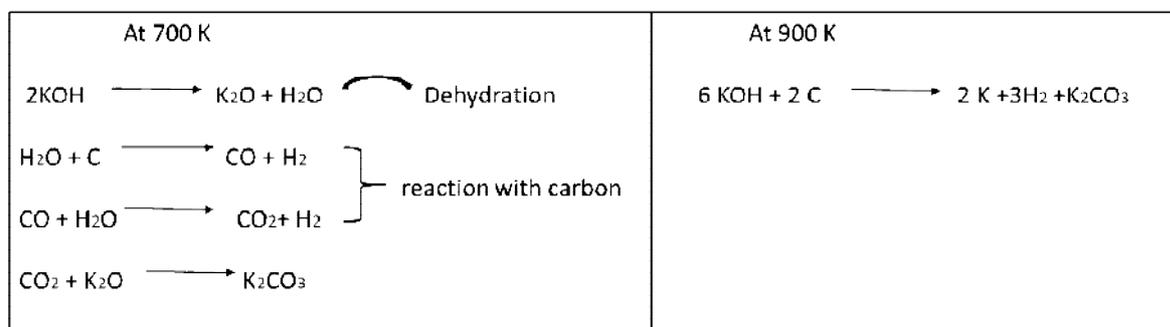
Due to the possession of multilayered porous structure banana peels exhibit superior electrochemical performance. These porous structured materials are further subjected to sulfur activation and used in the production of Lithium-Sulfur batteries. Like this many bio waste materials are used in the construction package of energy storage vehicles. They are listed as i) Agricultural crops- Rice, Wheat, Sugarcane, Millets, Groundnut, Coconut, Maize, Cloves and their respective shells and husks (residues) ii) Woods and wood wastes iii) municipal wastes & animal wastes iv) Aquatic plants and algae contribute their role in the storage devices [20 -24].

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#### Subjection of KOH

To this KOH when we subject activation sites, we increase their pore size and surface area. This KOH activation starts from a solid- solid reactions, till that the potassium compound is eventually reduced to metallic potassium. Usually KOH electrolyte reaction proceeds with low temperature, below 1000 K, along with activated carbon.



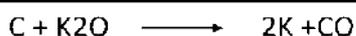
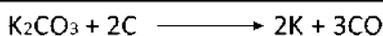
After obtaining  $\text{K}_2\text{CO}_3$  the temperature is raised to 1000 K which readily decomposes  $\text{K}_2\text{O}$  and  $\text{CO}_2$ .



Due to the high temperature,  $\text{CO}_2$  also undergoes the absorption of coke to give CO.



Direct Reaction: (Overall reaction)



The reaction between the potassium compounds  $\text{K}_2\text{CO}_3$  and  $\text{K}_2\text{O}$  are the chemical activation reactions between the activated porous carbon. The resulting potassium (metal) diffuses into the activated porous carbon lattice matrix.



**Saraswathi and Kanimozhi****Metalorganic Frameworks (MOF)**

Inorganic materials are used to store electrochemical energy and in the conversion technologies. MOF related materials acts as electrode materials for rechargeable batteries, electrochemical capacitors, efficient electrocatalyst, even electrolytes for electrochemical devices. MOF behaves as porous materials which generated a lot of interest by inserting variety of metal-nodes, organic ligands & connectivity. More than 20000 different MOF's have been reported till 2013 especially first-row transition metals of Fe, Co, Ni, Mn, etc., MOFs containing redox-active metal centers, are of particular interest for delivering the electrochemical activity. Compared to conventional inorganic and polymeric functional materials, MOFs strengthen their advantages, such as *fully accessible organic molecule-coordinated metal sites and easily tunable pore structures*.

a) electrode materials for rechargeable batteries b) electrode materials for electrochemical capacitors c) efficient electro catalysts for fuel production and utilization d) even electrolytes for electrochemical devices, e) Photocatalysis & electrocatalysis devices f) Energy storage devices. On the other hand, to overcome the limitations of insufficient electronic conductivity and chemical stability of most pristine MOFs, MOFs are converted into metal compounds, by reinforcing with *carbonaceous materials*, [25]. MOF-derived functional materials usually exhibit outstanding returns originating from their microstructures/nanostructures, showing great potential for energy related technologies.

**Super capacitors**

Supercapacitors, also called ultra-capacitors or electrochemical capacitors, have emerged as promising energy storage devices for electronic devices and electric vehicles due to their excellent power density, outstanding pulse charge-discharge performance, superior lifespan and low maintenance cost [26]. Capacitance is determined by two storage principles, double-layer capacitance and pseudo-capacitance[27]. A capacitor stores energy by means of a static charge as opposed to an electrochemical reaction. Touching an object releases the energy through the finger.

Super capacitors bridge the gap between conventional capacitors and rechargeable batteries. They store the most energy per unit volume or mass (energy density) among capacitors. They support up to 10,000 farads/1.2 Volt,[28] up to 10,000 times that of electrolytic capacitors, but deliver or accept less than half as much power per unit time (power density), [29]. While supercapacitors have specific energy and energy densities that are approximately 10% of batteries, their power density is generally 10 to 100 times greater.

**Working Principle**

The super capacitor also known as the condenser has two parallel plates with a bigger area. But the difference is, the distance between the plates is small. The plates are made up of metals and soaked in electrolytes. The plates are separated by a thin layer called an insulator. When opposite charges are formed on both sides of the insulator an electric double layer is formed and the plates are charged. Hence the supercapacitor is charged and has higher capacitance. These capacitors are used to provide high power and enable high load currents with low resistance. Capacitors stored the energy in a medium of electrostatic field between their plates. Due to the potential difference occurs at the conductors, an electric field develops across the dielectric field, causing positive charge [+Q] to collect on one plate and negative charge [-Q] to collect on the other plate. If a battery is attached to a capacitor for a sufficient amount of time, no current can flow through the capacitor. However, if an accelerating or alternating voltage is applied across the leads of the capacitor, a displacement current can flow. Besides capacitor plates, charge can also be stored in a dielectric layer. Capacitance is greater given a narrower separation between conductors and when the conductors have a larger surface area. In practice, the dielectric between the plates emits a small amount of leakage current and has an electric field strength limit, known as the breakdown voltage[30].

**Super capacitors derived from biomass carbon materials**

To develop super capacitors with high power density, sustainable and high-performance electrode materials are synthesized from biomass and their derivatives [30,31]. Based on charge storage mechanisms, super capacitors can be grouped into two main categories: (i) electrical double layer capacitors, where electrostatic charge is accumulated at the electrode surface and (ii) pseudo-capacitors, where capacitance arises from the fast and reversible surface redox





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reactions at the characteristic potential. Carbon-based materials, transition metal oxides/hydroxides and conducting polymers have been regarded as the most promising materials for supercapacitors. It is noteworthy that carbon-based materials, ranging from conventional activated carbons to advanced nanostructured carbons (such as graphene and CNTs) have been widely used for supercapacitor electrodes because of their attractive physicochemical properties, such as high specific surface area, excellent chemical stability, eminent electronic conductivity and controllable porosity [32,33, 34]. The discussion for the development of an electrochromic super capacitor based on electro active tetraaniline-sulfanilic acid polysiloxane (TASA) and versatile Prussian blue (PB) is given below. The electrode was prepared through electrochemistry-assisted hydrolytic crosslinking reaction coupled with electrochemical deposition. The as-synthesized electrochromic TASA/PB electrodes exhibit high electrochromic performances with high optical contrast, acceptable coloration efficiency of  $92.7 \text{ cm}^2 \text{ C}^{-1}$ , and good switching durability. It also exhibits specific capacitances as high as  $273.4 \text{ F g}^{-1}$  at the current density of  $0.25 \text{ A g}^{-1}$ . The charge storage level (charged/discharged state) of the electrochromic supercapacitor based on TASA/PB electrode switches from green to blue, demonstrating the potential applications in energy storage and electrochromism for smart windows.

#### Application of Supercapacitors

Due to unique storage capability of supercapacitors, it has been widely used in various applications like electric drives, UPS, traction, electric vehicles, SSD's, LED flashlights etc.

#### Hybrid Buses

Transportation is the biggest market for supercapacitors. In India, at the end of the month, October 2017 BEST (Brihan Electric Supply and Transport) has introduced emission-free electric buses. During braking, back emf is produced by the motors. This back emf as regenerative energy is used to charge the supercapacitors. Supercapacitors as the combined solution with battery increase the life of the battery, reduce the size of the battery.

#### First Super capacitor Bus ( Fig.9)

#### Lead acid Storage Batteries

Lead batteries is traditional time-honored and is being successfully applied to utility energy storage. Lead-acid batteries are easily broken so that lead-containing components may be separated from plastic containers and acid, all of which can be recovered.

#### Working Principle of Lead acid storage Batteries

The lead acid storage battery is formed by dipping lead peroxide plate and sponge lead plate in dilute sulfuric acid. A load is connected externally between these plates. In diluted sulfuric acid the molecules of the acid split into positive hydrogen ions ( $\text{H}^+$ ) and negative sulfate ions ( $\text{SO}_4^{2-}$ ). The hydrogen ions when reach at  $\text{PbO}_2$  plate, they receive electrons from it and become hydrogen atom which again attack  $\text{PbO}_2$  and form  $\text{PbO}$  and  $\text{H}_2\text{O}$  (water). This  $\text{PbO}$  reacts with  $\text{H}_2\text{SO}_4$  and forms  $\text{PbSO}_4$  and  $\text{H}_2\text{O}$  (water).



$\text{SO}_4^{2-}$  ions are moving freely in the solution so some of them will reach to pure Pb plate where they give their extra electrons and become radical  $\text{SO}_4$ . As the radical  $\text{SO}_4$  cannot exist alone it will attack Pb and will form  $\text{PbSO}_4$ .





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As  $H^+$  ions take electrons from  $PbO_2$  plate and  $SO_4^{2-}$  ions give electrons to Pb plate, there would be an inequality of electrons between these two plates. Hence there would be a flow of current through the external load between these plates for balancing this inequality of electrons. This process is called discharging of lead acid battery [5]. The lead sulphate ( $PbSO_4$ ) is whitish in colour. During discharging, both of the plates are covered with  $PbSO_4$ . Specific gravity of sulfuric acid solution falls due to formation of water during reaction at  $PbO_2$  plate. As a result, the rate of reaction falls which implies the potential difference between the plates decreases during discharging process. After disconnecting the load connect  $PbSO_4$  covered with  $PbO_2$  plate with positive terminal of an external DC source and  $PbO_2$  covered with Pb plate with negative terminal of that DC source. During discharging, the density of sulfuric acid falls but there still sulfuric acid exists in the solution. This sulfuric acid also remains as  $H^+$  and  $SO_4^{2-}$  ions in the solution. Hydrogen ions (cation) being positively charged, move to the electrode (cathode) connected with negative terminal of the DC source. Here each  $H^+$  ion takes one electron from that and becomes hydrogen atom.



$SO_4^{2-}$  ions (anions) move towards the electrode (anode) connected with positive terminal of DC source where they will give up their extra electrons and become radical  $SO_4$ . This radical  $SO_4$  cannot exist alone hence reacts with  $PbSO_4$  of anode and forms lead peroxide ( $PbO_2$ ) and sulfuric acid ( $H_2SO_4$ ).



Hence by charging the lead acid storage battery cell, [36].

#### Lead-acid battery recycling

Lead is the most efficiently recycled commodity metal and in the EU and USA, more than 99% of lead-based batteries are collected and recycled in a closed loop system [37].

#### Bipolar lead-acid batteries

One of the most important components of a bipolar lead-acid battery is the bipolar plate. The following demands have to be fulfilled by the materials used for the bipolar plate: high corrosion stability, high electronic conductivity, high overpotential ( $H_2, O_2$ ), good adhesion of the active mass, low cost, easy to handle for good integration in the production process. In order to increase the power to energy ratio of lead-acid batteries to values required for hybrid vehicles, a bipolar design is invented. Many years back itself bipolar constructions have been researched, more recently many concepts are showing better promise of technical and commercial success. In a bipolar battery, apart from the end-plates, the plates have one side operating as the positive and the other as the negative separated by a membrane that is impervious, electronically conductive and corrosion resistant. For lead-acid batteries, the reliable edge seal around the membrane is impregnated with porous alumina on either side of the electrodes. 'Ebonex [Conductive titanium suboxides] has reasonable electronic conductivity and is inert in a lead-acid cell environment but as a membrane, the resistance is relatively high'. Silicon is semiconductor material, can be made sufficiently conductive to operate as a membrane in a bipolar lead-acid battery. Gridtential, USA. Lead sheet is an excellent membrane provided that it is sufficiently corrosion resistant and advanced Battery Concepts have a design which uses a polymer support for lead sheet. Battery performance data for this design show good results [36 - 38]. A successful bipolar lead-acid design would offer an attractive energy storage battery.

#### Electromagnetic super conductor magnetic energy storage (SMES).

Even though the super conducting phenomena were developed in 1911, its application in electric energy storage system has been implemented only since 1970. There are some other energy storage systems that are available like Pumped Storage hydroelectric system (PSHS), Battery Energy Storage System (BESS), and Superconducting Magnetic Energy Storage (SMES). Among which SMES finds attraction due to its fast response and high efficiency around 95% [39]. The main limiting factor of SMES is its operating temperature, which decides the cost and





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operating conditions of the superconductor. Nowadays low temperature superconductor (LTS) is available and research is going on to develop high temperature superconductor (HTS). The design of superconductor is rather complex and has consider some important points for a stable, reliable and economic design of coil, like, (i) Configuration, (ii) Energy capability, (iii) Structure, (iv) Temperature and (v) Energy to mass ratio. The voltage across a coil is given by

$$V_L = L \frac{di}{dt} \quad (6)$$

To store/release the required amount of electric energy in magnetic field many segments are designed as shown in Figure 8. As the breaker switch is closed, the SMES unit is temporarily disconnected from the system and when it is opened, the current flows into the multi segment coil, as a result the electrical energy is stored through the dc-dc chopper from the dc link. The stored energy can be retrieved by controlling the average voltage across the coil which in turn is controlled by the duty cycle of the chopper. The efficiency of this kind of energy storage is high nearly 95% and suitable for continuous operation[40,41].

## FUTURE WORK AND CONCLUSION

The purpose of this paper is to explore the available technologies for storing energy in the case of solar power generation. ESS is very much essential in the case of renewable energy generations especially for solar power generation because it can support the grid as well as brings freedom to any standalone system. These studies reviled that storage systems are one of the important concepts in upgrading power systems as an economic alternative. The micro grid emergence in the distributed grid system improves the system reliability at challenging the controllability. However, lots of ESS technologies are developed and its integration to the renewable energy generation system is the timely requirements. Enormous research looking forward for new ESS technologies to meet high demand with minimum generation cost and more cycle efficiency.

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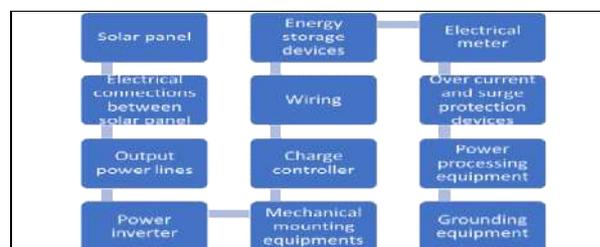
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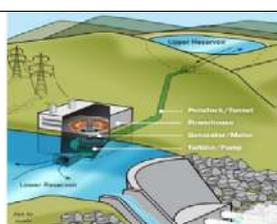


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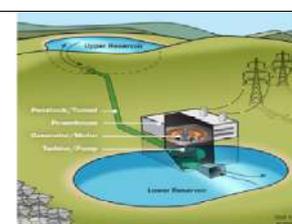
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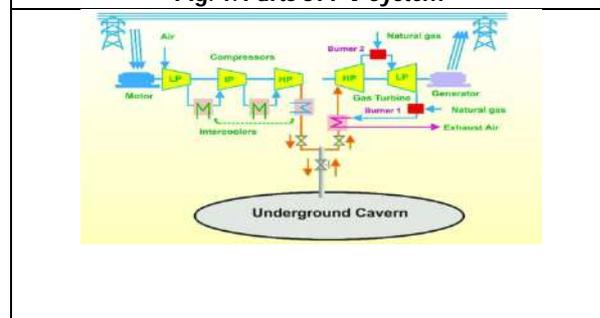
**Fig. 1. Parts of PV system**



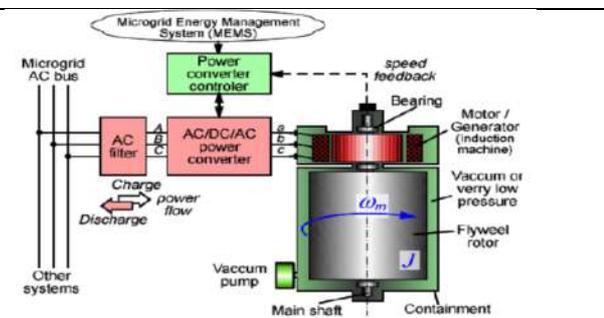
**Fig. 1 Open loop Pumped water storage system**



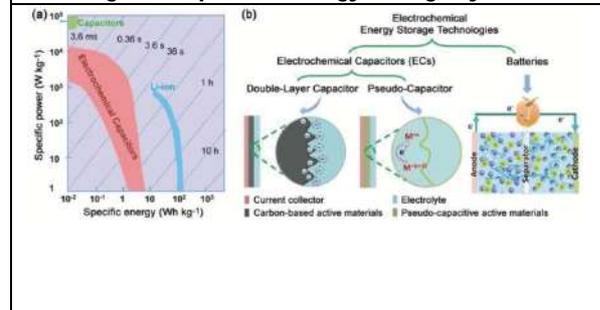
**Fig. 2 Closed loop Pumped water storage system**



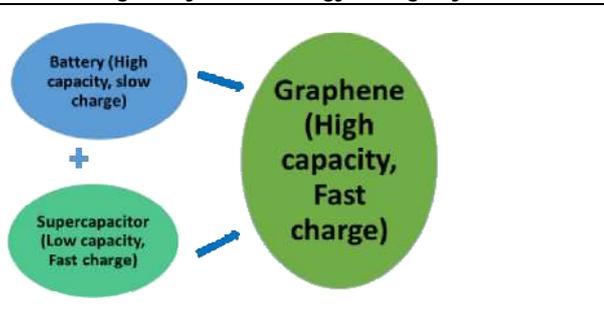
**Fig.3. Compressed Energy Storage System**



**Fig. 4. Fly wheel energy storage System**



**Fig. 5. Advanced Energy Storage Devices: Basic Online Library Wiley.com**



**Fig. 6. Graphite**





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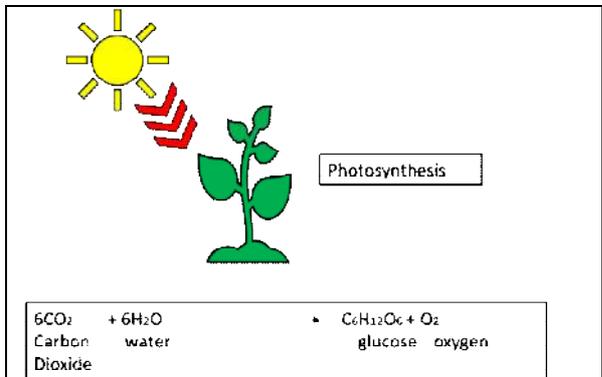


Fig. 7. The basic source of idea bloom

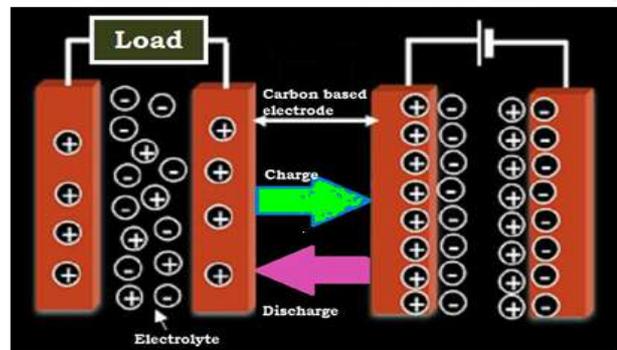
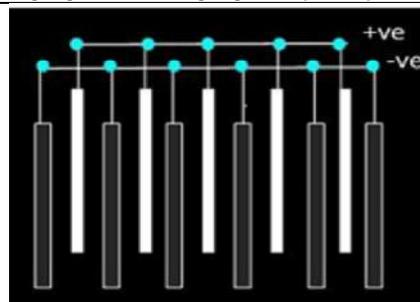


Fig. 8. Charging and recharging of super capacitor



Fig. 9. First Super capacitor Bus



Lead- Acid storage batteries

Fig.10. Lead-Acid Storage Battery



Fig. 11. Lead-acid battery recycling

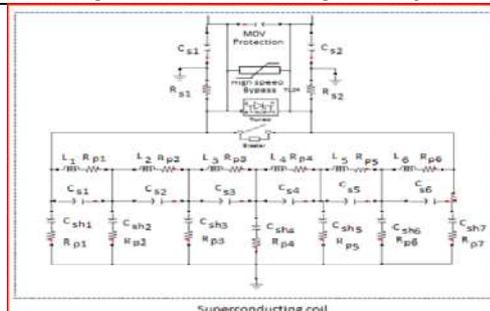


Fig. 12. SMES – Super conducting coil





## A Review on Perineal Talc use and Ovarian Cancer

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### ABSTRACT

Talc is a silicate, similar to asbestos that has been researched in relation to cancer risk. Over the last 25 years, several investigations have discovered a link between perineal talc powders and ovarian cancer. The summary relative risk is around 1.3 (95% confidence intervals 1.2–1.5), and these findings have been interpreted as supporting a causal involvement. Although talc and asbestos have certain structural similarities, the WHO's International Agency for Research on Cancer considers only asbestos to be causally linked to ovarian cancer. While understanding the different forms of asbestos and its oncologic biology is important, the history of asbestos' link to ovarian cancer is mostly dependent on retrospective observational research in women who worked in high-asbestos situations. Examine the chemical and morphological similarities and differences between talc and asbestos, and despite their chemical classification, talc does not have asbestos-like carcinogenic qualities. The International Agency for Research on Cancer's conclusion that asbestos has a clear causal inference to ovarian cancer must be called into doubt based on contextual misreading. This has significant clinical consequences in terms of how patients may be advised, as well as providing impetus to pursue study into the asbestos-ovarian cancer link. Talc is not a genotoxic substance. There is no evidence of a carcinogenic effect in mechanistic, pathologic, or animal model research. In conclusion, these findings do not support the hypothesis that cosmetic talc causes ovarian cancer.

**Keywords:** asbestos, mineralogy, ovarian cancer, pleurodesis, talc, pleurodesis



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## INTRODUCTION

Talcum powder is produced using powder, a mineral made up principally of the components magnesium, silicon, and oxygen. As a powder, it retains dampness well and making it valuable for keeping skin dry and assisting with forestalling rashes. It is generally utilized in superficial items, for example, child powder and grown-up body and facial powders, just as in various other shopper items.

In its normal structure, some powder contains asbestos, a substance known to cause problems:

- Regardless of whether ladies who apply baby powder routinely in the genital region have an expanded danger of ovarian disease.
- Regardless of whether individuals who have long haul openness to powder particles at work, like powder diggers, are at higher danger of cellular breakdown in the lungs from breathing them in [1].
- 

The relationship between perineal talc powder tidying and ovarian cancer was determined in 16 case-control studies (Cramer et al., 1982, 1999; Whittemore et al., 1988; Booth et al., 1989; Harlow and Weiss, 1989; Chen et al., 1992; Harlow et al., 1992; Tzonou et al., 1993; Purdie et al., 1995; Chang and Risch, 1997; Cook et al., 1997; Godard et al., 1998; Rosenblatt et al., 1998; Wong et al., 1999; Ness et al., 2000; Mills et al., 2004) and the Nurses' Health Study (Hankinson et al., 1993; Gertig et al., 2000). The summary relative risk for these studies in a meta-analysis (excluding Mills et al., 2004) is 1.33 [95% confidence intervals (CIs) 1.16–1.45] (Gross and Berg, 1995; Huncharek et al., 2003). Methodological issues such as response rates, validity, reliability, bias, the consistency of dose-response relationships and causality has been reviewed elsewhere (Muscat and Barish, 1998).

The risk of ovarian cancer related with perineal dusting is increased. Despite these concerns, the medical literature has not thoroughly explored a comprehensive evaluation of the talc research, as well as the conceptual and scientific understanding of how talc could cause ovarian cancer. The current analysis discusses the origins of the talc and ovarian cancer hypothesis, how some assumptions about talc carcinogenicity were misunderstood, and findings on a variety of additional talc and cancer studies that aren't related to perineal dusting. Finally, we make recommendations for new research directions in this field [2].

### What is Asbestos?

Asbestos is the name given to a group of little silicate strands found and mined in nature since old Greece [3,4]. The filaments could be woven into materials or admixed with other modern items to work on warm opposition. The different strands are gathered into two families: serpentine and amphibole. Serpentine strands incorporate mineral chrysotile, regularly alluded to as white asbestos, which represents 90% of the world's creation of asbestos. The amphibole group of minerals incorporates amosite (earthy colored asbestos), crocidolite (blue asbestos), and more uncommon filaments of anthophyllite, actinolite, and tremolite. Among both serpentine and amphibole asbestos, crocidolite is by and large acknowledged as the most cancer-causing. Regardless of its wealth, there remains contention with respect to whether chrysotile is itself pathogenic or regardless of whether it's tainting with amphibole filaments is the essential driver of disease [5,6].

### History of asbestos causes cancer

In the first half of the twentieth century and the expanded motorization achieved in the World Wars, asbestos turned out to be broadly mixed into compounds for its innate capacity to protect from heat what's more blazes. By the 1960s and 1970s, asbestos could be seen as in Everything from protection to talcum powder [7]. Soon afterwards, English specialists noticed an expansion in pneumonic horribleness and growth development in labourers engaged with the creation of asbestos. In 1960, Keal, a doctor working in London, first connected ovarian disease and stomach neoplasms to patients presented to asbestos in their functioning conditions. In a progression of 23 ladies with asbestosis, nine were died of intra-abdominal malignancy. One "had an ovarian carcinoma, four had peritoneal developments potentially of ovarian beginning, and in the leftover four the conclusion was carcinomatosis peritonei"





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[8]. Ensuing clinical exploration started to investigate the relationship among asbestos and ovarian disease, particularly as mounting proof showed an undeniably persuading connection among asbestos and pleural threatening mesothelioma, laryngeal, and cellular breakdown in the lungs. A significant thought for this examination turned into the right determination and differentiation of ovarian disease from dangerous mesothelioma. While Keal was depicting his companion of patients, two specialists, Enticknap and Smither, revealed a surge in all kinds of people with peritoneal dangerous mesothelioma, already an uncommon malignant growth [9]. For this situation series, every one of the eight men was depicted as having peritoneal harmful mesothelioma. Three ladies announced comparable openings; however two were expected to have ovarian disease and one dangerous mesothelioma. The creators further contended to perceive peritoneal dangerous mesothelioma as an unmistakable infection and addressed whether Keal, in his prior paper, could have misdiagnosed harmful mesothelioma as ovarian disease. Assuming threatening mesothelioma of the peritoneum might have been misclassified as ovarian disease, this could present inclination. Another early and bigger review, likewise from England, studying a bigger populace of people, assessed the growths and tracked down expanded paces of harmful mesothelioma in the two genders. Paces of ovarian disease were not expanded for all ladies, yet entirely the study announced a portion related expansion in ovarian malignant growth in the subset with the most elevated word related openness [10].

#### Mineralogy of talc and asbestos

Asbestos' carcinogenic effects have been extensively researched and reported in medical literature (Huncharek, 1986; Mossman and Gee, 1989) [11,12]. It is obvious that the morphologic structure of serpentine asbestos and the fibrous form of amphiboles, rather than their atomic constituents, is responsible for their carcinogenic effects (Stanton et al., 1977, 1981) [13,14]. Talc, a member of the montmorillonite/smectite group, on the other hand, is infrequently found in the asbestiform habit (a mineral's fibrous pattern of growth). Because of its chemical and physical qualities, even asbestiform talc is not carcinogenic like asbestos. Asbestos and talc are both silicate minerals. Minerals are classed based on their anionic structure, with subclasses defined by chemical composition or physical properties. The mineral talc is a magnesium silicate. Water molecules are trapped in hydroxide, between silicate sheets (from the silicate family). The clay group montmorillonite / smectite belongs to the phyllosilicate subclass. The other three major phyllosilicate clays are as follows: Kaolinite/serpentine, illite, and chlorite are the three groupings.

Asbestos is the generic or trade name for six naturally occurring fibrous minerals, including amosite, chrysotile, crocidolite, and fibrous variants of tremolite, actinolite, and anthophyllite, which have all been employed in industrial applications. Asbestos differs from talc in morphology and belongs to separate silicate mineral classes and subgroups. The asbestiform chrysotile mineral group includes the most prevalent variant of the serpentine mineral group, asbestiform chrysotile. It differs from nonasbestiform serpentines in that its bruted and silicate layers bend into tubes, resulting in tangled clusters of curled fibres. The fibres are bundled together, yet they can readily be separated from the host matrix. In surface rock, the inosilicate/amphibole group of minerals is particularly common. The inosilicate/amphibole group contains five asbestiform minerals that differ in chemical composition but all form solitary needle like fibres rather than bundled fibres. Asbestos fibres have a high tensile strength and a 20–1000 aspect ratio (length to diameter) [11,12].

The geographical characterization of minerals isn't straightforward and enhancements in logical methods have driven to changes in the classification over the long run. Minerals are Synthetically comparative however can have considerably unique properties. It was noted with levity that the issue with mineralogical analogies can be valued by the reality. That calcium carbonate establishes both a pearl and chalk [15] (Krause and Ashton, 1978).

#### Asbestos contamination and confounding

Restorative bath powder contains more prominent than 95-close to 100% unadulterated powder, though other tidying powders are ordinarily made out of powder, corn-starch and different added substances. Corrective grade powder is sans asbestos and has been for quite a few years, yet some child powders fabricated in the 1970s contained limited quantities of tremolite or quartz silica (Rohl et al., 1976) [7]. The X-beam insightful techniques to decide the convergence of these pollutants has been addressed (Krause, 1977) [15] and the diffraction designs didn't recognize

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stringy and non-fibrous minerals. In the epidemiologic investigations of ovarian disease that recognized dates of openness, the size of the chances proportions for perineal tidying didn't differ fundamentally among right on time and later openness periods. The general chances proportions in these investigations was moreover genuinely steady whether or not the examinations were directed during the 1970s or many years after the fact, recommending that glasslike quartz or different silicates in powder were not confounders [7,15].

### **Ovarian cancer**

Ovarian cancer is a type of cancer that affects women. It has been suggested that talcum powder particles (applied to the vaginal area or on sanitary napkins, condoms) could cause cancer in the ovaries if they travelled through the vagina, uterus, and fallopian tubes to the ovary [16].

### **Ovarian Cancer Symptoms and Next Steps**

There are no reliable screening tests for ovarian cancer. Women who suspect they have ovarian cancer will need to see a doctor to help monitor symptoms. Unfortunately, ovarian cancer symptoms often go undetected until the disease progresses into an advanced stage. Symptoms may include:

- Pain, pressure, or discomfort in the pelvic area
- Worsening pain in the back or lower abdomen
- Weight gain or loss
- Abnormal period cycles
- Vaginal bleeding or abnormal discharge
- Loss of appetite or difficulty eating
- Gas, nausea, or vomiting
- Consistent burning sensation in the throat and chest
- Frequent urination

Diagnosing ovarian cancer requires a physical exam, pelvic exam, lab tests and blood work, and an ultrasound or a biopsy. Treatment depends on the location of the cancer and stage of development: Surgery to remove cancerous tissue, the affected ovary, or sometimes the entire reproductive system

### **Chemotherapy**

It is essential to keep consistent records for medical and legal purposes. Building a strong claim requires extensive proof of the loss the victim sustained from her illness. Proper documentation will help with legal strategy and proving liability, while also increasing the likelihood of recovering the maximum damages [17]. Many women's research have looked into the probable link between talcum powder and ovarian cancer. The results have been varied, with some studies indicating a modest increase in risk and others indicating no change. A slight increase in risk has been identified in many case-control studies. However, because these studies generally rely on a person's memory of talc use from many years ago, they can be skewed. Prospective cohort studies, which do not have the same type of bias, have not consistently identified a significant increase in the risk of ovarian cancer. However, others have argued that particular types of women (for example, pregnant women) may be at higher risk [18].

### **Talc and other reproductive tract cancers**

Genital openness to powder dust was first estimated as not just a potential danger factor for ovarian growths yet additionally cervical and endometrial disease. It very well may be normal that the cervix is at more serious danger than the ovaries owing to the development of powder particles on the uterine cervix, which fills in as a hindrance to uterine pollution. This affiliation has not been considered, yet such information would be instructive [2].

### **What is the Evidence that Asbestos Causes Cancer?**

There are a few theories, counting one that cases there are progress metals implanted in Asbestos filaments that make receptive oxygen species<sup>19</sup>. This oxidative pressure causes through the 'frustrated phagocytosis of macrophages'— changes to neighbouring mesothelial cells [20]. Straightforwardly on mesothelial cells, *in vitro*

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openness of asbestos is profoundly cytotoxic and, a few cells might dodge quick cell death by initiation of the AP-1 pathway, intervening articulation of tumour necrosis factor- $\alpha$  receptors that forestall cell death through nuclear factor-B activation [21]. For this situation, asbestos is theorized to be defensive against apoptosis. Alternate manners by which asbestos has been found potentially to be connected to malignant growth are the *in vitro* changes prompting articulation of interleukin, essential fibroblast development factor, granulocyte state animating element, and vascular endothelial development factor protein levels on mesothelial cell lines [19]. Different investigations, nonetheless, have observed chromosomal modifications as an unmistakable element in asbestos related cell changes. An extra part of examination has focused on Simian virus as a potential co-cancer-causing agent alongside asbestos. All the more as of late, proof has arisen for BAP1 and the Hippo pathway activation as conceivably targetable in pleural harmful mesothelioma. The mechanism by which asbestos causes ovarian-explicit tumorigenesis additionally requires further clarification [22-24]. Early investigations noted cell death couldn't produce *in vitro* discoveries steady with the advancement of malignant growth. Moreover, unique asbestos filaments were utilized and caused various degrees of cytotoxicity in animal ovarian cells. In later investigations of human ovarian epithelial cell lines, balanced articulation of ATF3 was found. Like *in vitro* investigations of mesothelial cell lines, this prompts expanded creation of incendiary cytokines like interleukin furthermore granulocyte province invigorating component [25].

Exploratory research upholds conceivable enactment of favourable to provocative and hostile to apoptotic pathways in both dangerous mesothelioma and ovarian cancer, however the exact pathogenesis and early molecular triggers remain not completely comprehended, are a road for future examination, furthermore have not really been explored by the IARC. One trial the IARC explicitly featured was an *in vivo* concentrate on that gave a "biologic believability of a relationship between asbestos openness and ovarian cancer". In that study, tremolite asbestos was infused intraperitoneally into four well evolved animal species: mice, hamsters, guinea pigs and bunnies. The creators observed that main bunnies and guinea pigs delivered epithelial changes in the ovaries "like the sores found in the early ovarian injuries in people" [20,26,27]. This might have been because of the reality that quite a few years after the fact it was observed that, in guinea pigs and hares, steady estrogen openness invigorates the "arrangement of a papillary ovarian surface looking like human serous neoplasms of low dangerous potential [28].

#### **Mechanisms involved in talc-induced ovarian cancer**

given the dissimilarities among powder and asbestos as to their fibrous shapes, the powerless yet expanded relationship in the epidemiologic investigations could be credited to different components accepting that the factual affiliations are impartial and not due to jumbling. Asbestos strands in the lung start a provocative and scarring interaction, and it has been Suggested that ground powder, as an unfamiliar body, may start an incendiary reaction [29]. Pelvic incendiary illnesses, nonetheless, like endometritis, peritonitis, tubo-ovarian access development, and salphingo-oophoritis have overall not been related with an expanded danger of ovarian disease [30-33]. A meta-investigation of investigations of calming drugutilize observed no decrease in ovarian disease hazard [34]. Irritation instigates pleural fibrosis [35]. However the identification of powder particles in human ovarian careful examples was not joined by fibrosis in onestudy [36].

It was proposed that the relationship between perineal powder tidying and ovarian disease may be clarified by the enlistment of ANTI-MUC1 antibodies [37]. This thought has been bantered on factual grounds where baby powder applied to the perineum was related with expanded ANTI-MUC1 articulation yet the connection was likewise seen when powder was applied to other body parts. All the more significantly the basic perception that powder raises immunoglobulin protein levels in blood, perhaps through heat shock proteins appears to have no known direct significance for ovarian disease since Hostile to MUC1 is related with different diseases and in light of the fact that there is no known job of hotness shock proteins in ovarian disease hazard [38].

#### **Clinical detection, treatment and management of ovarian cancer**

Ovarian malignant growth usually gives not many particular manifestations. The most widely recognized sign of ovarian disease is ascites, which is abundance liquid amassing in the mid-region that causes stomach enlarging. Other signs incorporate stomach/pelvic inconvenience or pressure, back or leg torment, bulging, changes in inside





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work or on the other hand urinary recurrence, weakness, gastrointestinal issues, malnourishment, jaundice, paleness, queasiness, or loss of hunger and menorrhagia or abundance vaginal drying. Menorrhagia is menstruation with excessive flow and duration and is a common complaint in premenopausal women. The World Health Organization announced that 18 million ladies of 30-55 years see their feminine draining to be over the top however that just 10% of these ladies experience blood misfortune adequately extreme enough to be characterized clinically as menorrhagia. In an investigation of 187 patients with ovarian carcinoma, 24% announced over the top vaginal draining or menorrhagia [39], an indication that may prompt an impermanent expansion in powder use. A new survey observed that vaginal draining was one of the most detailed manifestations of ovarian disease [40].

Meta-analysis reveals heterogeneity in investigations and is an integral asset for investigating potential predispositions, especially as it doesn't depend on emotional suspicions about study Quality. A meta-examination of the powder tidying studies showed that hazard gauges shifted by concentrate on plan (for example clinic versus populace based) [41]. The general danger was 1.38 (1.25-1.52) for population-based investigations and 1.19 (0.99-1.41) for hospital based studies. Tried and true way of thinking recommends that this contrast is because of a non-representative openness rate in emergency clinic controls, and that the outcomes from population based studies are more precise. The extent of controls tidying with powder, be that as it may, was something similar in the two gatherings that are 32%. One clarification is that case members in population-based studies had the opportunity to audit writing about the reasons for ovarian disease after release yet before the meeting, while emergency clinic-based members didn't have this open door. Also, clinicians might perceive a 'treatment impact' among populace-based cases since many was interviewed months after release. Concentrate on polls may determine powder use before determination, yet patients in population-based examinations may not consistently make the qualification among prediagnosis and post-treatment use. Conversely, clinic based investigations determine openness data at the hour of release and detailed powder use isn't affected by post diagnostic treatment. The justifications for why post diagnostic powder use may be significant is that roughly 60% of episode ovarian diseases are stage III or IV (metastatic) infection, which is characterized by a low 5-year endurance rate (B10%). Patients with progressed malignant growth ordinarily go through chemotherapy, and potentially debulking medical procedure though beginning phase illness is typically treated with a medical procedure, entire stomach radiation, or on the other hand intraperitoneal radioactive phosphorus. Population-based studies might contain an excessively high number of beginning phase patients attributable to their ideal anticipation. Radiation therapy in beginning phase patients frequently actuates radiation dermatitis in the lower mid-region, an incidental effect that can be part of the way eased by powder tidying. One more component in the clinical administration of ovarian disease that is applicable to the study of disease transmission concerns the relationship in ladies who have gone through tubal ligation or on the other hand hysterectomy. These methods block the environmental defilement of the ovaries, and in the wake of barring ladies with two-sided oophorectomy, concentrates on that reported on whether the danger was adjusted by hysterectomy or on the other hand tubal ligation have not tracked down predictable contrasts.

The understanding of these information are confounded by evidence showing that there are other conceivable hormonal/natural clarifications for the diminished dangers related with tubal ligation other than ovarian impediment. For instance, the decreased danger of ovarian disease related with hysterectomy could be an ancient rarity coming about because of an expanded danger of ovarian malignant growth related with menopausal hormonal treatment in ladies with an unblemished uterus [42]. An increased risk associated with talc dusting in women who had these surgical procedures could also be biased in the talc studies by the failure to exclude women who underwent unilateral oophorectomy. Theoretically, the lower risk of ovarian cancer associated with hysterectomy in these women is reduced because 50% of their ovarian tissue was removed.

#### **Talc-dusting heterogeneity and the risk of ovarian cancer associations**

An awareness investigation of the perineal cleaning studies uncovered intriguing contrasts by concentrate on plan. The outline chances proportion was 1.19 (95% CI: 0.99-1.41) for medical clinic-based investigations and 1.38 (95% CI: 1.25-1.52) for population based investigations. Although traditional dogma suggests that population-based examinations are less one-sided, we have noticed that on account of a helpless anticipation, women taken on





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population- based investigations after medical clinic release are bound to be beginning phase cases with a history of radiation and therapy for skin bothering, or may have had the amazing chance to turn out to be more natural with known and proposed hazard factors. In addition, numerous of the investigations of perineal cleaning and ovarian malignant growth remembered data for portion of powder openness as far as length, recurrence and total use. Few, in any case, found a positive portion reaction relationship and a converse relationship was found in some.

#### **Therapeutic uses of talc**

Restorative grade powder is utilized remedially to treat non-malignant and harmful pneumonic infection. Powder insufflation causes bonds between the parietal and instinctive pleura, and is utilized in the treatment of bronchopleural fistulas, harmful pleural emanations, and pneumothorax (a breakdown of the lung from changes in intrapleural strain in the chest depression). The strategy includes the utilization of synthetic specialists, for example, restorative grade powder into the pleural space, causing a pleuritis that seals the air spill. The utilization of cancer-causing agents for clinical treatment isn't phenomenal (for example tamoxifen); nonetheless, powder pleurodesis has been utilized as a powerful treatment for a very long time without worries about its cancer-causing potential. Powder slurry is straightforwardly applied to the pneumonic pleura in focuses comparable to tentatively infused portions in creatures on a for every weight premise. Assuming that human bronchial or pleural tissue were dealt with with 5 g of asbestos rather than powder, it very well may be sensibly theorized that the treatment would essentially increment the pace of mesothelioma or cellular breakdown in the lungs in these patients. No case reports, in any case, exist of lung or pleural disease following aspiratory pleurodesis [43].

Powder pleurodesis is likewise utilized palliatively for the treatment of dangerous pleural emissions in patients with cutting edge bosom, lung and different tumours. As future is restricted in patients treated for dangerous pleural effusions, the drawn out cancer-causing capability of powder pleurodesis is definitely not a huge clinical concern, particularly as large numbers of these patients experience the ill effects of intermittent dangerous pleural emissions<sup>44</sup>.

## **CONCLUSION**

Although there is a statistical link between asbestos and ovarian cancer, the link is weak and inconsistent. To determine the causal relationship between asbestos and ovarian cancer, more scientific research is required. Physicians must address the causal explanation of environmental carcinogens such as asbestos with their patients. The intensity of the link between asbestos and ovarian cancer has substantial legal implications, as illustrated by the fact that asbestos is suspected of being the cause of ovarian cancer in talc. To better establish the strength of these connections, more research and better study design are required.

Ovarian cancers causes are unknown, but continuing research is likely to find major genetic factors of the disease. The findings on perineal dusting powders in ovarian cancer case-control studies are only part of a larger body of relevant literature and perspectives that have not been adequately considered with regard to talc 144 European Journal of Cancer Prevention 2008, Vol 17 No 2 and ovarian cancer, as discussed in this review. Given the lack of a consistent dose-response relationship with ovarian cancer risk and the lack of an established correlation between perineal dusting frequency and ovarian tissue talc concentrations, it could be argued that the overall null findings associated with talc-dusted diaphragms and condom use is more convincing evidence for a lack of a carcinogenic effect. The absence of mesotheliomas in patients treated with therapeutic doses suggests a high level of safety.

Asbestos Testing of Talc-Containing Cosmetics in 2021 the FDA has continued to examine talc-based cosmetics for asbestos contamination. The goods were chosen based on a variety of characteristics, including the type of talc-containing cosmetic product, price range, popular products on social media and in commercials, products targeted to children, and, if applicable, third-party allegations of asbestos contamination. On behalf of the FDA, AMA Analytical Services, Inc. (AMA) conducted sample testing. Polarized light microscopy (PLM) and transmission electron microscopy (TEM) were used to examine the samples.



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## Implementation of Data Mining Techniques with a Machine Learning Approach

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### ABSTRACT

The terms “Data Mining” and “Machine Learning” are often used interchangeably. This becomes increasingly confusing because of the fact that both Data Mining and Machine Learning has many aspects in common. Historically, the concept of Data Mining emerged before the era of Machine Learning. Data Mining has been around since 1930s and the Machine Learning came to play since 1950s. It can also be stated that Machine Learning uses Data Mining techniques for data analysis and interpretation. Data Mining incorporates the data management techniques provided by database tools with the analytical capabilities provided by statistical methods and algorithms. Machine Learning models uses similar algorithms to train itself by fitting a set of meaningful or raw data which are often constructed / gathered using various techniques like Data mining, Web scrapping, or collecting it from third party data providers like Quandl, Yahoo finance, Gapminder or US SEC. The key is, Machine Learning can make use of the information / data which are collected and processed by Data Mining to make better predictions. Despite of having many similarities and overlapping characteristics, both Data Mining and Machine Learning have their own distinct features. Data Mining is designed to derive Rules, Relationship and Patterns from huge amount of data, while Machine Learning is considered as “Semi Automated extraction of knowledge from data”. To elaborate a bit more on this statement, a Machine Learning process always starts with a question that might be answerable using data. Machine Learning also involves algorithms which are executed by a machine / compute, to automate the process of identifying the insights from the given data. It is also a fact that a Machine Learning process may not function well without human intervention. Hyper Parameter tuning can be considered as one example



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where expert human decision-making capabilities are necessary in preparing a Machine Learning Model. This paper is an attempt to identify and explore some of the Data Mining and Statistical techniques which can be incorporated in Machine Learning methods.

**Keywords:** Data Mining, Machine Learning, ROC, AUC, Cross Validation.

## INTRODUCTION

Data Mining is often considered as a part of the whole KDD process. The KDD, which stands for Knowledge Discovery in Database, is a sequence of step by step process which involves Selection, Pre-Processing, Transformation, Data Mining and Interpretation. The ultimate outcome of the whole process would be the Knowledge which can be derived from the available data. A Machine Learning model can then take advantage of this derived knowledge to train itself and make better predictions[2]. Though it is not a mandatory to use the result of a Data Mining process as an input of a Machine Learning process. Similar to the KDD process, Machine Learning also involves a set of steps / processes which need to be performed as part of its implementation. The key steps of a Machine Learning task can be stated as Data Collection, Data Preparation, Model Selection, Model Training, Model Evaluation, Hyper Parameter Tuning, and Prediction. The Data Preparation / Pre-Processing itself consists of many sub tasks like Outlier Detection, Missing Value handling, Conversion of Categorical data, Feature Selection / Construction, Feature Scaling etc. It is also a notable fact that many Machine Learning algorithms perform feature scaling as part of its training process. Feature scaling is also a key part to improve the model training performance by reducing memory usage.

### Data Mining and Machine Learning Steps in Brief

Machine learning techniques like "Classification" can make use of the "Labelled Data" which are derived from a "KDD" process to train itself and make better prediction. This may not be necessary in all cases, but using a well-formed data for training a Machine Learning model would result in a better prediction accuracy. Given the fact that the prediction accuracy of a model is heavily dependent on the accuracy and relevancy of the training data. Data collection plays a vital role in any Machine Learning process. The actual Prediction in a Machine Learning process might take the least amount of time while compared to other aspects of its pipeline. "Figure 1" shows the steps and tasks of a KDD process. Most of those steps are in fact part of a Machine Learning process as well. The Data Collection and Preparation steps involves most of the KDD steps in it and poses a great importance in Machine Learning as a whole.

One of the key difference between the KDD process and a Machine Learning process, shown in "Figure 2", can be considered as the last step of the whole sequence, which is "Interpretation" in KDD and "Prediction" in Machine Learning. This also implies the difference in the intension of applying one technique over another. The Interpretation is typically not an automated procedure. A user looks at the patterns and apply interpretations in order to obtain knowledge given by that pattern. Data visualization provides a powerful way to communicate data driven findings [3]. On the other hand, a trained Machine Learning model is capable of making predictions for an unknown data set, given that the new data set is similar to that of it is trained with.

### Algorithms and Techniques

Both Data Mining and Machine Learning uses various algorithms in its implementation process. Algorithms like K-Nearest Neighbour (KNN), Decision Trees, Support Vector Machines (SVM), to name a few. Different algorithms are suitable for different use cases and can also depend on the type of data which are used for the training / analysis. "Figure 3" can be considered as a high-level guide for algorithm selection. Choosing the right algorithm is a key to



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derive better outcome from the whole process. "Cross Validation" is a technique used to test and determine the efficiency of different algorithms with a certain data set. Cross validation is also used to perform Hyper Parameter tuning in Machine Learning. Choosing an algorithm is also dependant on the nature of the expected outcome. Machine learning tasks like Regression, Clustering, and Classification requires different algorithms to be used for the model training. Another factor which effects the selection of algorithm is the size of training data. Complex algorithms might take more time to get itself trained with the available data. A generic selection process of Machine Learning technique is given below.

**Machine Learning Fundamentals**

Machine Learning is not a single step input task which would give the expected output. It involves several tasks which requires some expert human decision making capabilities and understanding. Tasks like Model selection, Parameter tuning and Feature selection requires an experienced data analyst with a good intuition about the data which he / she is dealing with. Data scientists uses several statistical and analytical technics to get a deeper understanding of the available data. PCA is one of the most widely used algorithm to identify and detect corelation between variables[4].Cross Validation, Confusion Matrix, ROC (Receiver Operator Characteristic) and AUC (Area Under the ROC Curve) are some of the techniques used to understand the efficiency of a Machine Learning model.

**Feature Engineering**

Along with the right algorithm and optimized hyper parameters, the features present in the final model makes a whole lot of difference in the performance of a model's prediction capability. Data selection and clean-up are unavoidable part of any data mining / machine learning process. Though the feature engineering involves both selection and cleaning process, its scope is more than that. Feature selection can be helpful to retain the relevant features and remove irrelevant ones, which will result in a better performing and easier to understand model[7]. Interpretability of the model is important to understand why a prediction is happening, so that it can be even more beneficial for taking future business decisions. Excluding irrelevant data also helps to reduce the time and space needed to maintain and run the model. Feature engineering is not just about picking up the right features from the available data, but it also involves in deriving new features from the available data points. To make a decision on feature selection, there must be a clear understand on, how the presence or absence of a feature will impact the outcome of the model. Having irrelevant features in a model will add more noise in the prediction process than the intended outcome. Understanding the correlation between the features of a dataset will be helpful to decide which one to retain and which one to remove. There could be scenarios where some features that are deemed as low important for a bad model could be very important for a good model [11].So, it is always important to evaluate the predictive capability of a model using cross validation.

**Feature Correlation**

Feature correlation is a way to understand the relationship between multiple features of the dataset [9]. There are various possible ways to make use of corelation analysis while preparing data. "Figure 4" shows the correlation between the target variable and features, where the target variable in this sample is "Tran Amt". The result of a correlation analysis may be either "Positive Corelation", "Negative Corelation" or "No Corelation". The correlation is called positive if feature A increases, then feature B also increases and vice versa. The negative correlation is a case if feature A increases, then feature B decreases and vice versa. Since this sample dataset is only for one year, "Tran Year" feature become an example of "No Correlation". A corelation matrix is another way of deriving the relationship between each feature of the dataset. "Figure 5" is an example of such analysis. Correlation can be calculated between features or the relationship with the target variable / label with any particular feature. In certain cases, correlation can also be used to predict the missing values of one feature based on another one. Though correlation can be very useful to understand relationships between the features, it is also important to understand and segregate any potential "casual relationships" between features. Any highly correlated variable should be re-examined for statistical significance.A research / model supported by coincidental statistical association could be misleading [10].





### Feature Selection

There are several techniques involved in feature selection / dimensionality reduction. It all starts with a simple task of selecting a subset of features to use in the model. But this seemingly simple task will need several considerations and key decision making. Each decision on feature selection depends of the available data and the factors which need to be consider in order to come up with an appropriate set of features from that available data. There are several reasons to apply dimensionality reduction techniques while implementing machine learning models [8]. It helps to identify the “True dimensionality” from the “Observed dimensionality” of the data. The abundance of data in this world of big data comes with a cost of redundant and irrelevant features for a given context. This could easily end up in “Curse of dimensionality”, if not given enough attention. Having meaningful features in the model is not only helpful to have better predictions, but it is also helpful to justify the outcome as well. Having a justifiable number of meaningful features could potentially avoid overfitting of the model and will also reduce the execution time of the model training process as well. Having a greater number of features compared to the observations / records available, will have serious negative impact on the prediction performance of a model [8].

Though there are several technics available for dimensionality reduction, all of them may not be applicable / useful for all kinds of datasets, with same effectiveness. There is a need to selectively apply the right set of techniques which will be useful for the given source data. If the dataset is having lot of missing data, then a thorough analysis needs to be done in order to make a decision on whether to remove those missing data points or to derive meaning for those missing data. If the missing datapoints itself do not add meaning to the data, then consider removing those based on the percentage of missing values. When the percentage of missing values for a given feature is more than certain threshold, then an imputation technique may not derive meaningful values.

### Permutation Feature Importance

Permutation feature importance is a model inspection technique that can be used for any fitted estimator when the data is tabular [11]. Permutation feature importance measures the increase in the prediction error of the model, after the feature’s values been permuted, which breaks the relationship between the feature and the true outcome [12]. This approach makes this technique model agnostic and can be calculated many times with different feature permutations. The intension of calculating permutation importance is not to derive the actual predictive value of a feature by itself but to understand the importance of a feature for the model as a whole. “Figure 6” shows sample output of a permutation feature importance for a custom generated online transaction data. Though calculating permutation feature importance is a great way for feature selection, it could become unreliable when there are multicollinear or correlated features in the dataset and only one of those features is considered for permutation. One way to overcome this multicollinearity is by performing hierarchical clustering of the features and consider a single feature from each cluster to train the model.

### Feature Generation

Feature generation is a process of creating new features from one or multiple existing features [13]. This process could potentially add new information to the data, which can be used to prepare more accurate models. A feature is an individual measurable property or characteristic of an observation. Though there are libraries / tools which can help in automated feature generation, the feature generation process as a whole involves a lot of manual intervention. Because of this very manual nature of feature generation, it is important to have good domain knowledge, intuition and may have to go through lot of data manipulation to extract more meaningful features from the available data. “Figure 7” is an example of feature extraction, where “Amt Band” feature is generated by segregating the “Transaction Amount” (TranAmt) feature. While showing the possibility of feature generation, this example also shows the potential negative side of it as well. The chart shown in “Figure 7” is a permutation feature importance output, which clearly indicates the outcome of the model being impacted by the newly generated field with an unusual level of importance. A comparison between “Figure 6”, which is a permutation feature importance output before generating the new feature, makes this difference clearer. So, when dealing with feature generation, it is important to make sure that the newly generated feature is adding more meaning to the model but not being end up in an over fitted model.



**Vivik and Brintha Rajakumari****Cross Validation**

Cross-validation is a technique for validating the model efficiency by training it on the subset of input data and testing on previously unseen subset of the input data. It can also be described as a technique to check how a statistical model generalizes to an independent dataset. Several methods of cross validation are in practice, some of them are Validation Set Approach, Leave-P-out cross-validation, Leave one out cross-validation, K-fold cross-validation, and Stratified k-fold cross-validation [14]. The Cross Validation requires the available data to be split into two different parts. One for training the model and another for testing the model. It is considered as a bad practice to use the whole data available for the training process. The accuracy and efficiency of a machine learning model need to be evaluated by testing it with the data it has not seen before. An "Over fitted" model might have a high probability of correctly predicting the outcome of an input data which it has already been trained with. But it might perform poor when an unknown / new data is used for prediction. The amount of data which need to be segregated for testing is at the discretion of the data analyst. Though the general practice is to utilize maximum possible data for the training process, may be a 70:30 or 80:20 ratio would be suggested for training and testing. A "Ten-Fold Cross Validation" is also a general practice to use, where the available data is split in to 10 parts in the train-test split process. In extreme cases, the whole data except one is used for training and the remaining one data is used for testing. This is called as "Leave One Out Cross Validation". In either case, the process is repeated until all available data is used for both training and testing the model.

**Confusion Matrix**

Model selection is a process in which a decision needs to be made that, out of all the algorithms / methods available out there, which one will suite better with the available data. This becomes an increasingly tedious task as there are a lot of methods to choose from. To pick the model which works best for the given data, the data need to be divided in to training and testing datasets. Then the selected algorithms need to be trained and evaluated on those segregated datasets. This whole activity is done using the process termed as "cross validation" [5]. As part of this process, the training data will be used to train an algorithm. Then evaluate the trained model using the testing data and compare the results with the actual data. Now the results of this different models need to be summarized to understand how those models performed on the testing data. One way to do this is by creating a "Confusion Matrix" for each method. A sample Confusion Matrix is given in "Table 1".

Above is a sample confusion matrix where there are only two categories to choose from. In a Confusion Matrix, the rows corresponds to the predicted value of a Machine Learning algorithm, and columns corresponds to the actual data. The downward diagonal line represents the cells with correct predictions. The "True positives" are the items which are actually "Good" and are also predicted as "Good". Cell at the bottom right-hand side represent the "True Negatives". These are the "Bad" categories which are correctly predicted by the algorithm as "Bad". "False Negatives" are at the bottom left-hand side. These false negatives are those cases where the actual data were "Good", but the algorithm predicted it as "Bad". Lastly the top right-hand corner contains "False Positives". These are the cases where the data were actually "Bad" but the algorithm predicted it as "Good"

Model selection is a process in which a decision needs to be made that, out of all the algorithms / methods available out there, which one will suite better with the available data. This becomes an increasingly tedious task as there are a lot of methods to choose from. To pick the model which works best for the given data, the data need to be divided in to training and testing datasets. Then the selected algorithms need to be trained and evaluated on those segregated datasets. This whole activity is done using the process termed as "cross validation" [5]. As part of this process, the training data will be used to train an algorithm. Then evaluate the trained model using the testing data and compare the results with the actual data. Now the results of this different models need to be summarized to understand how those models performed on the testing data.

**Sensitivity and Specificity**

By continuing with the previous sample of confusion matrix prepared to predict the "Good" and "Bad" categories, it





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is possible to calculate the “Sensitivity” and “Specificity”. Sensitivity represents the percentage of “Good” category that has been correctly predicted by the algorithm (1). Specificity represents the percentage of “Bad” category that has been correctly predicted by the algorithm (2).

A model with higher sensitivity can be considered, if correctly predicting the “Good” category is more important than predicting the “Bad” category correctly. On the other hand, a mode with higher specificity can be considered, if correctly

$$\text{Sensitivity} = \frac{\text{True Positives}}{\text{True Positives} + \text{False Negatives}} \tag{1}$$

predicting the “Bad” category is more important than predicting the “Good” category correctly. With means a mission critical application which cannot miss any possible case, may have to choose a model with better sensitivity. But for a system where it should only consider those cases which has more certainty, may go for a model with better specify.

$$\text{Specificity} = \frac{\text{True Negatives}}{\text{True Negatives} + \text{False Positives}} \tag{2}$$

Calculating sensitivity and specificity of a confusion matrix with two rows and two columns may be comparatively easy to achieve. But when there is a confusion matrix with rows and columns more than two, then the calculation becomes a bit complex.

$$\text{False Positive Rate} = \frac{\text{False Positives}}{\text{False Positives} + \text{True Negatives}} \tag{3}$$

**(1 – Specificity)**

In such cases, the sensitivity and specificity of each categories need to be calculated separately. There is no single value for sensitivity and specificity for a confusion matrix which has rows and columns more than two. This could become more complicated when the number of possible predictions of a model are more.

**ROC and AUC**

Constructing confusion matrices and comparing the sensitivity and specificity calculated by those confusion matrices for deciding a batter algorithm or a tuning parameter seems to be an efficient approach. But when the number of confusion metrics are more, then things could get lot more complicated. So instead of being overwhelmed with a large number of confusion matrices, ROC (Receiver Operator Characteristic) graphs provide a simple way to provide all the information needed to choose the right algorithm or a hyper parameter[6]. The Y axis of a ROC graph show the “True Positive Rate”, which is same as sensitivity. The X axis shows the “False Positive Rate” (3), which is same as 1 – Specificity. Considering the same sample of predicting the “Good” and “Bad” categories mentioned above, the





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“False Positive Rate” tells the proportion of “Bad” samples there were incorrectly classified and are “False Positive”. “Figure 7” shows a sample ROC graph.

In a ROC graph, a point at (1, 1) means that, even though all of the “Good” samples are classified correctly, the model has incorrectly classified all of the “Bad samples”. A diagonal line in the graph where the starting and ending points touches (0, 0) (1, 1) shows where the “True Positive Rate” is same as “False Positive Rate”. Any point on this line means that the proportion of correctly classified “Good” samples is the same as the proportion of incorrectly classified samples that are “Bad”. A point at (0, 0)

$$\text{Precision} = \frac{\text{True Positives}}{\text{True Positives} + \text{False Positives}} \quad (4)$$

represents a result which has zero “True Positives” and zero “False Positives”. If all the calculated points are connected with a line, that gives a ROC graph. The ROC graph summarizes all of the confusion matrices that each case produced. Here the “cases” can be a comparison between different thresholds or a hyper parameter or different algorithms which are under consideration. Similar to ROC, which can be used to compare multiple confusion matrices, there is AUC (Area Under the ROC Curve), which can be used compare different ROC graphs. A higher AUC value refers to a better ROC curve. To state a sample, if the derived AUC of a Logistic Regression happened to be 0.82 and the AUC of a Random Forest happened to be 0.69, then Logistic Regression can be considered for the given dataset.

Although it is a common practice to use “True Positive Rate” and “False Positive Rates” to draw ROC graph, there are other methods which attempts to do the similar thing. One of the popular method is to replace the “False Positive Rate” with “Precision” (4). Precision is the proportion of positive result that were correctly classified. This can be extremely useful while dealing with “Imbalanced Data”. If there were lots of samples that were in “Bad” category with respective to the “Good” category, then Precision might be more useful than “False Positive Rate”. This is because Precision does not include the number of “True Negatives” in its calculation, and is not effected by the imbalance. In real world, this kind of imbalance can occur when analysing a rare disease. In such cases, the study is most likely to contain many more people without the disease than with the disease.

## CONCLUSION

In this attempt to identify the contrasts and commonness between Data Mining and Machine Learning, it is evident that both has its own stand in the exploratory data analysis and information extraction process. Both Data Mining and Machine Learning comes under a broader area of study, which is “Data Science”. In the growing era of IOT and AI, the scope of Machine Learning becomes more prominent. With the increasing amount of digital data being generated on a daily basis in this ever-connected world of internet, the scope of Data Mining, Machine Learning and AI is growing exponentially. As the industry is rapidly moving towards Robotics and Automation, Machine Learning becomes a key player in the market. There are many practical implementations of Machine Learning in the industry now, which can possibly be identified in the daily life. Chat bots, Product Recommendation systems, Identifying Trends in Social networks, Sentiment analysis, Natural language processing, Fraud detection in financial transactions, Prediction of future events like Stock price and weather are some of the real-time examples of Machine Learning. By implementing the Algorithms and techniques of Data Mining in a Machine Learning model, a wide range of decision making and prediction tasks can be efficiently automated.





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**Table 6 - Confusion Matrix**

|  |             |                 |                 |
|--|-------------|-----------------|-----------------|
|  |             | <b>Actual</b>   |                 |
|  |             | <b>Good</b>     | <b>Bad</b>      |
|  | <b>Good</b> | True Positives  | False Positives |
|  | <b>Bad</b>  | False Negatives | True Negatives  |





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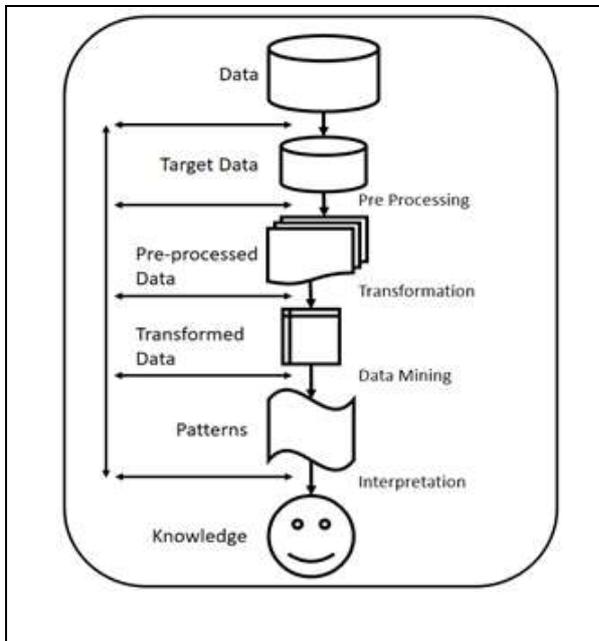


Figure 12 - KDD Process

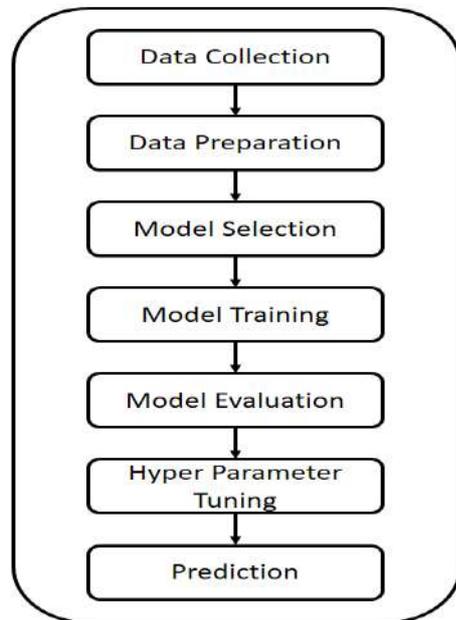


Figure 13 - Machine Learning Tasks

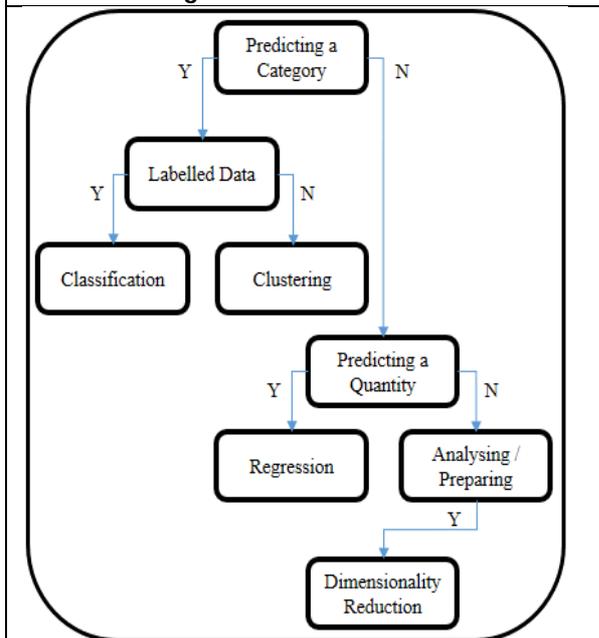


Figure 14 - ML Technique Selection

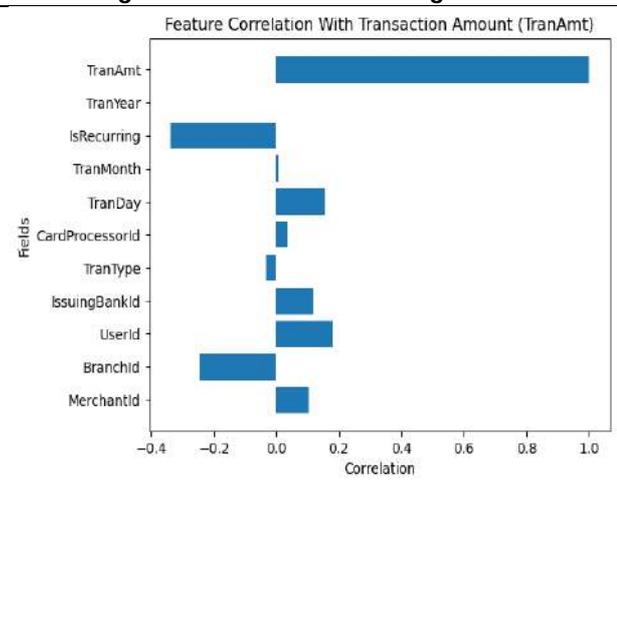
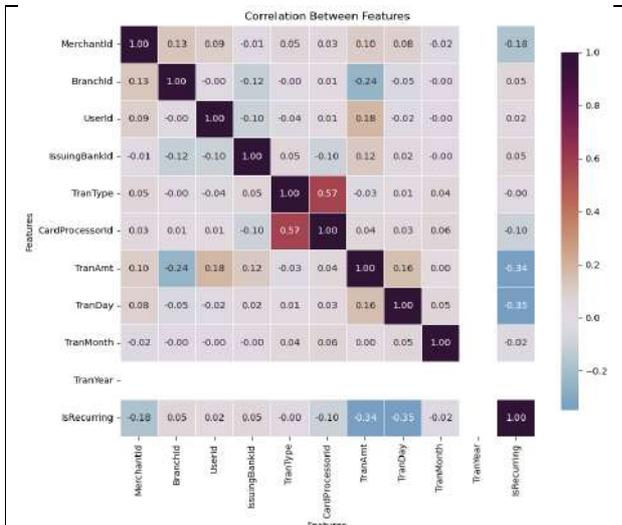


Figure 15 - Feature Correlation with Transaction Amount

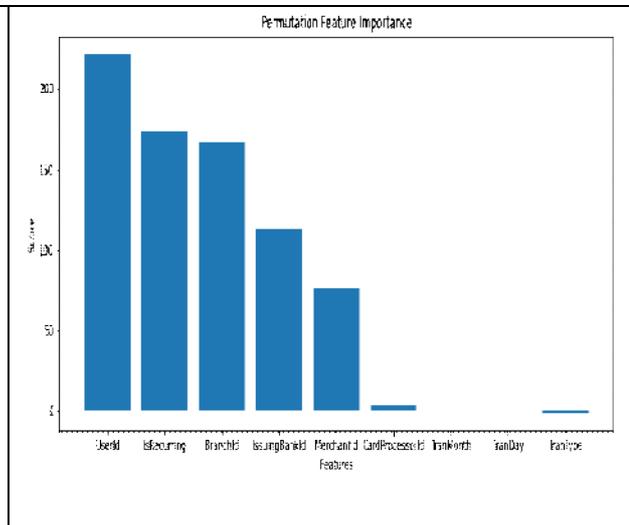




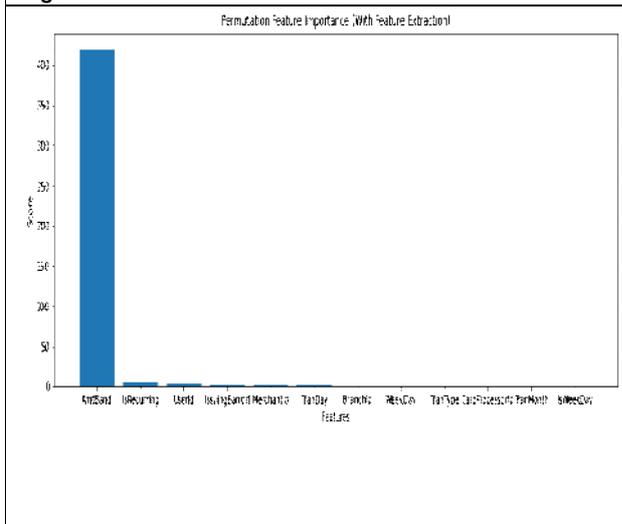
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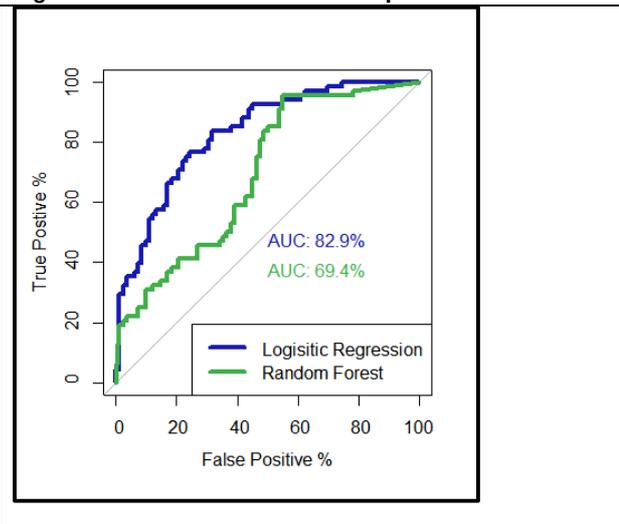
**Figure 16 - Correlation Between Features**



**Figure 17 - Permutation Feature Importance**



**Figure 18 - Permutation Feature Importance with Feature Extraction**



**Figure 19 - A Sample ROC graph**





## An Adaptive Water Purification and Monitoring System using IoT

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### ABSTRACT

Water being a vital element in human life, water purification has become a necessity. Till date, many experiments have been conducted to improve the quality of water, especially for household use. As of now, water consumption in households is feasible by the availability of water purifiers. At present water purification processes in household purifiers rely on RO cartridges for purification which have a limited lifespan and filtering capacity. Hence, implementing an efficient purification mechanism is needed by utilizing RO cartridges. Another requirement of this IOT is automation and remote monitoring of the purification process. Also, the consumer should be aware of the quality of his drinking water. To make the purification system more reliable with high standards, it is required to integrate an intelligent monitoring and automation system with the purifier. In this paper an IoT enabled Water Purification System which can dynamically adjust the water purification process based on the TDS value of the input water is presented. The results show that the work explained in this paper is commercially viable and can be scaled to solve the water purification problem in the Indian households due to unprecedented water contamination.

**Keywords:** Internet of Things, IoT, Water Purification.

### INTRODUCTION

Though water is the precious gift of nature to human beings, it is polluted day by day with increasing urbanization. Also, these freshwaters in all the water bodies are getting contaminated by human and industrial activities. The main source of such polluted activities includes domestic sewage, industrial wastewater, and agricultural run-off [3]. Even many of these water bodies are used for household purposes without any notice about its contamination. Contaminated water is not suited for consumption as it leads to many health issues to human lives and to the ecosystem. According to WHO statistics, at least 2 billion people around the world use a drinking water source



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contaminated with faeces [2]. WHO report further says that Contaminated water can transmit diseases such as diarrhea, cholera, dysentery, polio and typhoid. Contaminated drinking water is estimated to cause 485,000 diarrheal deaths each year. With children particularly at risk from water-related diseases, access to improved sources of water can result in better health, and therefore better school attendance, with positive longer-term consequences for their lives [7]. There exists an increasing demand for fresh water due to fast urbanization, and it is necessary to know about the quality of water before consumption. The situation is worse in developing countries compared to developed nations. In the USA, the main aim of the federal clean water act is "To protect and maintain the chemical, physical and biological integrity of the nation's waters", highlighting the necessity of maintaining the water quality and the aquatic habitat [1]. People in developing countries like India must be aware of the purification and maintenance of these fresh waters, making themselves involved in learning and research activities about the new technologies that help in the water purification systems. Water purification can remove all the microbes, chemicals, and infective elements from the water resulting in good quality of it. There are different purification techniques like Ultraviolet Filtration, Reverse osmosis, Ion-exchange Resin filter, and Activated Carbon. One of the most important and commonly used filtration processes is Reverse osmosis [1]. This purification process uses a partially permeable membrane that separates ions and unwanted chemical solutes from the water present in the freshwater as pure solvents. It is generally involved in the purification of sea waters by removing salt and other chemical solvents from the water molecules.

In this paper, the Implementation details and the experimental results of an IoT enabled Dynamic Water Purification System is presented. In this work, Water quality monitoring system using IoT is developed as a portable, automated quality analysis and notification system aimed at decreasing manual efforts and enhancing automation. Recently, many such systems have reported weak energy management, Data management [6]. Through recent improved technologies we aimed at secure management systems that are to be real-time implemented. Water quality monitoring is a challenging task since it involves analyzing and maintenance of many parameters. It aims at improving the quality of water through filtration and notifying the users when the system detects bad water quality. The entire process is fully automated and the complete data is maintained in a server and available at the disposal of a consumer through a Mobile Application. The remaining portions of this paper is arranged as follows. Section 2 deals with the Literature review from recent articles reported in this topic. Section 3 presents the methodology adopted in this work. Section 4 discuss the experimental results and the conclusion is drawn in Section 5.

## LITERATURE REVIEW

Recently an efficient solution for monitoring the water purification process is proposed [4] in which, the main idea is to incorporate the TDS sensor and pH sensor along with the purifier. TDS sensor detects the TDS level of the water and pH sensor detects the pH level. The system also consists of Node MCU to transfer data to web applications to show the status of water quality. The system is switched off when the TDS level and pH level of water are abnormal. An intimation is also given to the user about the abnormal water. Even Though they have achieved the IoT enabled monitoring, the implementation of purification process is the same as the conventional purification process. In another work reported recently [8] a solution to treat greywater using RO cartridges is proposed. The proposed idea is to purify greywater using an RO cartridge along with some pre-filtration cartridges such as microfiltration and aerobic biofiltration. The water flow is to be maintained at a certain pressure which is 100 - 400 psi to achieve the purified water. The main drawback of this work is that the quantity of water wastage is large. The authors achieved effective purification by incorporating pre and post filters along with reverse osmosis, however the process is not monitored in real time. In another work [3] the proposed idea is to use an RO cartridge for water purification. The system also has cartridges such as pre-carbon filters, post-carbon filters, sedimentation filters, and UV light radiation. Pre carbon and post-carbon filters both are used to remove active carbons from the contaminated water. UV light radiation is used to kill any bacteria present in the water. A sedimentation filter is used to remove any ionized salts present such as salts and minerals. On the whole, the system depends on every cartridge present for the purification process. This system does not look out for exceptional cases like the lifespan of RO membrane and the effect of such





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cases on the quality of purified water. Another article [4] presented proposed a solution for efficient purification of water for emergencies. The system uses manpower for power supply by pedaling process and purification is done by multiple RO cartridges. This system comes in handy during floods and other disasters. The idea of using multiple RO cartridges has paved the way to produce clean water in times of emergencies. Though it can produce good quality water, the unstable power supply is a limitation in this work. Another recent work [5] proposed an idea to monitor the water purification process. The main idea is to implement an IoT system in household purifiers to enable predictive maintenance. The implemented system allows the water purifier supplier to monitor the working status of the customer's purifiers in remote access. The profile of the customer and data from the customer's device are collected and stored in the cloud server on a daily basis. This allows the water purifier supplier to monitor the customer's device and provide necessary support to the customer in the desired time. Similarly, [8] proposed an idea for water quality monitoring and filter replacement. The main idea is to monitor the quality of outlet water from the purifier and alert the customer and water purifier provider if the water quality exceeds the normal range. The water quality is determined by factors such as pH level, dissolved oxygen content and conductivity value of water using respective sensors. If the data from sensors exceed the reference range, the customer and the provider are intimated about the condition of the filter using the GSM module. This gives the feasibility of filter replacement to the provider. It also ensures the customer to avoid drinking impure water by alerting them. Based on this literature review, it is found that there is a research gap on implementing a water purification which can automatically and dynamically adjust the cartridges based on the input TDS level of the water, which is also connected to the Consumer through IoT Technology.

## METHODOLOGY

According to the World Health Organization (WHO), the TDS level of good quality water is between 50 and 150 ppm. The input water may be with a TDS value of 1000 or higher in highly contaminated areas, and 300 or above in medium contaminated areas. The proposed method can handle the water with a wide TDS range. This is achieved by including three RO cartridges to which the water flow can be adjusted. TDS sensors and flow sensors are incorporated into this process along with RO cartridges. TDS sensors are used to determine the TDS level of input and output water whereas flow sensors are used to determine the quantity of water. Using relay and solenoid valves, alteration in the existing machine can be done which reduces the cost of implementation.

### Block Diagram of the Proposed Method

The detailed block diagram of the proposed system is given in Figure 1. It has four blocks namely, Electronic Sensing and Processing Unit, Water Purification Unit, Actuator elements and IoT Components. The flow sensor mounted on the inlet water hose measures the input quantity of the water and the TDS sensor measures the TDS value. Based on the TDS values the Atmega Controller will control the relay and solenoid valves to control the flow of water into the cartridges. The opening and closing of the valves to the Cartridges are depending on the signal from the microcontroller based on the TDS value. The dynamically purified water is stored in the Water Storage connected to the Outlet valve. At every stage, the process is monitored through an IoT system connected to the Water Purifier and the data is sent to the Server. The information is displayed on a Web Page or an App which can be used by the Customer.

### Process Flow of the Proposed Method

Figure 2 shows the overall process flow of the proposed system. The workflow includes not only the purification process but also exception handling that may be encountered in the purification process. The water from the water tank on the top of the house flows into the purifier. Initially, water is checked for TDS level. Based on the TDS level, the purification process begins. Here, the quantity of inlet water is also determined by the flow sensor. If the TDS of water is less than 50 ppm, it is necessary to infuse the desired minerals into the water. So, water is directed to the alkaline cartridge. Then it flows to the outlet tank. If the TDS of water is between the range of 50 - 150 ppm, then no purification is required. It directly flows to the outlet tank. If the TDS of water is greater than 150 ppm, it is directed





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to the first RO cartridge for purification. The output of the cartridge is checked for TDS after the first cartridge. If it is normal, it goes to the outlet tank. If the TDS of output water of the first RO cartridge is not normal, it is directed to the second RO cartridge. The output of the cartridge is checked for TDS after the second cartridge. If it is normal, it goes to the outlet tank. If the TDS of output water of the second RO cartridge is not normal, it is directed to the third RO cartridge. The output of the cartridge is checked for TDS after the third cartridge. If it is normal, it goes to the outlet tank. If the TDS of output water of the third RO cartridge is not normal, using a solenoid valve the water flow to the outlet tank is blocked to prevent the consumption of impure water. If the outlet water storage is full, the power supply to the system will be switched off. This is implemented to prevent power wastage.

### Hardware Design of the Proposed Method

Figure 3 shows the hardware design within the purifier. Initially, the water reaches the TDS sensor and flow sensor. Each RO cartridge has 2 solenoid valves attached at the front and back. Same as the input side, right before the outlet tank, the TDS sensor and flow sensor are incorporated. The architecture is designed in such a way that water enters the purifier and goes to the first RO cartridge for purification. Based on the TDS level of output the next stage of purification begins. So, the purification process in the system is not a single-level purification but multi-level purification with TDS measurement at each stage. The purification mechanism may also be altered in such a way where the cartridges are used alternatively by calculating the quantity and TDS value of water entering each RO cartridge. This may increase the lifespan of the RO cartridges. The cost of the Hardware may be further reduced by incorporating only one TDS sensor in the water inlet and decision is taken based on the TDS value at the inlet. However, this will not ensure that the required TDS is achieved at the outlet of the Purifier. Table 1 shows the decision taken by the microcontroller based on the TDS sensor data. Based on the TDS data the microcontroller triggers the relay to open and close the solenoid valves for efficient purification. If the TDS level of water is less than 50 the water is directed to the alkaline cartridge for attaining desired quality for consumption. If the TDS level is normal, then the water directly goes to outlet storage. If the water is slightly contaminated, water flows to one cartridge for purification at every instance when water enters the system. Express purification is a case where water flows to each cartridge for quick purification. If the water is moderately contaminated, water flows to two cartridges connected in series for better purification. If water is highly contaminated, water flows to three cartridges connected in series for multi-level purification. The alternative use of the RO cartridges for the same TDS value helps to increase the lifespan of the cartridges. That means, the purification process is distributed among different cartridges for same TDS value. This is relatively a new feature in the realm of water purifiers used for household water purification. A prototype implementation of the Proposed System is given in Figure 4. The implementation shows that the proposed methodology can be incorporated to existing water purifiers thus reducing the cost of implementation. The software design focuses on a web application to provide the data analytics of the purifier system. It enables us to monitor the quality and standard of the water which we consume. The monitoring system has become possible by integrating IoT technology in the system. Node MCU is integrated with the Atmega microcontroller for data transmission. Firebase acts as cloud storage. Through IoT, the TDS level, mineral levels and pH values are continuously updated to mobile application every second. Data analytics such as TDS level of water, pH of water, amount of water consumed, and lifespan of RO cartridges can be seen in the web application. The application also has a feature which enables us to turn on/off the machine remotely.

## EXPERIMENTAL RESULTS AND DISCUSSION

To assess the system implemented, various test cases are required. The input test cases applied should be distinct from each other. Also, the performance of the system need to be measured for a small duration to verify the expected working. To evaluate the performance of the proposed system, the working of the system is closely monitored and the data is recorded for a week of time. On each day water with different TDS value are applied to the input of the proposed system and the output TDS level is noted. The three contamination levels are obtained from corporation water, Water Added with NaCl and Bottled water. It is seen from the Table 2 that water added with NaCl is with the highest TDS value and the Bottled water lack the required minerals. The proposed system is able to handle all the



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cases including extreme TDS values and very low TDS values. For all the different TDS values on different days, the System performance is as expected and satisfactory. As we can see from the results in the table, the input TDS level of each test case is different. But the output TDS level of all test cases is between 50 - 150 ppm. The system has been feasible in handling exceptional cases also. The solenoid valve connected right before the outlet tank has worked as planned to block the contaminated water from flowing to the water storage. The system need not be switched off when the outlet tank is full as it is a fully automated system. So, an LED has been implemented in the tank to indicate the water level. If the tank is full the power supply will cut off, else the machine will be running. This has proven to be working fine in the case of handling power wastage. On the other hand, as an unavoidable loss, the quantity of wastewater is high due to multi-level purification. This disadvantage need to be further explored and effective solution need to be incorporated for commercial implementations.

## CONCLUSIONS

Fast urbanization across the world demand for purified water needs. Many of the studies show that the water contamination is at alarming level in developing countries. Thus it is required to address the water purification problem for household requirement using some efficient implementations compared to the existing methods. The commercially available existing RO cartridge based water purifier system has problems like very small life span, static purification settings to varying input TDS level, huge water wastage and lack of connectivity. In literature some attempts have been made to improve the connectivity of the water purification system by incorporating IoT technology into it. In this paper, the details of an idea crafted to implement a water purifying system with higher efficiency and greater lifespan along with a good monitoring system is presented. The proposed system is a multi-level purification system which can dynamically change the settings to accommodate varying and unpredictable TDS values in the input side. The enhancement of the purification process using RO cartridges has paved the way to execute multi-level purification. Exceptional cases like power usage when outlet tank is full, the flow of impure water to outlet tank once the membrane of all RO cartridges is incapable of purifying water are handled. Strategies to increase the life span of the costlier RO cartridges also adopted in the proposed method. The IoT connectivity helps the consumer to monitor the quality of the water in a real time manner and take decisions based on that. Assessment of the design implemented in the purifier has been carried out using different test cases for a week and satisfactory results are obtained. The system can be further refined to use in real time scenarios.

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**Table 1. Decision making conditions programmed for the Proposed Methodology**

| TDS Value                           | Water Quality           | Cartridge 1 | Cartridge 2 | Cartridge 3 | Alkaline Cartridge |
|-------------------------------------|-------------------------|-------------|-------------|-------------|--------------------|
| <50                                 | Acidic                  | CLOSE       | CLOSE       | CLOSE       | OPEN               |
| 50 - 150                            | Normal                  | CLOSE       | CLOSE       | CLOSE       | CLOSE              |
| 150 - 300                           | Slightly contaminated   | OPEN        | CLOSE       | CLOSE       | CLOSE              |
| 150 - 300                           | Slightly contaminated   | CLOSE       | OPEN        | CLOSE       | CLOSE              |
| 150 - 300                           | Slightly contaminated   | CLOSE       | CLOSE       | OPEN        | CLOSE              |
| 150 - 300<br>(Express Purification) | Slightly contaminated   | OPEN        | OPEN        | OPEN        | CLOSE              |
| 300 - 1000                          | Moderately contaminated | OPEN        | OPEN        | CLOSE       | CLOSE              |
| 300 - 1000                          | Moderately contaminated | CLOSE       | OPEN        | OPEN        | CLOSE              |
| 300 - 1000                          | Moderately contaminated | OPEN        | CLOSE       | OPEN        | CLOSE              |
| >1000                               | Highly Contaminated     | OPEN        | OPEN        | OPEN        | CLOSE              |

**Table 2. Experimental Results on Purification of water at different TDS values**

| TIME STAMP | INPUT WATER           | INPUT TDS LEVEL (ppm) | OUTPUT TDS LEVEL (ppm) |
|------------|-----------------------|-----------------------|------------------------|
|            | Corporation Water     | 637                   | 94                     |
| 05/12/2021 | Water Added with NaCl | 1414                  | 103                    |
|            | Bottled Water         | 17                    | 67                     |
| 06/12/2021 | Corporation Water     | 739                   | 102                    |
|            | Water Added with NaCl | 1334                  | 110                    |
|            | Bottled Water         | 34                    | 78                     |
| 07/12/2021 | Corporation Water     | 698                   | 93                     |
|            | Water Added with NaCl | 1852                  | 121                    |
|            | Bottled Water         | 56                    | 122                    |
| 08/12/2021 | Corporation Water     | 586                   | 86                     |
|            | Water Added with NaCl | 1620                  | 119                    |
|            | Bottled Water         | 48                    | 91                     |
| 09/12/2021 | Corporation Water     | 766                   | 110                    |
|            | Water Added with NaCl | 1598                  | 134                    |
|            | Bottled Water         | 42                    | 66                     |





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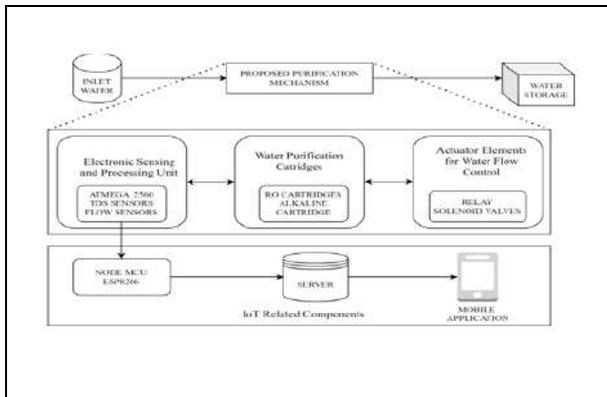


Figure 1. Block Diagram of the Proposed Methodology

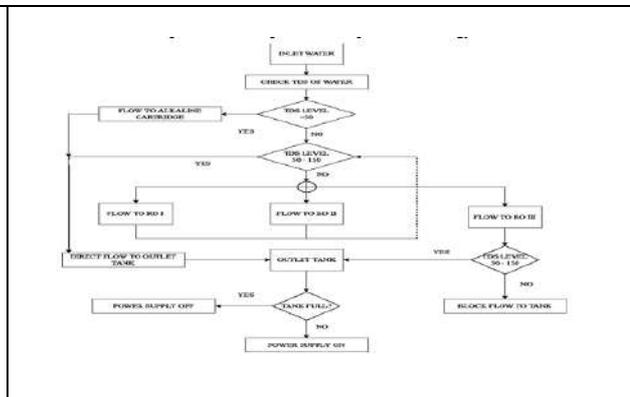


Figure 2. Flow Chart of the Proposed Methodology

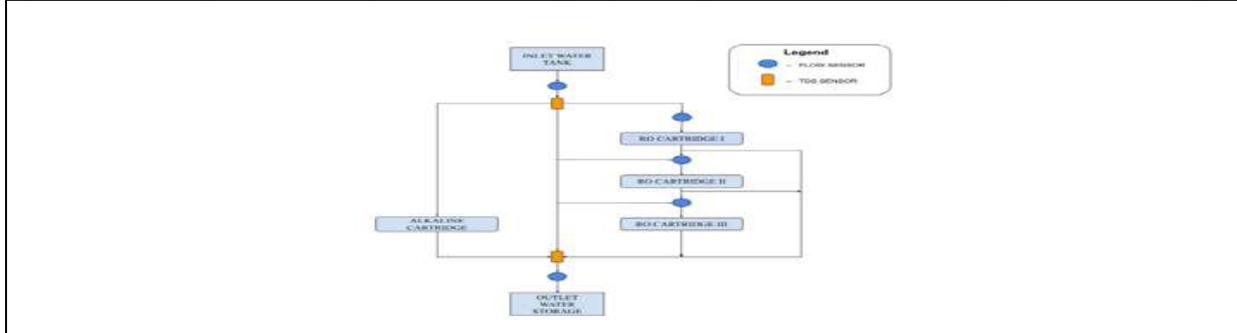


Figure 3. Hardware Design of the Proposed Methodology



Figure 4 (a) Front View of the Implementation

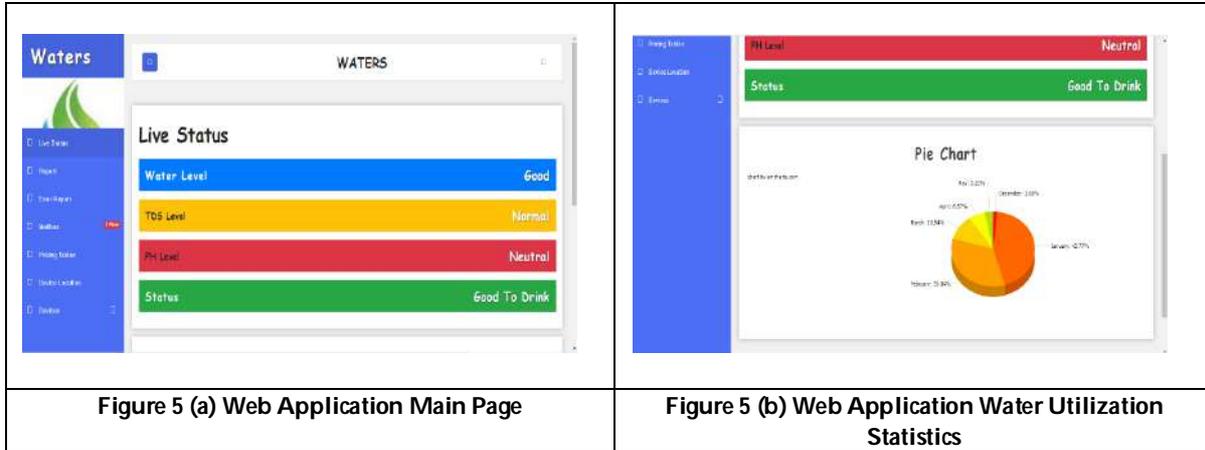


Figure 4 (b) Side View of the Implementation





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## Advances in Intelligent IoT Systems

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### ABSTRACT

The Internet of Things (IoT) is a network that connects everything to the Internet using pre-determined protocols and data sensing equipment to exchange data and communicate in order to perform smart recognitions, tracing, monitoring, and administration. With the Internet of Things (IoT) approaching the next phase of development, it's more important than ever to understand the various possible areas for IoT applications, as well as the associated research problems. This paper highlights future uses and research issues as well as the current progress of IoT technology.

**Keywords:** Internet of Things, Digital Transformations, IoT applications, future technologies

## INTRODUCTION

In the past decade, the world has witnessed various strategic digital transformations. Integrating disruptive technology to continually boost productivity, value creation, and social welfare in a business is what digital transformation is all about [4,5]. The Internet of Things (IoT) devices are having a big impact on the globe right now. The way people live, study, work, communicate, and interact has all changed as a result of the digital revolution. The Internet of Things (IoT) has an impact on the digital strategies of commercial operating models and fast-changing marketplaces [9]. The Internet of Things (IoT) was coined by MIT's Kevin Ashton, a member of the RFID development community in 1999, and it has only lately become more significant in the real world, thanks to the rise of mobile devices, embedded and ubiquitous connectivity, cloud computing, and data analytics. Smart cities, smart homes, Industry 4.0, and Society 5.0 are just a few of the interesting applications and services enabled by IoT [2].





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According to the study, by 2020, 50 billion products will be connected to the Internet [3]. In addition, the statistics show that 6 products per person (approx.) are used [3]. This means that IoT will be used to its full potential, and performance will be six times better. And this is a large amount in and of itself, demonstrating the technology's long-term viability. The rest of this paper is organized as follows. Section II describes Digital Transformations. In Section III, an introduction to the Internet of Things (IoT) is presented. Section IV discusses the characteristics of the Internet of Things (IoT). Section V provides the recent applications taking place in the field of IoT. Section VI briefs about the major role of IoT in Industry 4.0. Section VII provides the future aspects of IoT. Finally, the paper is concluded in Section VIII.

### Digital Transformation

The use of digital technology has an impact on a large number of commercial businesses and corporations. Digital technology integration influenced goods, company processes, sales channels, and supply chains, resulting in higher sales, productivity, value creation innovation, and customer engagements. As a result, business models might be altered or eliminated entirely (Downes and Nunes 2013). The goal of digital transformation plans is to bring together and prioritize the many different threads of digital change[5]. The continuing digital transformation process entails the deliberate regeneration of an organization's business model, collaborative approach, and culture using new digital technology [13,16].

### The Internet of Things

The Internet of Things (IoT) was coined by MIT's Kevin Ashton, a member of the RFID development community in 1999, and it has only lately become more significant in the real world, thanks to the rise of mobile devices, embedded and ubiquitous connectivity, cloud computing, and data analytics. Smart cities, smart homes, Industry 4.0, and Society 5.0 are just a few of the interesting applications and services enabled by IoT [2]. The Internet of Things (IoT) is a network of uniquely addressable physical objects that are outfitted with sensors, software, processors, and the ability to communicate and collaborate via the Internet[6]. Lightbulbs, locks, and vents are examples of simple objects having exceptional computing and analytical ability. The Internet of Things (IoT) is a network of machines or gadgets that can communicate with one another and with the cloud. It is the most current technology to demonstrate its presence on a worldwide scale. IoT has increasingly gotten a lot of interest from a variety of consumers and sectors. IoT is one of the most important areas in which future technology must be developed[7]. According to the survey, the number of Internet of Things (IoT) devices globally is expected to nearly triple by 2030, from 8.74 billion in 2020 to over 25.4 billion

### CHARACTERISTICS OF IoT

The fundamental characteristics of IoT are Connectivity, Things, Data, Heterogeneity, Intelligence, Action, and Ecosystem. [6,7,11].

**Connectivity:** There must be a connection between multiple levels with everything going on in IoT devices and hardware, with sensors and other electronics, and connected hardware and control systems.

**Things:** The Internet of Things (IoT) provides privacy protection and semantic consistency between physical and virtual things to items within its boundaries. Sensors or sensing materials can be mounted to objects ranging from sensors to household appliances to tagged livestock.

**Data:** Data is the fuel of the Internet of Things. The tracking of IoT devices is aided by data received from a variety of physical objects via various sensors.

**Heterogeneity:** The gadgets are diverse, with many hardware platforms and networks. Through numerous networks, they can communicate with other devices or service platforms.

**Intelligence:** The aspect of intelligence is in the sensing capabilities in IoT devices and the intelligence gathered from big data analytics (also artificial intelligence).





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**Action:** Intelligence is responsible for the action. This action can be manual, action based upon debates regarding phenomena (for instance in smart factory decisions), and automation, often the most important piece.

**Ecosystem:** The Internet of Things' place in respect to other technologies, communities, and goals, as well as its greater context. Consider the Internet of Everything, the platform dimension, and the value of strong partnerships.

### Applications of IoT

Individuals, corporations, and society as a whole use and incorporate IoT in practically every aspect of daily life. The Internet of Things allows for the establishment of a variety of industry- and user-specific IoT applications. Device-to-device and human-to-device interactions are trustworthy and resilient with IoT applications, while devices and networks enable physical connectivity. Device-based IoT applications must ensure that data/messages are received and processed in a timely way[19]. The IoT application covers transportation, buildings, cities, lifestyle, retail, agricultural, manufacturing, supply chain, emergency, healthcare, user interaction, culture and tourism, environment, and energy.

### Internet of Medical Things (IoMT)

The Internet of Medical Things (IoMT) is a network that connects healthcare IT by connecting Internet-connected medical devices, physical infrastructure, and software applications. IoMT, also known as the Internet of Things in healthcare, allows wireless and distant devices to securely connect through the Internet in order to process medical data quickly and efficiently. In-home IoMT allows people to transfer medical data from their homes to other sites, such as their primary care provider or a hospital. On-body IoMT refers to the usage of wearable medical equipment that is linked to remote tracking or monitoring systems. Wearable technology in the future will be capable of detecting ailments early on and triggering treatment at an early stage. Nanosensors with high sensitivity will be able to detect components in our body fluids (sweat, tears, and saliva) and alert us to physical irregularities that could lead to more serious diseases in the future. Surgically implanted nano-sensors will detect potential medical issues (such as cancer) in our bodies before they become severe. When a medical problem is detected early, it can be treated more effectively.

### IOsL (Internet of Smart Living)

The Internet of smart living vastly improves the ability to control and monitor all of the operations that occur in your house. Refrigerators with LCD screens that display what's inside, food that's due to expire, and items that need to be purchased, all accessible via a smartphone app. Washing machines with an interface to a Smartphone app allow for remote temperature control and monitoring of the oven's self-cleaning feature, and kitchen ranges with an interface to a Smartphone app allow for remote temperature control and monitoring of the oven's self-cleaning feature. Intruders can be deterred by detecting window and door openings and infractions. Remotely turning on and off appliances to minimize mishaps and save energy. The virtual glasses, fitness bands that track things like calorie burn and pulse rate, and GPS tracking belts that we've been using for a while are examples of smart products used every day [20].

### IOsE (Internet of Smart Environment)

Controlling factory CO<sub>2</sub> emissions, automobile pollution, and farm-produced hazardous gases. As part of the combustion gas monitoring and pre-emptive fire conditions, weather factors such as humidity, temperature, pressure, wind speed, and rain are monitored to establish warning zones. Early Detection of Earthquakes The appropriateness of water in rivers and the sea for drinkable usage is being investigated. During rainy days, water level differences in rivers, dams, and reservoirs are monitored. Tracking collars with GPS/GSM modules that can be used to find and monitor wild animals and provide their coordinates via SMS.

### IOsC (Internet of Smart Cities)

Another IoT application that is piquing people's interest around the world is the smart city. Internet of things applications for smart cities includes smart surveillance, smarter energy management systems, automated



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transportation, water distribution, urban security, and environmental monitoring. Intelligent Highways and Smart Roads with warning messages and detours based on weather conditions and unexpected events such as accidents or traffic bottlenecks. Residents can find and reserve the closest available parking spaces thanks to real-time monitoring of parking spaces in the city. Products like the cellular communication-enabled Smart Belly garbage will send alerts to municipal agencies when a bin needs to be emptied[8].

**IOsE (internet of Smart Energy)**

Monitoring and management of energy consumption. Monitoring and analyzing the energy flow from wind turbines and power plants, as well as two-way communication with smart meters to assess consumption trends. A controller for AC-DC power supplies determines the required energy and enhances energy efficiency with less energy waste for power supplies connected to computers, telecommunications, and consumer electronics applications. The performance of solar energy plants is monitored and optimized without any manual interactions.

**IOsA (Internet of smart agriculture)**

Controlling the microclimate to increase the quantity and quality of fruits and vegetables produced. To prevent fungus and other microbial pollutants, humidity and temperature levels in alfalfa, hay, straw, and other crops must be controlled. Animals grazing in open pastures or large stables are located and identified. Investigation of agricultural ventilation and air quality, as well as the detection of hazardous gases emitted by feces. Control of offspring's growing environment at animal farms to ensure their survival and health, field. Reduced spoilage and crop waste will result from improved monitoring, accurate ongoing data gathering, and management of agriculture fields, including better control of fertilizer, energy, and watering [21].

**IoT and Industry 4.0**

Industry 4.0 is a new business paradigm that capitalizes on the advantages of enabling technologies that enable intelligent systems and environments. While smart homes and workplaces often acquire, analyze, and act on a wide range of relevant context information, smart automated manufacturing systems could benefit from the same capabilities. Smart manufacturing systems, for example, can make well-informed decisions in real-time to adjust and improve their production processes or accommodate a customer's specific preferences without delaying production. Manufacturing has undergone a digital transition as a result of the growth of smart enabling technologies. This paradigm shift is referred to as the Fourth Generation Industrial Revolution (Industry 4.0) or the Factory of the Future (FoF). Thanks to the Cyber-Physical Systems (CPS)-enabled production and the Internet of Things (IoT), smart factories are seen as the foundation for producing smart products through smart processes and procedures. Hundreds, if not thousands, of sensors and equipment are connected in large factories, not just within the plant but also with other companies and the outside world. Smart products will plan, regulate, and optimize their production processes with minimal human interaction, thanks to advancements in sensor technology, machine-to-machine connectivity, big data analytics, and machine learning. The goal of this digital transformation is to improve production process transparency across the manufacturing enterprise's organizational boundaries. To support data-intensive business operations and time-critical applications, the factory of the future will use Internet-based data-accessing and data-processing services.

**Future Trends of IoT****5G and IoT**

5G allows for faster, more stable, and more secure communication, which is helping to advance everything from self-driving cars to smart grids for renewable energy and AI-enabled manufacturing robots. The Internet of Things (IoT) and 5G technology are more than just new generations of wireless technology. It marks a watershed moment in the mobile ecosystem, releasing a potent mix of incredible speed, greater bandwidth, low latency, and increased power efficiency that will power billions of new connections over the next five years, transforming our world. It's launching a vast IoT ecosystem in which networks can support billions of connected devices while balancing speed, latency, and cost [12,18].



**Ruth Rubavathy et al.,****ICT for Smart Cities**

IoT is capable of constructing a green environment based on energy efficiency. IoT results in the conservation of natural resources, the reduction of expenses, and the reduction of technical influence on the environment and human health. As a result, green IoT focuses on environmentally friendly production, design, use, and disposal.

**Nanotechnology and IoT**

The advancement of nanotechnology and the Internet of Things has enormous promise in practically every domain, and its union is seen as the next evolutionary step in 21st-century technology. Researchers are currently developing IoNT (Internet of NanoTechnology) -based nanomachines for live deployment in a variety of sectors in the near future. Work on establishing an IoNT-based Nano Sensor Network for Industry or Agriculture for various monitoring tasks will begin in the near future[22,10].

**CONCLUSION**

According to a market research estimate, worldwide expenditure on IoT software and hardware is expected to increase significantly, from US\$726 billion in 2019 to US\$1.1 trillion in 2023. 2 According to a recent IoT expenditure analysis, Asia/Pacific accounted for the majority of IoT investment in 2019, with India investing US\$20.6 billion[15, 17]. Because of its wide range of applications and a heterogeneous blend of multiple communications and embedded technology in its design, the Internet of Things is an important study issue for researchers in embedded, computer science, and information technology.

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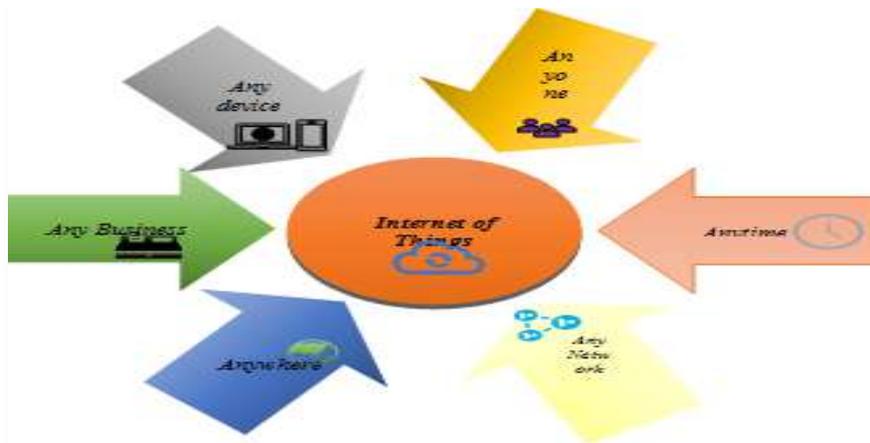


Figure 1: Internet of Things





## IoT Enabled Paddy Field Monitoring and Disease Detection System

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### ABSTRACT

In the realm of agricultural information, the automated detection and diagnosis of paddy leaf diseases is greatly needed. To reduce the number of network parameters while increasing the accuracy of paddy leaf disease identification, researchers in this study built a Convolutional Neural Network model utilizing deep learning. It is possible to train and evaluate four various kinds of paddy leaf diseases by adjusting settings, changing pooling combinations, adding dropout operations and rectified linear unit (ReLU) functions and decreasing the number of classifiers. An average accuracy of 97.32 percent is achieved by the model while recognizing four different paddy leaf illnesses. The enhanced strategy may have improved paddy leaf disease accuracy and reduced iterations, resulting in improved training and identification efficiency. Utilizing the internet of things to predict disease occurrence in addition to the approaches outlined above. That is, when the humidity is high, brown spot disease develops and when the soil moisture level rises, there is a greater chance of leaf blight developing. We can forecast disease occurrence as early as feasible by collecting data on these criteria. It is included agri-automation in this article in addition to that of the detection part. We are combining IoT and CNN to anticipate and identify paddy leaf diseases such as leaf smut, leaf blight, brown spot and rice blast.

**Keywords:** Raspberry pi, moisture sensor, DHT11, float sensor, Convolutional Neural Network (CNN) and Thing Speak



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## INTRODUCTION

In terms of both quantity and quality, plant diseases are by far the most common cause of agricultural output losses. These losses have a negative influence on both the cost of production and the profit margins of agricultural stakeholders. However, quick and accurate recognition tools are still limited. There is a direct correlation between disease outbreaks threatening farmer livelihoods and in turn, the nation's food supply and nutritional health security. Farmers and plant pathologists have long relied on their eyes to diagnose illnesses and make judgments based on their experiences, which is often erroneous and prejudiced because many diseases appear to be similar in the early stages of development. They must also pass on their knowledge to succeeding generations. The use of pesticides that aren't essential results in higher production expenses as a result of this method. According to the findings of this study, farmers, especially those who are new to farming and lack expertise, need a dependable database and a precise disease detector. Advances in computer vision open the way for this using state-of-the-art ML techniques. In order to safeguard the crop in a timely way, an early disease detection system is needed. Monitoring and disease detection in paddy fields would be made easier with an IoT-enabled solution. There are several variables that may be measured on the farm to assist anticipate paddy field disease as well as increase crop yields, such as moisture, water level, humidity, and temperature. Many studies have been conducted in the past. Publicly accessible online dataset "Plant Village" is the most often used dataset, with Convolutional Neural Networks (CNN) being the most popular models. The CNNs, on the other hand, require a large quantity of training data to work properly. We suggested a CNN approach to address multi-class classification for four diseases: blast, brown spot, leaf blight, and leaf smut (shown in figure1) in this paper. When data is scarce, the suggested approach aims to improve model accuracy. As a guideline, the rest of this project is divided into the following. Afterwards, Section II shows how the recommended modal works, Section III describes the obtained outcome, and Section IV ends by looking back at the previous work in this area. This monitoring system consists of two parts: one is prediction and other is detection. In the prediction part we are enabling the Internet of Things and the detection is done using CNN further details about prediction will be detailed in section II.

## MATERIALS AND METHODS

Rice is a staple food in all of India, and India produces the most rice after China. Because it requires average temperatures of 25 to 26 degrees Celsius and a minimum of 100cm of rainfall, it is regarded as a top crop to grow in the Monsoon. Brown spot, rice blast, leaf smut, and leaf blight are four distinct illnesses. Rice blast is disseminated by deep irrigation, while brown spot disease develops in locations with high relative humidity (86-100 percent) and temperatures ranging from 16 to 36 degrees Celsius. It's frequent in soils that haven't been flooded and are nutrient-deficient, as well as soils that have accumulated hazardous compounds. This measure is used to monitor rice blast disease using a float sensor and the water level of the paddy field. There are two stages to the suggested methodology: Phase 1 and Phase 2 that is depicted in figure 2. One is for monitoring/prediction, while the other is for detection.

### PREDICTION

#### DHT11

The DHT11 sensor consists of a capacitive humidity sensor and a temperature sensor. As a dielectric, a moisture-holding substrate serves as the humidity sensor capacitor's dielectric. The capacitance value fluctuates as a result of variations in humidity. Analog resistance measurements are digitized using the integrated circuit (IC). The resistance of this sensor decreases as the temperature rises because it utilizes a Negative Temperature Coefficient Thermistor to monitor temperature. Ceramic or polymer semiconductors are typically used to build this sensor because of their high resistance value even at the tiniest temperature changes. Using the DHT11, one can measure temperatures from 0 to 50 degrees Celsius with a two-degree precision. Here, it is used to measure the temperature and humidity of the paddy field. The above figure depicts the experimental setup of prediction phase that consists of DHT11, Float sensor and soil moisture sensor for sensing and RaspberryPi 3 for processing the sensing data.



**Float sensor**

A float switch, which serves as a level sensor, can be used to check the liquid level in a tank. As the liquid level changes, the mechanical switch floats on top and switches on or off. Here, it is used to sense the water level in a paddy field.

**Moisture sensor**

When a small charge is given to the electrodes, the sensor's electrical resistance is measured. As plants use water or soil moisture decreases, resistance builds in the sensor. As soil moisture levels rise, the resistance drops.

**Raspberry pi 3**

Raspberry Pi, a tiny computer with all the power of a desktop computer. All the components are soldered to the board for an all-in-one solution, including the CPU and the GPU in one integrated circuit. Here, it is used to process the information which was collected from sensors using a Raspberry Pi 3 and the output is displayed in the Jupyter software, with the result graphically represented in ThingSpeak cloud, and finally the result is displayed in Jupyter along with detection part which will be detailed in further section. ThingSpeak - the cloud platform, generates API keys. With the help of API key, users can show our output in the same platform in which the output of the detection part is present.

**ThingSpeak**

IoT analytics platform ThingSpeak collects, visualizes, and analyses streaming data in real time. ThingSpeak allows us to transfer data from our devices, produce real-time graphs and issue alarms across the Internet of Things.

**DETECTION**

The input layer is where the entire CNN gets its information. It usually represents the image's pixel matrix in a neural network for image processing. The convolutional layer is used to extract features from an image. Output in a CNN is a fully connected layer that flattens and delivers the input from the other layers to transform the output into the desired number of classes. Below, users will go through the feature extraction process used in the Convolutional layer in more detail.

**Dataset Collection**

At all stages of object recognition research, a usable dataset is required, from training algorithms to evaluating their performance. A total of 410 pictures were gathered from various sources, such as Google websites, spanning various periods of paddy leaf disease prevalence and grouped into four groups. Leaf diseases of paddy are depicted in Figure 1. Leaf spots, leaf blights, brown spots, and blast were among the diseases evaluated in this study. A Python script that compared images received from several sources cleaned up the images. By comparing the metadata of the photographs (name, size, and date), the script was able to identify duplicates. The photographs were examined numerous times by human specialists after they were automatically removed.

**Augmentation**

To train properly a CNN, a substantial quantity of data is required. The more data CNNs are exposed to, the more features they will be able to extract from that data. Alternate approaches must be utilised to increase the dataset since the initial dataset of leaf image data collected in this study is inadequate for the separation of distinct illness groups. The above methods increase the dataset, which helps to reduce over fitting during the training stage. The paddy leaf dataset contains 410 pictures in total, including 317 (77.4%) for training and 93 (22.6%) for testing. Table I displays the paddy leaf disease picture dataset.

**Image pre-processing and labeling**

Preprocessing the dataset for the deep CNNs classifier before training improves feature extraction and consistency. As one of the most important jobs, image dimensions and kinds need to be standardized. Python program built on



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the OpenCV framework expand all photos in this research to a resolution of 256\*256 pixels. To make sure that each category in the collection reflected a disease, agricultural experts evaluated leaf photographs organized by keyword search and classified each image with the right ailment term. It is widely accepted that the training and validation datasets must contain images that have been accurately recognised. Only in this manner is it possible to develop a model that is both appropriate and reliable. In addition to the training and testing datasets, this process involves labeling various dataset classes and subsets.

### Convolution

CNNs are built on the convolutional layer, which is an essential component. Learning filters (or kernels) with a small receptive field yet spanning the entire input volume make up the layer's parameters. To create a two-dimensional activation map for each filter, a dot product calculation between the filter entries and the input volume is performed during the forward pass. Filters are activated when the network detects a specific feature in the input data at a specific point. Filter activation maps are stacked in depth to produce the final output volume of the convolution layer. To put it another way, the output volume may be thought of as the output of a neuron that only assesses a small portion of the input and shares parameters with other neurons in the same recurrent neural network.

### Activation function

$F(x)=\max(0,x)$  is used in the rectified linear unit activation function (ReLU). A zero is placed in front of any negative values in an activation map. The decision function and overall network are introduced with nonlinearities without affecting the convolution layers' receptive fields.

### Pooling

With more convolutional layers, the network's parameters will grow at an exponential rate. The number of network parameters may be greatly reduced using the pooling process. By analyzing the statistical characteristics of a region, users can more precisely and efficiently describe everything which makes up that region. Different pooling combinations will be tested in this project to see how they affect identification accuracy.

### Dropout

As a solution to the problem of a lack of training samples in neural networks, dropout has been proposed. There is a unique structure associated with each input sample, yet hidden nodes from all of these unique network structures are shared, resulting in separate samples that fit various models. A dropout procedure will be introduced to this test to prevent over fitting and increase model generalization.

## RESULTS AND DISCUSSION

Four paddy leaf dataset samples are used in this experiment, where the CNN model's classifier is used to perform several iterations. Only after a total of 50 iterations is the top – 1 accuracy and model loss assessed. There is a loss curve shown in Figure 7 of the model and a change in top-one test accuracy shown in Figure 6. In this experiment, the model's starting learning rate is 0.001. A top – 1 average training accuracy of 97.32 percent and a testing accuracy of 94.60 percent have been demonstrated by experiments utilizing this CNN model for training and testing the paddy leaf image dataset. The collected data from DHT11, moisture and float sensor are processed in Raspberry Pi and the output is displayed in the ThingSpeak platform. The ThingSpeak cloud platform possesses an API key. Using the API key, users can retrieve the cloud data in the Jupyter platform itself. The image of a paddy leaf infected is used as input, and the afflicted illness, as well as field temperature, humidity, moisture, and water level, are returned as output. "Area under the ROC Curve" is a phrase used to describe the number of runs over the full training dataset that the machine learning algorithm has performed. Those familiar with the concept of the area under the ROC curve should think of the AUC as a two-dimensional measurement of the full area under the ROC curve (1,1). Here, AUC and epoch are inversely related. The training and validation losses for the four models of paddy leaf disease detection are shown in this image.





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## CONCLUSION

Accuracy in testing and training of the general convolutional neural networks model for paddy leaf disease diagnosis was 97% and 94.0%, respectively, in this study. When the train-test set is between 77.4 and 22.6, the classification strategy utilized in this study allows the systems to collect a wide range of sample scenarios with robustness. Experiments have demonstrated that adding a ReLU function and dropout procedures, as well as increasing the diversity of pooling processes, may all enhance recognition accuracy. It will be necessary to use new algorithms and deep learning architectures when new paddy illnesses are discovered in future study. To accurately forecast the onset of illness, users can make use of an Internet of Things (IoT)-based prediction model. Using mobile devices in conjunction with this strategy, farmers are able to make timely and educated decisions about crop disease information.

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**Table 1. Collected dataset**

| S.no | Class       | Total number of images | Number of images for training | Number of images for testing |
|------|-------------|------------------------|-------------------------------|------------------------------|
| 1    | Brown spot  | 123                    | 100                           | 23                           |
| 2    | Rice blast  | 110                    | 80                            | 30                           |
| 3    | Leaf smut   | 60                     | 40                            | 20                           |
| 4    | Leaf blight | 117                    | 97                            | 20                           |
| 5    | Total       | 410                    | 317                           | 93                           |





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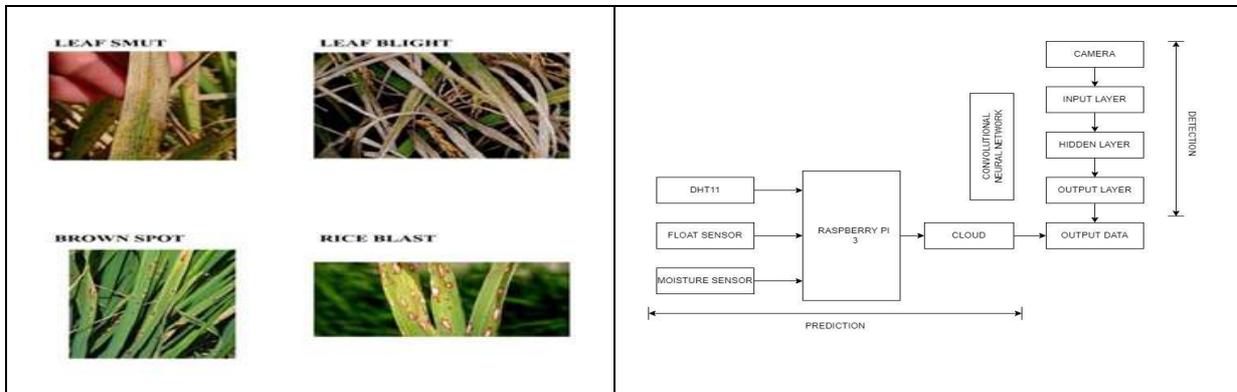


Figure 1: Paddy leaf diseases

Figure 2: Block diagram



Figure 3: Prediction phase

Figure 4: Output in ThingSpeak platform

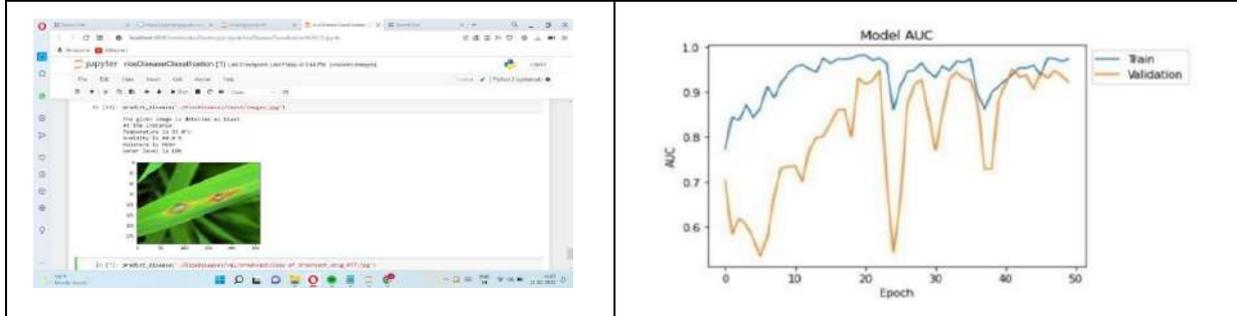


Figure 5: Output of proposed methodology

Figure 6: Epoch vs AUC

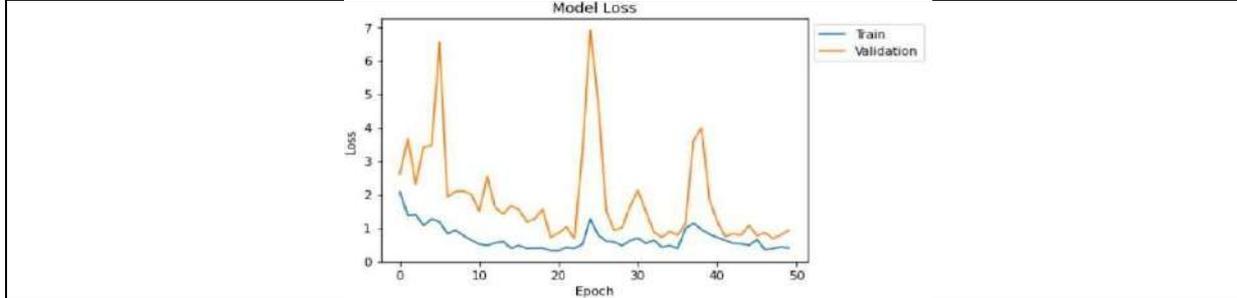


Figure 7: Loss curve





## A Novel Analysis on Surf and ORB Techniques for Hand Dorsal Vein Recognition

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### ABSTRACT

The Science and technology is a hurriedly blooming meadow in concern with Digital Image Processing (DIP) for various applications such as authentication, medical image analysis, recognition and so on. The hand dorsal vein pattern has played a special role in biometric technology in recent decades among the researchers. Dorsal hand vein recognition is preferable for the purpose of authentication and identification because it is impossible to pilfer the vein patterns and they are unique from each other. For obtaining better accuracy in matching the dorsal hand vein pattern, here in this paper the contribute is with four matching algorithms were carried out. In this paper, the various algorithms are analyzed to predict the betterness of image recognition and the accuracy of all the four algorithms are predicted with various threshold levels. FAR and FRR for different threshold values are computed and from the above calculation ORB techniques are comparatively better than SURF technique.

**Keywords:** Speeded-UP Robust Feature, Dorsal Hand Vein, Features from Accelerated Segment Test, Oriented FAST and rotated BRIEF, Robust Feature Extraction and Matching

### INTRODUCTION

As per the advancement in technologies, vein recognition has churn out to be the most vital part of hotspot research worldwide since a few decades. Due to the uniqueness of vein patterns, it is impossible to steal or pilfer the exactness of any human vein pattern [1]. The matching algorithms give a hand to come-up with accurate pattern matching. The matching of vein patterns aids in securism, identification of theft and is more reliable. SURF techniques help in comparing and predicting the dataset with similar invariant representation. Oriented FAST and rotated BRIEF relies on a typically on the proposed work of Ethan Rublee, et al., in ICCV [1]. ORB algorithm relies on FAST and BRIEF matching techniques to overcome the difficulties of rotation and the speed has improved greatly along with rotational invariance. BRIEF matching algorithms focus mainly on the image patch as a string of binary which has a



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very small number of intensity. FAST matching techniques involve extracting the feature points by implementing corner detection methods. Here in this paper we compared the two different algorithms for local invariant image with the performance measures. The performance measures are evaluated by Accuracy, recall, FAR and FRR.

**Dataset**

Dorsal hand vein dataset is a cluster of images which comprises 100 subjects with five pictures of the same individual per hand which is gathered from the Cairo University [12]. The dataset images of hand vein gathered from the Cairo University is of 500 pictures and are from various expert people like understudy, laborers, staff and so on. Dorsal hand vein dataset is an cluster of images which comprises of 100 subjects with five pictures of same individual per hand which is gathered from the Cairo University [13]. The dataset images of hand vein gathered from the Cairo University as in Fig.1 is of 500 pictures and are from various expert people like understudy, laborers, staff and so on. The database of dorsal hand vein is in bitmap format with the dimensions of 320\*240. Both male and female hands that are under the age of 16 to 65 years are composed as a vein data. The fig.1 is a sample dataset image which was collected from Cairo University [14].

**Pre processing**

The quality, perfection and performance of an image are contrasted by processing the dataset in distinct ways under random and illumination conditions. The thinning method is enhanced to the image in order to diminish the objects in and around the images.

**Contrast Enhancement**

The input images are processed to enhance the contrast present in the image quality. The image quality and performance are better once contrast enhancement is done as in Fig.2

**Filtering**

The filtering techniques are followed to remove the noises to transfer the intensity of an image's pixel. The surplus noises [15][16] are removed with high pass filter and the histogram[17] are favor with contrast adjustment as in Fig.3

**Morphology**

The image's structure and its outward appearance are accounted as a goal of morphology in order to remove the deformity. Two processing operations under morphology techniques are dilation and erosion:

**Skeletonization**

The dataset region of background is reduced as a skeletal remnant from a binary image which extends the connectivity of dorsal vein by throwing away the pixels of original foreground. Fig.4 represents skeletonization of an image.

**Perimeter Determination**

The pixel perimeter is determined by its neighborhood. Based on the intensity of binary image pixel the hand dorsal vein quality prolongs as in Fig.5

**Overview of Feature Extraction and Matching Techniques****Feature extraction:****SURF**

The Speeded-Up Robust Feature is a robust, simple, ease and fast algorithm technique in comparing the images of a dataset for the local similarity invariant representation. The prominent features of SURF algorithm are local descriptors based approach and the interest point for the invariant representation of an image. SURF image matching techniques follow two steps, each step involved in this matching techniques are essential for the image recognition. The steps are Feature extraction and feature descriptor. H. Bay et al. extracted the proposed work under Speeded Up Robust Features (SURF) [3], representing the merit of novel invariant images in terms of rotation and scaling. Based





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on the Hessian Matrix, SURF helps in exploiting the images which are integral to ameliorate the feature detection speed using the BLOB detector for predicting the interest point. [2]. The primary goal over SIFT to the SURF is its computational cost which is low. The point “ $x = (x,y)$ ” of the Hessian Matrix has a scale “ $\sigma$ ” which is represented as follows in the equation (1).

$$\mathcal{H}(x, \sigma) = \begin{bmatrix} L_{xx}(x, \sigma) & L_{xy}(x, \sigma) \\ L_{xy}(x, \sigma) & L_{yy}(x, \sigma) \end{bmatrix} \quad \text{---- (1)}$$

Here the convolution occurs with second order derivative of Gaussian with its input image as “ $I$ ” in the concerned point “ $x$ ” which is represented as “ $L_{xx}(x, \sigma)$ ”, and similarly for “ $L_{xy}(x, \sigma)$ ” and “ $L_{yy}(x, \sigma)$ ” [3].

### ORB

Oriented FAST and rotated BRIEF algorithm [4], is proposed in concern with FAST algorithm [10,11] and BRIEF algorithms. The binary string helps in describing the feature points for the above methods With the help of improved FAST feature detection, ORB’s feature points are detected easily and it is described using the feature descriptor-BRIEF. The naturalness of speed is very fast in concern with FAST and BRIEF feature descriptors. The vital role of ORB is its speed. By utilizing the ORB algorithm, the sensitivity to noise is reduced but it is very fast in speed and has rotational invariance.

### FEATURES FROM ACCELERATED SEGMENT TEST (FAST)

Features from accelerated segment test (FAST) are a special method which focuses on detecting the corners of an image. Thus it is represented as a corner detection method. FAST feature detector plays a vital role in extracting the feature points. Once it was done the later part was to map objects which are tracked as a task in the computer vision. Computational efficiency is the prominent merits of the FAST corner detector. The A’s pixel neighborhood will have ample or sufficient pixels in the grey area of an image which act as a base knowledge of the feature detector in predicting the FAST corner. Comparatively when dealing with grayscale images, The grey will be neither greater nor lesser to the area’s A’s pixel value. In selecting the center point as an arbitrary pixel from the circular area. Circular area will be suggested as pixel point nearby value. Gray value is represented as  $I_y$  of point P. In common neither 12 or 9 will be chosen to achieve faster with the requirements and 9 is the value in ORB algorithm [1].

$$| I_x - I_p | > t \quad \text{---- (2)}$$

### BINARY ROBUST INDEPENDENT ELEMENTARY FEATURES

BRIEF [9] is an effective and a general purpose descriptor for the feature point detection, which is combined with arbitrary detectors. This image feature detection is efficient to compute and store in the memory. Once a key point of an image is predicted, continue to compute the descriptor of an image for each one among them. The interesting information are encoded by the feature descriptors and it is moved towards as series of numbers to act as numerical dorsal vein print. which will be wont to differentiate features from each other. Patch is a neighborhood of an image’s pixel or a keypoint which is represented in a square format for the pixel of width and height [5]. BRIEF helps in converting the patches of an image into the binary feature vectors or descriptors which are represented in 0 or 1. The image with noise is dealt by the BRIEF and the patches are then pre-smoother to reduce the noise sensitivity. The images are smoothed in BRIEF by the use of Gaussian Kernel.

### Feature Matching

Feature matching is a comparison of the two or more images which may be different in the illumination conditions such as orientations, perspective, lighting, or even differ in sizes and colors. A general approach in image matching is by detecting the interest points which are alike with the image data of an image descriptor. The next step is to set up





the prefatory of feature matching among the images. Matching method relies on the characteristics or behavior of an interest point and also correlates with the image descriptors. Based on the image augmentation, the blob and corner detector is opted.

### Performance Analysis

The evaluation performed for dorsal vein recognition is done under two categories. Recall or Sensitivity and Accuracy are the performers. The accuracy and recall with the favor of False Acceptance Ratio (FAR) and False Recognition Rate (FRR). FAR is used to measure the biometric security system in concern with the average number of false acceptance of an image[6]. FAR is easily computed with the ratio of number of false acceptance to total number of attempts and FRR is also computed with the ratio of number of false rejections to total number of attempts. FAR primarily helps in determining the accuracy of a biometric system [5]. FAR is calculated as follows.

$$\text{FAR} = \text{No. of False Acceptance} / \text{No. of Attempts} \text{ ---- (3)}$$

True Positives (TP) - TP are determined by the values which are predicted as positive (i.e.,) the actual and predicted classes are true. True Negatives (TN) -TN are determined by the values which are predicted as negative (i.e.,) the actual and predicted classes are not true. When there is no actual class but the predicted class is available then it is referred to as False Positive (FP). When there is an actual class but the predicted class is not available then it is referred to as False Positive (FP).

Accuracy - This performance measure is the most important measure for predicting the observation from the overall observations. It is the ratio of exactly predicted observations to the overall observations.

$$\text{Accuracy} = \text{TP+TN} / \text{TP+FP+FN+TN} \text{ ---- (4)}$$

Recall (Sensitivity) - Sensitivity or Recall is also an important measure in predicting the positive observations to the overall observations in actual class - yes.

$$\text{Recall} = \text{TP} / \text{TP+FN} \text{ ---- (5)}$$

### Comparative Study

SURF and ORB algorithms played a special role in determining the insights of dorsal hand vein patterns even at illumination conditions and at different view positions. This article shows the analysis of SURF and ORB feature detectors - descriptors. The below table represents the analysis of two different techniques.[7] FAR and FRR[8] performance analysis evaluates the resultant of an image under comparison with the threshold values with intervals of 10 as in Fig.6 and 7. The above Table-I represents the analysis of 100 persons' images by calculating the threshold values ranging from 50 to 90 with the interval ranges from 10 to 50. The above Table-II represents the analysis of 200 persons' images by calculating the threshold values ranging from 50 to 90 with the interval ranges from 10 to 50.

## CONCLUSION

In this paper, two different algorithms are compared and analysis is predicted. Even though SURF algorithms performed under various scenarios, ORB performed better than the SURF algorithm with its prominent characteristic of fastness and robust. The accuracy and sensitivity of different people's images are predicted with various threshold values under intervals of 10. The paper concludes with the result of two graph images under threshold values between 50 and 90 with rapidly increasing percentage values. The values of FAR rapidly decline whereas the values of FRR contiguously increase. By increasing the samples of a person's vein patterns or images, it's much easier to predict the values of FAR and FRR with the result variations. Thus by accuracy and recall procedures, the paper





concludes ORB performs better comparatively with SURF algorithm. The research will be dealt with further to enhance the futuristic work with infected person's veins.

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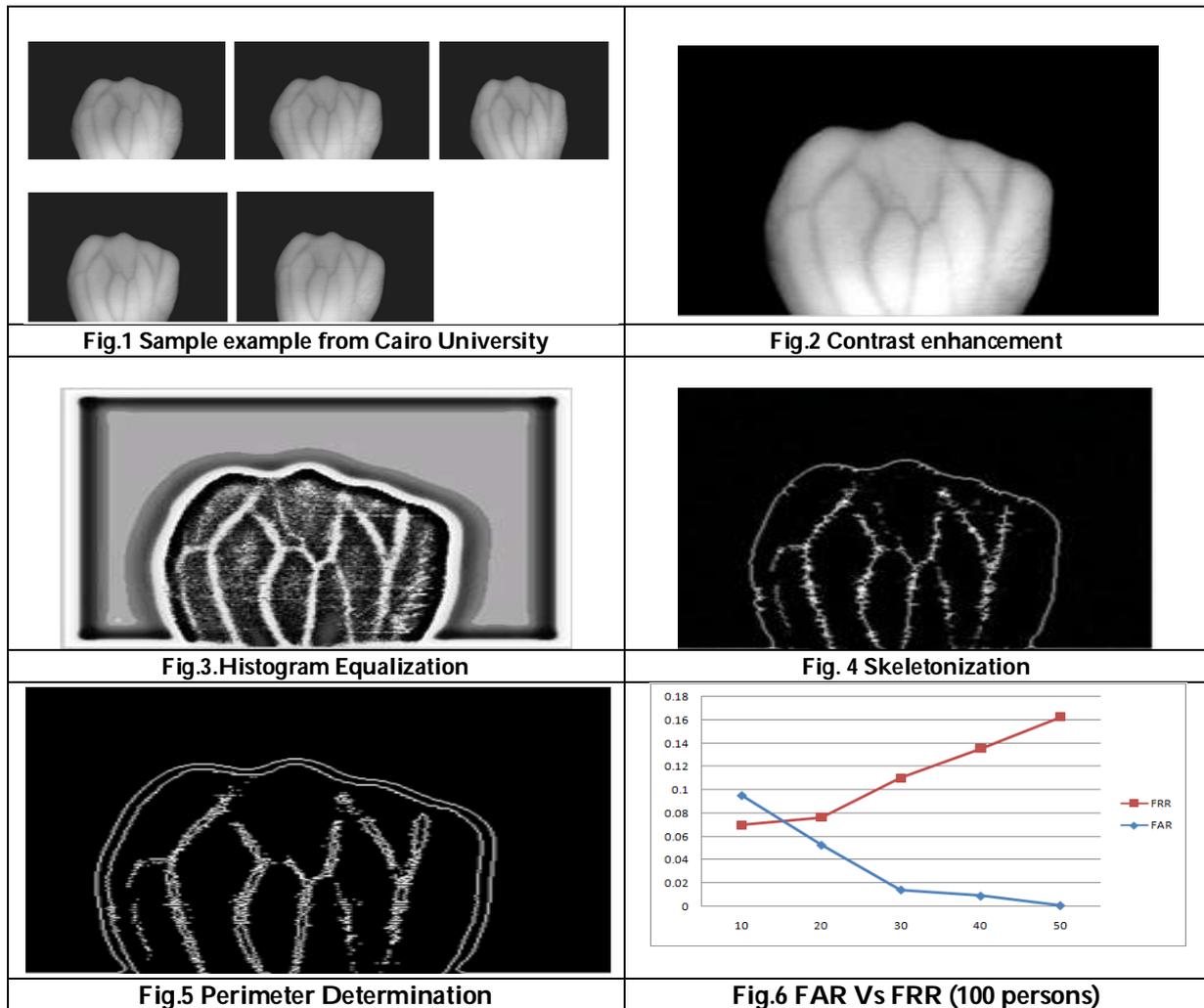


**Table -I : FAR & FRR with 10 intervals for 100 persons**

| S.No | Threshold | FAR    | FRR    |
|------|-----------|--------|--------|
| 1    | 50        | 0.0753 | 0.0697 |
| 2    | 60        | 0.0526 | 0.0763 |
| 3    | 70        | 0.0142 | 0.1099 |
| 4    | 80        | 0.0089 | 0.1354 |
| 5    | 90        | 0.0007 | 0.1623 |

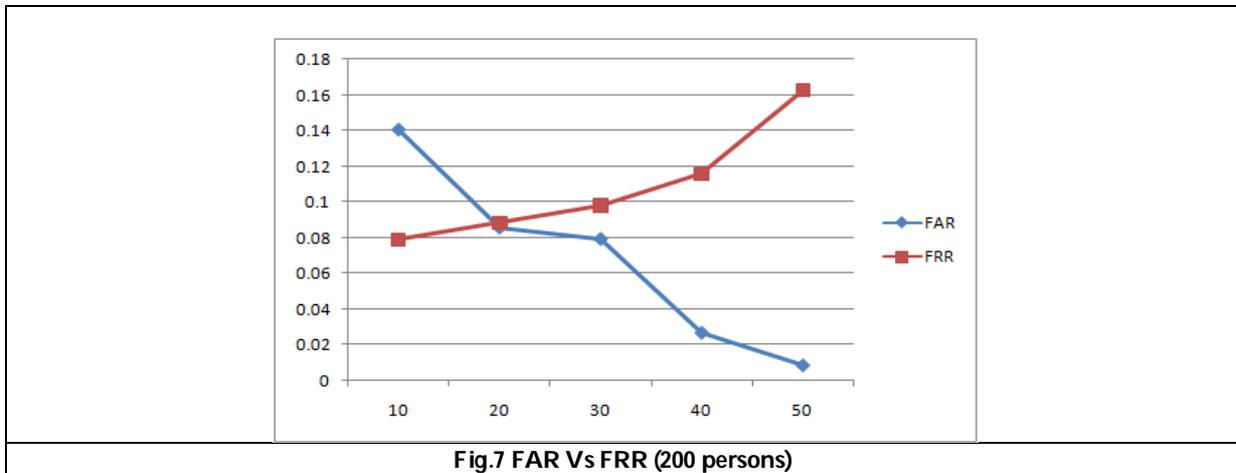
**Table -II : FAR & FRR with 10 intervals for 200 images**

| S.No | Threshold | FAR    | FRR    |
|------|-----------|--------|--------|
| 1    | 50        | 0.1403 | 0.0792 |
| 2    | 60        | 0.0856 | 0.0833 |
| 3    | 70        | 0.0793 | 0.0981 |
| 4    | 80        | 0.0269 | 0.1159 |
| 5    | 90        | 0.0087 | 0.1623 |





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## Real-Time Sign Gesture Detection using Tensor flow

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### ABSTRACT

Using computer vision, this work offers a real-time CNN-based system for identifying Sign Language gestures. People with hearing and speech difficulties typically communicate via sign language since it is their only option. This is a critical communication barrier between persons who do not understand sign language and those who do. The major goal of this project is to create or construct a system that allows persons with disabilities to communicate and express their sentiments with others. This model's concept is unique in that it can recognize signs regardless of sign language standards (i.e., the American Standard or the Indian Standard). Existing translators function poorly because each letter must be motioned out, and the time it takes to compose a basic sentence is very long. This challenge is solved by this Pre-Trained model, which was trained using the SSD machine learning method. It recognizes gestures as words rather than alphabets. The suggested approach can recognize five different sign movements, and test results indicate an average accuracy of 93.8 percent when trained with 75 photos and evaluated with 25 images.

**Keywords:** Convolutional Neural Network, Deep Learning SSD ML algorithm, Tensor Flow object detection module, Real-time.

### INTRODUCTION

The act of communicating or exchanging information, ideas, or sentiments is known as communication. Both persons must know and comprehend a common language in order to establish communication between them. Differentially abled persons, on the other hand, have diverse communication methods. People who are deaf or hard of hearing communicate with each other and with others through sign language. Because not everyone knows or understands sign language, communication between a normal person and a differently-abled person can be challenging. Even if you don't speak the language, the only way to communicate is to use human translators, which is expensive and not everyone can afford it. Chinese, Spanish, Irish, American Sign Language, and Indian Sign Language are among the

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more than 100 sign languages used across the world. Only two of these are often used (i.e. ASL and ISL). The Machine Learning-based Sign Gesture Detection system seeks to identify, recognize, and interpret various hand gestures acquired using computer vision with a high degree of accuracy. This approach converts computer vision-captured signs/gestures into text so that the user can easily read and understand what the person is attempting to say, regardless of whether the user is familiar with sign language.

**LITERATURE REVIEW**

Bergh [1] proposed the first technique to sign language recognition in 2011. Haar wavelets and database searching was used to create his hand gesture recognition system. Although this technique produces excellent results, it is confined to only a few types of movements. The system developed by Balbin et al. [2] could only detect five Filipino words and employed colored gloves to recognize hand position. Our model has been taught to detect a variety of motions and can be identified without the need for colorful gloves. [6] Shows a completely neuromorphic implementation of sensor fusion for a hand-gesture recognition system by Ceolini et al. The suggested study was built on prior work using comparable sensor fusion approaches for hand-gesture detection, which was implemented in a mobile phone application for personalized medicine using a typical machine learning methodology. The research shows how a Convolutional neural network outperformed a Support Vector Machine (SVM) on a gesture detection challenge in terms of accuracy. The novelty here is that the sensor fusion is done on a completely neuromorphic system, from the event-based camera sensor through the classification phase and that three event-based neuromorphic systems are used. L. Lamberti and F. Camastra proposed a real-time hand gesture detection system based on a colour glove in this study [10]. Three modules were used to create the system. The first module extracts the image of a hand from the photo. The image is represented as a nine-dimensional feature vector in the second module, which extracts the features. Learning Vector Quantization is used in the third module, which deals with classification. The system was put through its paces on a dataset of 907 hand gestures, with a recognition rate of over 98 percent. Zhi-Hua Chen [6] proposed a new approach for hand gesture detection in which the hand area is recognized from the background using the background subtraction method. The palm and fingers are segmented, and the fingers in the hand photo are found and recognized using this information. A simple rule classifier is used to recognize hand movements. The results of the experiments suggest that this method works effectively and is suitable for real-time applications. However, there are certain restrictions, such as moving objects with a hue close to that of the skin causing hand detection, which may reduce hand gesture recognition performance. The ml algorithms, on the other hand, can distinguish the hand from the background. The photos in our model were acquired using a PC Cam, and we were able to achieve an average precision of 93.8 percent. Motion sensors, such as electromyography (EMG) sensors [3], RGB cameras [4], and Kinect sensors [5], and their combinations, were used in other models to record these. Although the detection accuracy is good, there are some drawbacks. For starters, they demand huge datasets with various sign movements, which necessitates a high-end computer with powerful specs. In our approach, however, this may be accomplished with the bareminimum of requirements. Two unique algorithms, YOLO and SSD [7], [8], were released in 2016 with the goal of real-time object recognition in testing photographs. To minimize the spatial dimension detection box, YOLO employs a Convolutional neural network. To produce border-box predictions, linear regression is used. The detection box size is normally fixed in the case of SSDs and is utilized for simultaneous size detection. As a result, one of the acknowledged benefits of employing SSD over Yolo is the simultaneous recognition of objects of varied sizes. Unlike previous systems that can simply recognize alphabets, our model focuses primarily on gesture recognition, making it more usable and effective.

**MATERIALS AND METHODS**

Object detection is a Computer Vision approach that determines where an object is in an image. It is also known as object segmentation or semantic segmentation, and it detects or extracts characteristics contained in pictures. We focus on categorizing photos and attempting to estimate the ideas and positions of each object in the images to better comprehend them. Due to the significant advancement of Object detection in Deep learning, object detection was classified into



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- (1) Model-based on region proposal: CNN, RCNN, Fast RCNN, Faster R-CNN are examples of models based on region proposals.
- (2) Models based on regression/classification: YOLO and SSD are two examples of models based on regression/classification.

Using a convolutional neural network, the suggested method illustrates the detection of objects in real-time from images. Artificial Intelligence (AI) has been rapidly expanding in its ability to bridge the gap between human and machine capabilities. Researchers have been working on a variety of facets in the field in order to achieve fantastic results. Computer Vision is an example of a related domain. The goal of this field is to enable machines to see the world in the same way that humans do, and then to apply that knowledge to a variety of tasks such as image and video recognition, image analysis and classification, media recreation, and recommendation systems, natural language processing, and so on. For all models, the overall design of a Convolutional Neural Network comprises identical layers.

**Convolutional layer**

This layer contains filters and feature maps, with filters carrying input weights based on the output value and feature maps being the output based on the filter's weight.

**Pooling layers:** The pooling layer's primary function is to down sample the feature map.

**Fully connected layer:** This is a traditional feed-forward neural network that makes predictions using an activation function (e.g., ReLU, Tanh, Sigmoid, etc.).

The model we're utilizing here is SSD, which is a pre-trained object detection model. Many individuals are perplexed by the differences between object detection and picture categorization. To put it another way, image classification specifies what the picture or image is, whereas object detection recognizes distinct items in the image and uses a bounding box to find where they are in the image. YOLO (you only look once) and Single Shot detector are two popular single-shot detectors. SSD with a single-shot detector is used because it is a more efficient and speedier method than the YOLO algorithm. The model's name reveals the majority of the model's characteristics; unlike other models, it detects the item in a single pass over the input picture or image, rather than traversing the image several times to obtain an output detection. As previously stated, the SSD model recognizes objects in a single pass, which saves a significant amount of time and appears to have exceptional accuracy. The SSD model produces predictions at multiple scales from the feature maps and explicitly divides predictions by aspect ratio to achieve this high detection accuracy.

The SSD model is made up of two parts:

1. The backbone model: The Backbone model is made up of a feature map extractor and a pre-trained image classification model. The network's final picture classification layers are removed here, leaving only the retrieved feature maps.
2. The SSD head: The SSD head is a convolutional layer integration that is added to the top of the backbone model. This gives you the bounding box of the object as an output. The distinct items in the picture are detected using these convolutional layers.

SSD extracts feature maps using the VGG16 CNN model. Then, using the Conv 4X3 layer, it's utilized to identify objects. It generates four-item predictions for each location. Each prediction has a boundary box and 21 scores for each class, and we choose the class with the greatest score as the bounding object's class. Regardless of the depth of the feature maps, the Conv4X3 layer produces a total of 38x38x4 predictions (i.e. four predictions per cell). The majority of convolutional layers have rectification nonlinearity (ReLU). We ultimately achieve feature maps with reduced resolution and extremely strong semantic information after executing a pile of convolutional, max-pooling, and ReLU layers. Fully linked layers and a softmax layer are utilized for picture categorization in the original VGG16



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Net. To perform gesture categorization and hand segmentation, we replace these layers with SSD layers. The SSD network conducts hand segmentation and hand gesture categorization in the second stage, which is the most crucial aspect of the system. SSD's basic function is to estimate category scores and bounding box offsets for a collection of default bounding boxes. Object categories in our work comprise five hand gestures and the background. This design allows for excellent precision and simple end-to-end training, which improves speed and accuracy even further.

**SYSTEM DESCRIPTION**

With the aid of LabelImg software and Tensor Flow Object Detection API, a real-time gesture recognition system was constructed in this project. The initial aspect of this system is the picture-taking procedure for database generation, which is separated into three phases. We developed some programming to automate the photo-taking procedure for this. We utilized the labeling program to separate the photographs into the relevant categories once they were collected. These labels are then given names that convey the meaning of the gesture. After the photos have been labeled, two files are produced for each image. The first file is the picture itself, while the second is an XML file containing the position of the item that the model should be looking for in the image throughout the training phase. The training procedure begins when these files are prepared, with the Deep Learning SSD ML algorithm extracting features from the desired image. We use the Tensor Flow Object Detection API after extracting features to do this object detection phase. The collected characteristics are then loaded into the Tensor Flow module, which aids in comparisons with the real-time video in the frame. When any of these traits are detected, the algorithm will draw a bounding box around the gesture and generate a forecast. Because the image's label will be displayed in the prediction, it's critical to comprehend the gesture. Finally, once all of the aforementioned processes have been completed, we can begin testing it for real-time gesture recognition.

**Dataset Creation**

The labeling program is used to graphically label pictures, which are then utilized in image recognition. We must remember that labeling must be done correctly, i.e., the gesture must be labeled with the correct label so that the movements may be recognized correctly later. An XML file is produced for each image once it has been identified and saved. During the training phase, this XML file includes the position of where the model should be searching in the picture. Where the model should be searching in the picture. Because this model was taught to recognize five different motions, five separate labels were employed to identify them. Twenty photographs were utilized for each gesture, all of which were taken from different perspectives. The photographs are taken automatically and saved in a certain folder using a code. Drawing a box around the gesture is used to label it. This box is referred to as the Ground Truth, and it contains a collection of measurements that are known to be significantly more accurate than the measurements taken by the system under examination. The photos are labeled using LabelImg software, as shown in the figure below (Fig. 2). The accompanying graphic shows an XML file connected with a labeled image demonstrating where the model must look for the gesture during training the ML model (Fig. 3).

**Training and Testing**

Five of the 20 photos acquired, together with the XML files created for each image, were utilized for testing, while the remaining 15 were used to train the model. A pre-trained SSD MobileNet v2 model was used to train the ML model. Tensor Flow is a python open-source package for numerical computing and machine learning that makes gathering data, training models, serving predictions, and improving future outcomes easier. The TensorFlow Object Identification API is an open-source framework built on top of TensorFlow that makes building, training, and deploying object detection models simple. Model Zoo is a collection of pre-trained models that are already accessible in their framework. The COCO datasets have previously been used to train the available pre-trained models. The TensorFlow object detection API provides a platform for building a deep learning network that can detect objects. TensorFlow combines Machine Learning and Deep Learning models and algorithms into one package. It is extensively used because it uses Python as a user-friendly front-end and executes it in efficient C++. Because of TensorFlow, instead of worrying about little things like finding out how to connect the output of one function to the input of another, the developer can concentrate on the application's main logic and complete it faster. So we've trained the model with the aid of tensor flow and Python. After the model has been trained, we employ



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'Checkpoints,' which are saved points generated by the model to keep track of how much it has learned. In the event that the training process is stopped, it will simply restart from the checkpoint. Because training might take a long period, this method allows the model to protect itself against system failures. The learning rate of our model when using 10000 steps for training is shown below in (Fig. 4). The output of the machine learning algorithm is optimized using a loss function. The model's final loss is calculated using the training and testing data, and its decoding is determined by how well the model performs in these two sets. It is the model's total number of mistakes for each sample in training or testing that is being utilized here. The loss value indicates how well or poorly a model performs after each iteration of optimization performed during training. Our SSD MobileNet v2 model's loss has been lowering with each iteration, indicating that the model's object identification accuracy has improved. Our model's loss values are displayed in (Fig.5). The discrepancy between the ground truth box and the model's anticipated boundary box is referred to as the localization loss. The SSD ml model just takes into account predictions from positive matches, and all negative matches may be discarded. The projected boundary box is the one predicted by the SSD model when evaluating the photos, while the ground truth box is the one we made using labeling software while making the labels. As seen in (Fig.6), our model has a localization loss of 0.05. It is the loss for producing a class forecast, according to the confidence loss. The loss is calculated based on the confidence score of the appropriate class for each good match prediction. In the case of negative match predictions, the loss is calculated using the class's confidence score. No item has been discovered, according to class "0." As seen in ( Fig.7), our model has a confidence loss of 0.19. The assessment results and evaluation metrics for a 10000 step machine learning model are depicted in the figure below (Fig.9). The average accuracy and average recall make up an assessment measure. An IOU is calculated for each accuracy and recall. The ratio of the area of intersection between the Ground Truth and predicted box to the area of union between the Ground Truth and Predicted box is known as IOU (Intersection over Union) ( Fig. 8). When training the model, a loss function is a formula for generating loss values. The loss (L) that the model generates for each sample or batch of samples determines the model's performance during training. The projected loss indicates how "far" the expected value  $y_0$  differs from the produced value  $y_1$ . The loss will be deemed very high if  $y_0$  is far distant (completely different) from  $y_1$ . If  $y_0$  is near to  $y_1$ , however, the loss is deemed small. The loss is used as an "indicator" by the model to update its parameters and yield extremely minimal losses in future forecasts.

## RESULTS AND DISCUSSION

It was demonstrated how to recognize real-time gestures using an SSD Mobile Net v2 model technique and the tensor flow object recognition API, as well as how to create a database using Open CV for recording photos from a PC camera. Gestures are translated into written statements using this technique, making it easier for persons with diverse abilities to communicate with others. Using deep learning approaches, this system produced excellent results. The system's outcomes are discussed in this section. The recognition of the 5 distinct sign movements that the system was trained on had an average accuracy of 93.8 percent, as seen in the image above (from fig 10-14). With the data set provided, the system took roughly 6 hours to train. However, due to the system's limited database, occasional problems appear while identifying gestures. Distinct labels for different gestures are occasionally shown by the system. This can be further lowered by raising the detection box's thresh-hold and increasing the dataset's size.

## CONCLUSION

Using actual coloring photos captured with the aid of a PC camera, a real-time ML-based Gesture Recognition system was constructed in this research. New datasets were created to provide a greater range of properties, such as variable lighting, skin tones, backdrops, and a wide range of hand gestures. The system has an average detection accuracy of 93.8 percent for the various movements displayed. In addition, the system demonstrated great accuracy when new test data was introduced that had not been utilized in the training. This concept has a lot of potential since we can label these photos and the gestures in any language needed, allowing the user to communicate with others





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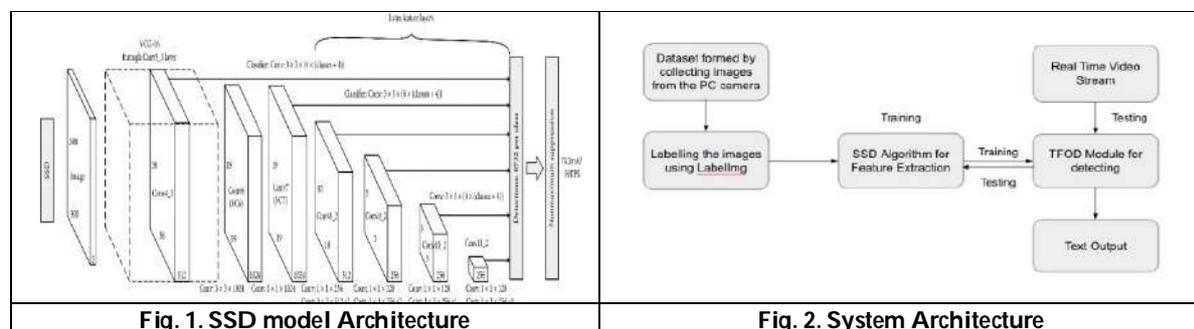
regardless of language barriers. There are certain limitations to this approach due to the small number of datasets used. It may also be solved with a large dataset and the use of additional convolution layers.

**ACKNOWLEDGEMENT**

First, the author wishes to thank the anonymous reviewer for his valuable comments. The work was developed by Utkarsh Umarye, under the supervision of Prof. Amit Patil, as a project for M.E. in Computer Science and Engineering. Also, all the images in the result section are contributed by the author as a part of the project.

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|--|---|----------------------|----------------------|----------------------|
|  |   |                      |                      |                      |
| <p><b>Fig. 3. Labeling using LabelImg software</b></p>   | <p><b>Fig. 4. learning rate vs training steps</b></p>   |                      |                      |                      |
|  | $L_{loc}(x, l, g) = \sum_{i \in P_{obj}} \sum_{m \in \{cx, cy, w, h\}} x_{ij}^k \text{smooth}_{L1}( l_i^m - g_j^m )$ $\hat{g}_j^{cx} = (g_j^{cx} - d_i^{cx}) / d_i^{cx} \quad \hat{g}_j^{cy} = (g_j^{cy} - d_i^{cy}) / d_i^{cy}$ $\hat{g}_j^{w} = \log\left(\frac{g_j^w}{d_i^w}\right) \quad \hat{g}_j^h = \log\left(\frac{g_j^h}{d_i^h}\right)$ $x_{ij}^p = \begin{cases} 1 & \text{if IoU} > 0.5 \text{ between default box } i \text{ and ground true box } j \text{ on class } p \\ 0 & \text{otherwise} \end{cases}$ |                      |                      |                      |
| <p><b>Fig. 5. Different loss values vs training steps</b></p>  | <p><b>Fig. 6. localization loss</b></p>   |                      |                      |                      |
| <p>It is calculated as the softmax loss over multiple classes confidences <math>c</math> (class score).</p> $L_{conf}(x, c) = - \sum_{i \in P_{obj}} x_{ij}^p \log(\hat{c}_i^p) - \sum_{i \in N_{obj}} \log(\hat{c}_i^0) \quad \text{where } \hat{c}_i^p = \frac{\exp(c_i^p)}{\sum_p \exp(c_i^p)}$ <p>where <math>N</math> is the number of matched default boxes.</p> |   |                      |                      |                      |
| <p><b>Fig. 7.confidence loss</b></p>   | <p><b>Fig. 8. The Ground Truth vs Predicted box</b></p>   |                      |                      |                      |
|  |   |                      |                      |                      |
| <p><b>Fig. 9. The assessment results and evaluation metrics for a 10000 steps.</b></p>   |   |                      |                      |                      |
|  |   |                      |                      |                      |
| <p><b>Fig:10</b></p>   | <p><b>Fig:11</b></p>  | <p><b>Fig:12</b></p> | <p><b>Fig:13</b></p> | <p><b>Fig:14</b></p> |





## Detection of Smart Photo Capture using Raspberry Pi Bynodered

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### ABSTRACT

Motion Detection is a most important process that detects the images or movements which plays an important role in Investigation activities. In crime and observance applications, motion detection using business camera swith off-line high-level formula processing is n't economical. The New system proposes that Raspberry pi is used to sense the motion once a movement is sensed. It helps us to capture images and videos with the help of Raspberry pi and camera module for detecting the motion along with capturing of photos. Node-RED is software for connecting sensor devices designed for the internet of Things and alternative applications to quickly assemble flows of varied services. In this, we use Node-RED to take photos by creating a connection of no des namely inject, processing and debug nodes which will give the user inter face for the given function. By using this application, we can detect several motions and images which are highly used in burglary detectors and nature or different fields. In Addition to this, the images can be saved in a chosen directory to view already existing images or videos and can be used for future works.

**Keywords:** Motion Detection, Raspberrypi, Node Red, Internet of Things

### INTRODUCTION

Now a days Security could also be a significant problem in the world. The exploration of machineries, and other methods employed by criminal's area unit extended up to a certain limit. Consequently, it's necessary to expand essential police work methods by the international amendment. The smartest and upcoming Growth in knowledge used in contrast to the the ftbe sides felony area unit follows a major role in the Screening system. However, the rate and cost of care of the systems are not that much effective for people to buy. The Raspberry pi is an open source computer. The camera is connected with the hardware to take photos then videos which can be controlled

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automatically. When ever the movement is sensed via the camera which gets connected by the Raspberry then it will get started and the software is enabled. It will locate the camera port on Raspberry Pi and start capturing photos or videos. Later, it will be stored in the cloud memory.

## Literature survey

Mukul Sharma et al., presented a system in which the movement is recorded through PIR, it then takes the photo in assistance of an associated camera besides directs the alert information to the controller room by base Application Programming Interface. So, this system consists of an Arduino Microcontroller board along with a Passive Infrared sensor to detect the movement nearby. The detected movement will later be conveyed to android phone by the Firebase client. These can be done using different coding languages. Nashwan Adnan Othman et al. presented that Raspberry is employed and a camera module can record a picture once the motion detection sensing element detects slight disturbances. The Support Vector Machine is employed to notice the motion among detection options. Generally, the techniques used are supported and provide human motion capturing rates and are compared with the coloring ways. The values obtained by the technique are comparatively little. So, the motion of the human's methodology is the foremost famed methodology.

ChingYeeYongetal., established a watching scheme which in turn increases the human movement recognition which is the most famous and acceptable algorithm, enforced in different programming techniques. The motion detection and analysis results are very much useful and it guides users for effective study researches. The result compares the movement of different humans and is compared efficiently. Finally, a good signal objective and watching scheme is performed for human recognition capability. Umesh Chandra Pati et al., developed the PIR and is employed to notice movements .It debates the applications of detectors which have some Devices in addition to the use of angularity. Detector nodes that are unit established in each space send knowledge to the middle node once the gesture is perceived. Completely dissimilar detector nodes that use ZigBee for wireless broadcast area units altogether associated with different detector nodes aimed at wireless broadcast area units entirely related to a middle protuberance.

Alaeldden Abduelhadi et al., established a motion detection supported by low ADPS hardware wherever accustomed detention copy once sensed, the unofficial movement is sensed by electrical phenomenon ultraviolet devices. Every time the gesture is sensed by the finished PIR device the copyist ken to the finished camera and held on within the raspberrypi component that sends the mail. It examines the photographs of the signal incidence over a web done electronic mail server, so the system provides an associated Nursing advanced method to robbery finding is treatment IOT. ZakariaRada etal., developed a system using Raspberry that performs a Python package that jumpsonce the Raspberry delays the signal to be noticed by the PIR device. Once the signal is sensed, the hardware begins recording video or snaps a photograph and sends notification to the Smartphone through application via partner. The instructed new mechanism employed by Raspberry pi and PIR detector will build intelligent recording for attention- grabbing objects in order to build the quantity o fvalid video high and improve video's quality.

## SYSTEMARCHITECTURE

This architecture clearly explains the connection of hardware and software devices that demonstrates the working mechanism of the components with a clear proposed system. It will detect the motion of the humans like photos and videos that will be used for many security purposes as shown infig1 In this project, we designate a complete IOT system that screens motion detection by gathering actual information in exact places. TheFig2 shows the flowchart for the proposed system.





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#### Components used: Hardware

- Raspberry pi board
- MicroSD Card
- RaspberryPicamrav2module
- Raspberry pi power supply

#### Software

- Nodered
- No dered Dashboard

#### Working Mechanism step 1: Attach the raspberry pi camera unit

First fix the camera with the shutting in the CSI port. Then check the camera with the ribbon blue letters fronting Upwards connected with in the right orientation is shown fig 2.

#### Tep 2: Allow the Camera

Towards usage of the Camera element, modify the camera computer code with the kit. Within the setting, visit the hardware Formation opening below the Favorites set menu, exposed the Interfaces tag and modify as shown in fig3.

Enter the command in the Terminal

```
pi@raspberrypi:~$sudo raspi-config
```

Choose the inter facing selections in the raspberry package confirmation device as shown in fig4 Activate camera in addition and

Restart pi shown in fig5

#### Tep3: Fix Raspberry Camera Node

Type the subsequentcmd to fit the camera node on Node-Red.

```
pi@raspberrypi:~$ sudo npm install -g node-red-contrib-camera api
```

#### Step 4: Choose the Photos Directory

Select a directory wherever the photos are briefly saved. Simply ought to run the settings folder. Use only among subsequent guide lines as a result of Node-RED manual connection is also totally dissimilar.

```
pi@raspberrypi:~$ sudo nano /root/.node-red/settings.js
```

Before, rollback folder, realize HTTP Static location, and sort the required manual to accumulate the Cameraicon. This is shown in the fig. 6

```
httpStatic: '/home/pi/pictures/'
```

#### Step5: Start Node-Red

Open the terminal and type command in the console to start Node-red.

```
pi@raspberrypi:~$ sudo node-redstart
```

Create a new tag in the search engine to access Node-RED, and enter the cmd:

```
http://Your_RPI_IP_address:1880
```

Change the RPI IP address according to the current IP address. Otherwise create the following cmd in the console to get Raspberry IP address.

```
pi@raspberrypi:~$ hostname -I
```

#### STEP 6: NODE-REDCONSOLE

To add the Dashboard widgets, make a tag and cluster scheduled NodeRED as shown in fig7.



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Modify the tag's term be sides variation in its representation a sin fig 8. Name: Choose the name whatever you want. Icon: choose the name accordingly to the icon's names in fig8

**Step7: Making the nodered Series**

Previously forming the movement, check the came raapi node, in the fig 9. Check the above instructions in connecting the hardware Camera Node, if it doesn't present on the Node red. Next, Drag and Drop nodes in the series: Model node, Camera API Take Photo Node and Restore node as in fig10

**Step 8: Camera apinode**

Lastly, modify the camera node with the following specifications as shown in fig. 11

**Step 9: Connecting nodes**

Join the nodes as exposed in the fig12 Finally, press the Deploy button and save the changes.

**Step 10: node red dashboard**

Lastly, this request is prepared to work. To connect the dashboard, choose any search engine in net besides enter: **http://Your\_RPI\_IP\_address:1880/ui**

**Step 11: Output**

Following diagram displays the node REDD as board appearances. By the new set up model anyone can access the printing status of the rooms from anywhere by using the **TAKE A PHOTO** button as shown in fig13. If the image is not displayed on Node-RED dashboard, then follow URL and check whether the HTTP Static track remained established correctly: **http://Your\_RPI\_IP\_address:1880/Photo1.JPE**

If the Camera doesn't take photos, check whether the camera band is linked with port as in fig 14. Also check that it allows the Pi's raspi-config set menu. Check whether the camera node has the right file path.

**RESULTS AND ANALYSIS**

One of the major impacts on this paper is on the visualization area where it provides an accurate analysis of motion detection on the basis of the AQI Index. All the data will be useless when it can't be represented in a proper way and that cannot be understood by the user. Data visualization helps to represent our data to the right people, at the right time, enabling us to gain knowledge in an effective way. Gender, age, weight and height performed half dozen activities in 15 trials with in the same setting and conditions:

Currently visualization solutions have evolved as rapidly joined will demonstrate every single current status of the gadget and its operation. This dataset consists of time-series data generated by measuring devices and rotating sensors (attitude, gravity, User Acceleration and Rotation Rate). Data is collected in 50HZ sample rate and a team of 24 participants vary Downstairs, Upstairs, Walking, Jogging, Sitting and Standing as in table 5.1. With this dataset, we have a tendency to aim for private attributes fingerprints in time-series of sensing element knowledge.

**CONCLUSION AND FUTURE WORK**

The primary objective is to create awareness about theft detection. In this proposed system, we use Raspberry and camera elements for detecting motion along with capturing of photos. We use Node-RED to take photos by creating a connection of nodes namely inject, processing and debug nodes which will give the user interface for the given function. By using this application, we can detect several motions and images which are highly used in burglary detectors and to take images of nature or different applications. In Addition to this, the images can be saved in a chosen directory to view back already existing images or videos and can be used for future works.





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In Future Work, we can enhance this application by additionally applying the system for multiple cameras. This system can also be applied in Road, Transport activities for video record of insurance claim activities. This system can be further used in algorithms for dialogue credit schemes in order to get very correct and consistent speech effort.

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**Table.1. Readings of each people for motion detection**

| Age | Walk  | sit   | Run   | Move up | Move down |
|-----|-------|-------|-------|---------|-----------|
| 40  | 0.245 | 6.456 | 0.456 | 3.678   | 0.345     |
| 56  | 2.578 | 2.689 | 2.567 | 6.366   | 1.678     |
| 32  | 6.467 | 4.567 | 3.567 | 2.356   | 2.675     |
| 36  | 0.352 | 0.524 | 3.255 | 1.558   | 1.634     |
| 23  | 7.356 | 0.578 | 0.985 | 0.224   | 0.256     |





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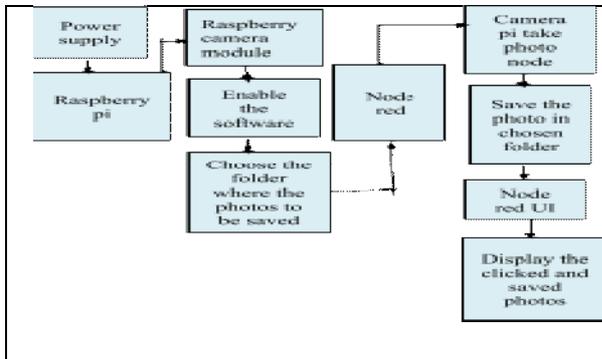


Fig.1.Architecture of Proposed system

Fig.2. Raspberry camera alphabets fronting up S

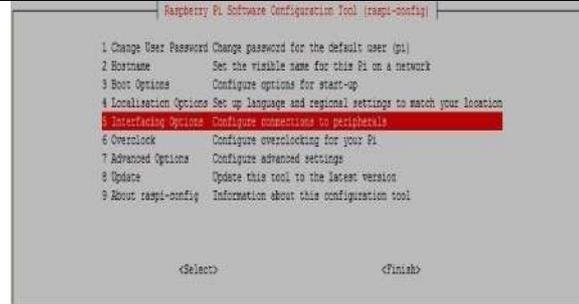
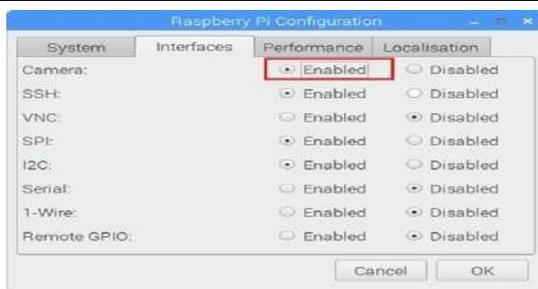


Fig.3. Camera option enabled up

Fig.4. Select inter face options tool

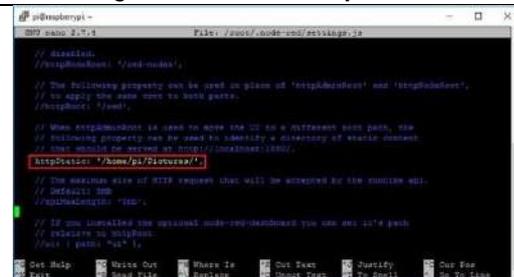


Fig.5. Activate the camera option S

Fig.6. Starting up the file

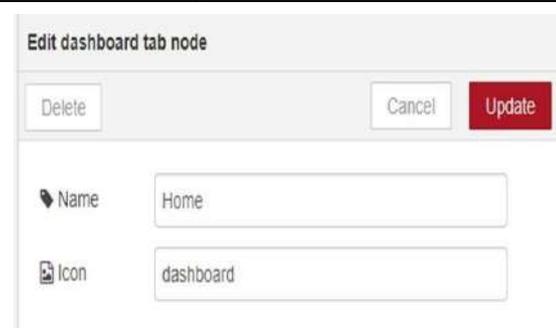
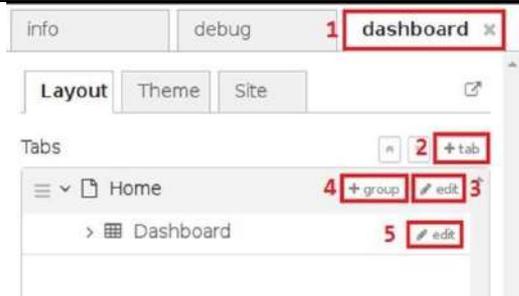


Fig.7. Nodered Dashboard option

Fig.8. Edit the Dashboard name





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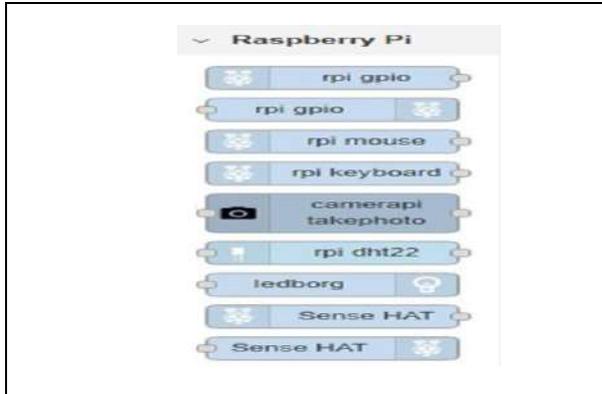


Fig.9. Raspberry pi work flow node

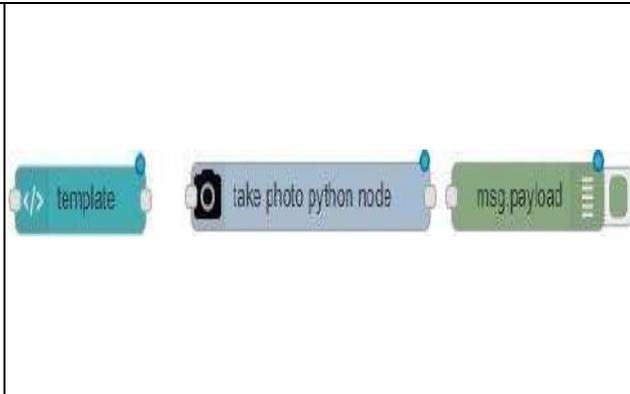


Fig.10. Sequence of nodes



Fig.11. Edit the camera Node

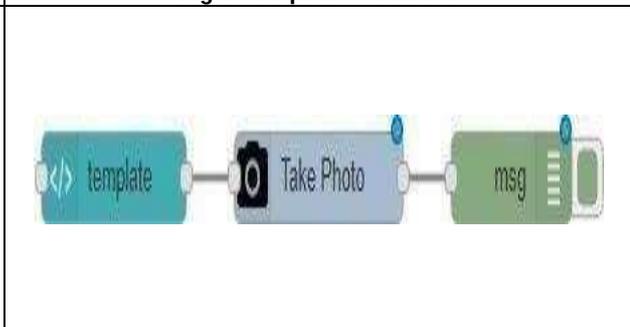


Fig.12. Wiring the nodes

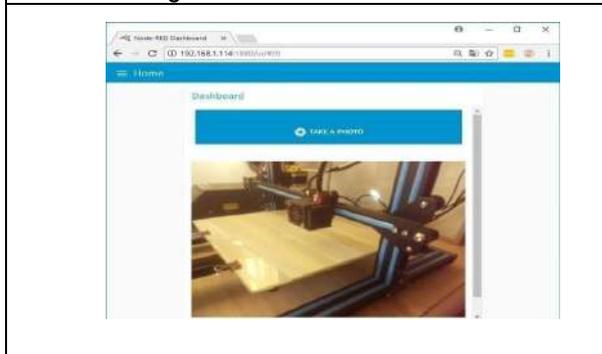


Fig.13. Nodered Dashboard



Fig.14. Output for Raspberry photonode

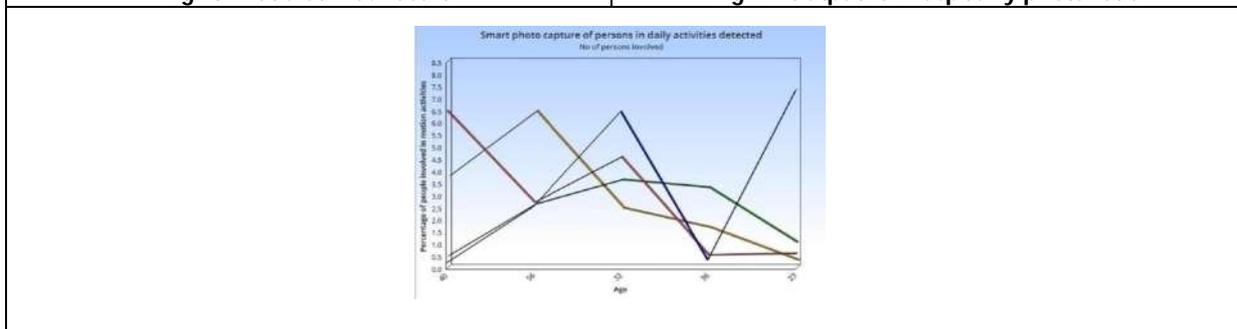


Fig.15. Line chart Analysis for motion detection





## Metaverse and Modern World

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### ABSTRACT

Metaverse is a virtual reality that allows people to connect with one another in a virtual dimension without needing to meet in person. The Metaverse is a post-reality universe; a never ending and persistent multiple user environment .It merges the physical reality along with digital virtuality. The multisensory interactions with virtual environments are enabled by the combination of technologies and rely on virtual reality and augmented reality. The Metaverse is actually an interconnected web of social, networked immersive environments in persistent multiuser platforms. It enables flawless user interaction in real-time and dynamic interactions with digital artifacts

**Keywords:** Post-reality, multiuser platform, digital artifacts, interconnected social web networking, virtual connectivity, share digital spaces.

## INTRODUCTION

### What is Metaverse?

The term "Metaverse" is a combination of the words "Meta" and "Universe," emphasizing the virtual world and universe. People can swap virtual products for real money or Cryptocurrencies in the Metaverse, according to sources. NFT refers to virtual products or objects in the Metaverse (Non-Fungible Token). NFT can be defined as products that are the only ones available on the internet and have no duplicates. As a result, they become more valuable. Now you understand why that ugly monkey NFT gets sold for millions of dollars.



**Chinchu Nair et al.,****How does Metaverse work?**

As Metaverse is a whole new virtual world, users have to use some technical gear which includes AR, VR, and XR technology that enables them to dive into Metaverse. Now, this tech gear includes VR headsets, AR sensors, and XR motion sensors. With this tech, the user will be hovering in Metaverse with a custom avatar and can communicate with other users virtually. In the Metaverse, the user can do anything without restriction like "Throwing a virtual party", "Conduct a virtual meeting", "Visiting virtual places together" and what else. Until it is virtual, the user can do anything in the Metaverse. As everything runs with money, Metaverse also runs with NFTs and Cryptocurrencies which allows users to buy and sell digital goods. As we are familiar with MMORPG (Mass Multiplayer Online Role Playing Games) like PUBG (Player Unknown Battlegrounds, Fortnite, and Free Fire are all popular games. All of them enable gamers to purchase avatars or outfits using virtual cash. Players in other games such as Upland and The Sandbox can buy or rent lands in return for bitcoins.

**Understanding the Metaverse and its mechanism**

With the information we've gathered so far about Metaverse, we can see it as a virtual environment with genuine human interaction. Let's dive deeper now. A basic layer idea is the easiest way to describe Metaverse. All seven levels, including the first layer's infrastructure, govern and administer the Metaverse. Users cannot connect to a virtual environment without the right equipment. As a result, the significance of suitable equipment and infrastructure is prioritized in the first place. So, who will make use of the gear? Humans. As a result, human contact has reached the Metaverse's second layer. All of the devices and associated triggers that allow users to interact with the virtual environment are included under Human Interaction. Because the Metaverse is a virtual world, no single person or entity has influence over it. This is where Decentralization's third layer enters the picture. All Metaverse actions are managed by automated artificial agents and blockchain, with complete transparency for all users. This implies that everyone can have a look on everything that is going on. For instance, if you were the one who purchased the ugly monkey NFT. It is recorded and uploaded to the blockchain's register of cryptocurrency transactions using automated AI. 3D engines like Unity and Unreal are utilized to develop and control all three layers. Which are in charge of constructing 3D virtual environments that allow users to engage in social computing. As a result, it reaches the Metaverse's fourth layer. The Metaverse, as we all know, is not ruled by a single person or organization. Digital assets may be created, purchased, and sold by anybody. Allowing individuals to expand their creativity while also earning money from their projects. Creators may profit not only from digital assets, but also from tools, commerce, and designs, thanks to Metaverse's vast possibilities. The Creator Economy has made its way to the Metaverse's fifth stratum. Because it is so important in the cryptocurrency treasury. Keeping this in mind, where there are viewers, there will be commercials. Many ad networks enter the picture to display their virtual banners on various virtual structures in order to attract real users. Because the Metaverse is an Open World Source, there is a lot for users to explore, engage with, and interact with the virtual world, making "Discovery" the Metaverse's sixth layer. Finally, "Experience." In a virtual environment, the user must feel real. Metaverse enabled users to feel and participate in virtual games such as social communication and esports by providing infrastructure, human connection, Social Computing, Creator Economy, and Discovery. Aside from the entertainment sector, Metaverse allows users to visit business establishments such as Virtual Shops, Stores, and Theatres.

**Future of IoT and Internet**

As we all know, every gadget that links a user to the internet falls under the IoT umbrella (Internet of Things). After the Metaverse is deployed, there will be a vast production and use of VR headsets, AR sensors, and XR sensors. Mobile phones, GPUs, and wearable tech devices must all be improved to achieve the degree of setup necessary to render a virtual environment. Tech behemoths like Oculus VR, Microsoft, and Facebook are continually working on this technology to create affordable Metaverse hardware. Apart from the equipment, the number of people that are online at the same time would increase internet use. In Metaverse, there is also a cyber danger to the user's data and behaviour. As the number of people using the internet grows, so will the number of cyber dangers. As a result of all of these Metaverse flaws, the deployment of the Metaverse is taking longer than intended.



**Chinchu Nair et al.,****Impact of Metaverse on Modern World**

On the plus side, Metaverse enables users to connect and interact with people from all over the world from the comfort of their own homes. WFH (Work from Home) has been accepted by the whole educational system and the business working system in the last two years. Because they are connected over the internet, they were able to spread their franchise to any location in the world. Many Edu Tech companies, such as Vedantu, Byjus, and others, saw a significant boost in their user base. Similarly, with Metaverse, the digital world is entirely dependent on the Virtual World, and user contact with other users will be much strengthened. However, Metaverse has several drawbacks that may or may not be resolved in the future. People are becoming addicted to social media and are suffering from anxiety, depression, and loneliness on a daily basis. Excessive use of computers and mobile phones are reportedly causing back discomfort and vision difficulties. Long-term usage of a virtual reality headset can cause severe headaches and damage to the eyes. Cyber dangers, on the other hand, are present all over the internet. It is not a joke to construct Metaverse by conquering all of these numerous obstacles only for the purpose of technological advancement.

**IMPORTANCE OF METAVERSE****Decentralization**

The metaverse is never under the control of a single entity.

**Interactivity**

The metaverse should allow users to communicate and interact with other users as well as metaverse platforms.

**Corporeality**

The metaverse should maintain compliance with the laws of physics even in a virtual world alongside staying true to the concept of resource scarcity.

**Creator Economy**

One of the most important highlights of best Metaverse applications would refer to the facility for an independent creator economy. Users can create and trade new assets or experiences in the virtual worlds of the metaverse alongside enjoying complete ownership. Creators can use their assets in any environment and trade them for the desired value.

**Pros of the Metaverse**

- Connecting the world and negating physical distance
- Immersive experience
- Upgrading social media
- Improvements to online learning and education
- Positive impact on cryptocurrencies and NFTs
- New opportunities for financial gain

**Current Revelations of Metaverse**

If we can take a look around us, we would find at least one thing that is related to the Metaverse. For example. The games on our mobile phones, our virtual meetings, virtual exams. These are the foundation and revelations of Metaverse. Some countries are also trying to make cryptocurrency the primary mode of payment for their online services. People are in dilemma about Metaverse and its capabilities. Everyone knows what Metaverse is. But, No one particularly knows how it is going to be implemented. Platforms like Upland, and Sandbox sell their pieces of virtual land as NFTs. Surprisingly, most of the lands have been sold and also developed by users all around the world. Sandbox uses a pixelated aesthetic like Minecraft. On the other hand, Upland uses a polygonal aesthetic. If a user buys land on both platforms. It cannot be merged or linked because of the irregularity in the aesthetics of the platforms. While the virtual worlds are increasing effectively in numbers, Metaverse is making progress. Recently a Virtual Gaming Centre is opened in Mumbai, which offers a Real-Time Virtual Experience. The Gaming Centre is succeeded in attracting many people including tourists just to dive into the virtual world to shoot some zombies. It depicts that the people are so fascinated by all these emerging technologies like Virtual Reality, Augmented Reality





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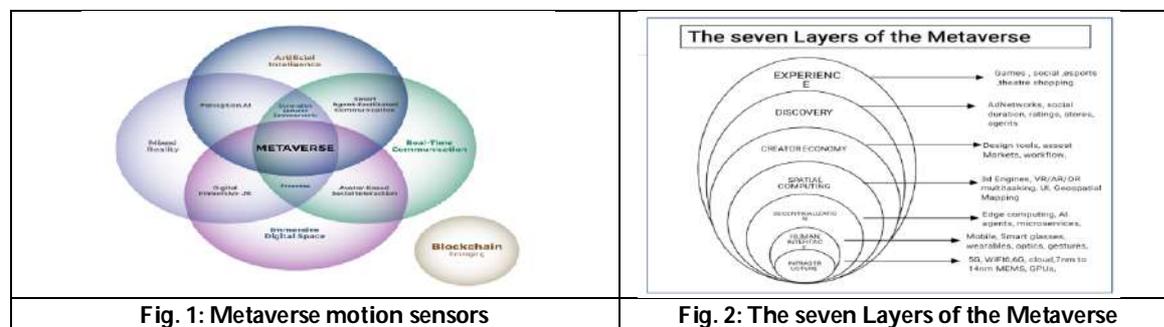
and etc... These days, the gaming world is vastly increasing and encouraged all over the world. Ed Tech platforms like Udemy and Frontrow offer gaming tutorial course which teaches the tips and tricks for building up a career in the gaming field. If we peek into the corporate development, the companies encouraged remote work and offered Work from Home (WFH) for their employers and stated that it increased their production. It allowed companies to grow their franchises or departments all over the world. Social Media platforms like Slack, Discord and Telegram are being used by the companies for better communication. These platforms organize and allow users for group chats precisely. Virtual Video Meetings services like Gmeet, Zoom and Microsoft Teams also had a huge increase in their user base than before. The Internet became more accessible than before. There's been a huge technological advancement in mobile phones and their configuration. These days with a couple of hundred dollars people are able to get a smartphone with advanced technology. Almost, everyone has access to a smartphone. People are learning new things and encouraging technology by keeping away all the myths. Technological Awareness plays a huge role in any aspect or introduction of a new concept like Metaverse. Likewise, many cryptocurrencies are emerging. We are well aware of the chocolate brand "5 Star" also released their own cryptocurrency digital coins called Nothing coins. Cryptocurrency is just a block of code and an open-source. Companies are looking forward to having their unique cryptocurrency for their digital services. The hype of Cryptos, NFTs, and digital assets all make their way to the Metaverse. Metaverse is the current trending digital revelation that is evolving every day. With this hype and speed, we may experience the Metaverse earlier than we expected.

**CONCLUSION**

Through the years, the Internet has changed. Every technological advancement has advantages and disadvantages. From wires and cables to wireless and virtual, we've come a long way. The Metaverse is a brilliant idea. Social interaction will be at its peak. With only your fingers, you can access everything from anywhere on the planet. To prevent repercussions and harm, real-life experiments and experimentation can be carried out online. Not only that, but Metaverse has all possibilities and potential that any human mind could possibly conjure up. However, there is a cost to everything. We must not overlook Metaverse's dark side and ensure that it is utilized in a positive and constructive manner.

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## Classification of Outdoor Natural Scenes using Discrete Wavelet Transform and Resilient and RBF ANN Classifiers: A Performance Analysis

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### ABSTRACT

Recent technological developments in the field of image sensors widen the application of digital image processing in the areas of remote sensing, medical diagnosis, industrial automation and other services. Among the many image processing applications, Classification of outdoor natural scenes is the most promising research area around the world. In this proposed system, the classification of outdoor natural scenes is carried out in two different phases. In the first phase, the statistical features from the images are extracted using two approaches. In the first approach, the four wavelet sub-bands values are directly used for calculating the statistical features. In the second approach, the fractal components extracted from the wavelet sub-bands are used for extracting the features from the images. The wavelet decomposition is done by two dimensional discrete wavelet transform (2D DWT). The Daubechies wavelet is used to decompose the image into four sub-bands. Then the feature vectors obtained using the two approaches are normalized and stored for the classification purpose. During the second phase, the neural classifiers resilient back propagation neural network (RPNN) and radial basis function neural network (RBFNN) are applied for the outdoor scene classification. The Radial Basis Function Neural Network based classification algorithm provides better performance than resilient back propagation neural network classifier.

**Keywords:** Neural Classifiers; Resilient back propagation; Radial Basis Function Neural Network; Natural Scenes, Fractals.



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## INTRODUCTION

The classification of outdoor natural scenes is one of the most vital areas of research in the field of machine vision. The natural outdoor scene is a collection of arbitrary shape, colour and texture and each image differ from the other in this respect (SilvaDDN De et al, 2019). The effect of illumination difference has more impact on the image and hence to model the classifier is a difficult process. Many research techniques have been proposed in the past with varying degree of success based on the choice of feature vector, classification algorithms, number of training and testing dataset and semantic knowledge for the automatic classification of Natural outdoor scenes. The main objective of this research article is to make a comparative performance analysis study on neural classifiers trained with the features extracted from the images using wavelet decomposition and classify the test images by applying the test feature vector to the trained classifiers. The research work mainly focuses on the classification of natural scenes with the help of features extracted from the given dataset using fractal components determined from the wavelet coefficients.

## LITERATURE REVIEW

The researchers have proposed a technique based on edge analysis for the automatic classification of scenes present in the digital photographs as indoor or outdoor (Andrew and Sameer, 2005). The straightness of the contours, textures of edges can also be analysed for further understanding the nature of substances in the scenes like presence of foliage or bushes. Girish patil et al., (2015) introduced a new method for the image classification using the image features such as shape, color and texture information. The classification is done by Backpropagation Neural Network with single hidden layer. The classification rate of 90 % is attained for testing data sets. The researchers (Mayada Ali et al., 2013) introduced a classification scheme using human inspired features like dominant direction, openness and roughness. A two layer feed-forward neural network with sigmoid function is used for image classification. Shweta Lawanya Rao and Dolley Shukla (2014) stated that Radial Basis function Neural Networks is highly successful class of neural networks for the object detection. Compared with other neural networks, the Radial Basis function Neural Networks (RBF) is much more advantageous than other schemes of neural networks. Seenivasagam et al., (2012) introduced a novel method for fire colour image segmentation using Radial Basis Function Neural Network (RBFNN). RBFNN is used to train input layer to target vector. The experimental results obtained using RBFNN for fire colour segmentation is better when compared to conventional k-means algorithm. Gagandeep Kaur and Paramjit Kaur (2014) introduced Colour image restoration algorithm based on filling in technique using Radial Basis Function neural network. Filling-in technique provides more impact on image restoration. Nadia M. G. Al-Saidi et al., (2014) introduced a novel gray fractal dimension method by fusing the fuzzy set theory, escape time principle and pixel covering method. The proposed method can be used to compute the fractal dimension for any given set. This method provided a better performance in term of precision. Mohammed Talibi-Alaoui and Abderrahmane Sbihi (2012) introduced Kohonen map and Mathematical morphology-based method for the unsupervised image classification. The fractals features are extracted by using fractal dimension are considered as the input vector for the classifier.

## WAVELETS AND MULTI FRACTALS

The multifractal framework (Antonio and Angela 2002, 2008) is explicitly well adapted to most of the real world images or scenes. The fractal components present in the natural scenes provide edges and contours in the images. The fractal components can be obtained from the statistical properties of the real world images. Those fractals generally contain the following features in common (a) no characteristic length, (b) self-similarity and (c) fractal dimension. Wavelet analysis is capable of revealing information like self-similarity, breakdown points, discontinuities in higher derivatives, etc. In order to extract the features, the 2-D wavelet transform is used to decompose the image into four sub-bands, namely the low-low (LL), low-high(LH), high-low(HL) and high-high(HH) sub-bands (Jayaraman et al., 2009). The Discrete wavelet transform (DWT) (Gonzalez, 2018 ; Daubechies,





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1992) can be obtained by filtering the given signal through a series of digital filters at different scales. During the process of subsampling, the scaling operation is carried out by changing the signal resolution.

The discrete wavelet transform of image  $f(x,y)$  of size  $M \times N$  is given by

$$W_{\varphi}(j_0, m, n) = \frac{1}{\sqrt{MN}} \sum_{x=0}^{M-1} \sum_{y=0}^{N-1} f(x, y) \varphi_{j_0, m, n}(x, y) \tag{1}$$

$$W_{\psi}^i(j, m, n) = \frac{1}{\sqrt{MN}} \sum_{x=0}^{M-1} \sum_{y=0}^{N-1} f(x, y) \psi_{j, m, n}^i(x, y) \tag{2}$$

Here,  $j_0$  represents an arbitrary starting scale. The  $W_{\varphi}(j_0, m, n)$  values define approximation coefficients at scale 0.

The  $W_{\psi}^i(j, m, n)$  values define horizontal, vertical and diagonal coefficients for scales  $j \geq j_0$ .

**DATA SET PREPARATION**

The two hundred numbers of forest images and two hundred numbers of street images available in the MIT database are considered for the proposed work. The images are available in the following web link: <<http://cvcl.mit.edu/database.htm>>. (Computational visual cognition Laboratory Urban and Natural Scene categories 2001). Some of the sample images of the forest (class1) and street (class2) classes were shown in Figure 1 a,b,c and d respectively. It was considered that the images were free from noises hence no noise removal method was adopted.

**METHODOLOGIES**

The work flow diagram of the proposed work is shown in the Figure 2. Two approaches are used for extracting the feature sets from the images. In the first approach, the coefficients obtained from the wavelet decomposition process are directly considered as a feature sets. In the second approach, the fractal exponents of the wavelet sub-bands are considered as a feature vector for the neural classifiers. The proposed work considers the following statistical properties (Gonzalez 2010) of the image as the features to be extracted from the wavelet decomposition process.

The mean of an image is given by

$$Mean = \frac{\sum_{x=0}^M \sum_{y=0}^N f(x, y)}{M * N}$$

The standard deviation ( $\sigma$ ) is given by

$$\sigma = \sqrt{\frac{\sum_{i=1}^N (Xi - \mu)^2}{N - 1}}$$

The entropy of an image is the measure of the amount of orderliness present in the given image.

Where, P represents the pixel intensity.

The energy defined as the sum of all the pixel values (I) present in an image by

$$E = \sum I \quad Entropy (H) = - \sum_{i=1}^N P_i \log_2 P_i$$



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## EXPERIMENTAL RESULTS AND ANALYSIS

### SCENE CLASSIFICATION USING (RPNN)

The feature vectors extracted by using Daubechies wavelet in this section are considered for the classification purpose. The neural network attained its goal in 28 epochs. The Figure 3(a) shows the converging training graph of RPPN classifier for the approach-1. From this research work, it is observed that RPNN provides the average classification rate of 91.5% with execution time of 12.86 seconds using Daubechies wavelet. The neural network achieved its goal in 172 epochs. The Figure 3(b) shows the converging training graph of RPPN classifier using fractal based approach-2. In the 100 testing images from each class, RPNN classifies 98 images from forest and 85 images from street class. From this research work, it is seen that RPNN provides the average classification rate of 91.5% with execution time of 12.72 seconds using Daubechies wavelet.

### scene Classification using Radial basis function neural NETWORK (RBFnn)

This section details the classification of outdoor natural scenes as forest or street using RBFNN. The architecture of RBFNN consists of an input layer, a hidden layer with RBF function and an output layer. The hidden layer consists of 200 neurons. The goal is set to 0.001 with spread as 500. In the feature extraction process,  $1 \times 16$  features are extracted from the single image. The training data set consists of 100 forest images and 100 street images. The testing data set consists of 100 forest images and 100 street images. For the training phase,  $16 \times 100$  features of forest scenes and  $16 \times 100$  features of Street scenes from training data sets are used. For the testing phase,  $16 \times 100$  features of forest scenes and  $16 \times 100$  features of Street scenes from testing data sets are used. The Figure 4(a) shows the converging training graph of RBFNN classifier. The neural network achieved its goal in 200 epochs. In the 100 testing images from each class, RBFNN classifies 98 images from forest and 98 images from street class. From this research work, it is seen that RBFNN provides the average classification rate of 98% with execution time of 5.49 seconds using Daubechies wavelet. The Figure 4(b) shows the converging training graph of RBFNN classifier using fractal approach. The neural network achieved its goal in 200 epochs. In the 100 testing images from each class, RBFNN classifies 96 images from forest and 97 images from street class. From this research work, it is seen that RBFNN provides the average classification rate of 96.5% with execution time of 5.51 seconds using Daubechies wavelet. The Simulation work is conducted using matlab software to train and test the neural classifiers with the feature vectors extracted from the two approaches. A comparative study has been carried out on the performance of the proposed system with and without fractal components extracted from the wavelet coefficients using the classifiers: RPNN and RBFNN on the test samples. In Table 1, the Classification performances of the two classifiers based on average classification rate is shown. The Radial Basis Function Neural Network provides better performance on the basis of average classification rate and the computation time than the resilient back propagation neural network classifiers using the features extracted from the scenes.

## CONCLUSION

In this research article, The RBFNN classifier provides highest average classification rate of 98% with computation time of 5.53 seconds using level-1 Daubechies wavelet decomposition approach. But the RBFNN with fractal-based feature extraction approach provides highest classification rate of 96.5 % with computation time of 5.22 seconds. From the results, it is observed that the RBFNN classifier performs better using the proposed feature extraction techniques compared to RPNN. The research work can be further extended with multiple classes of images and deep learning neural networks.





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**Table 1–Proposed work performance comparison**

| Method | Approach 1 | Approach 2 |
|--------|------------|------------|
| RPNN   | 91.5%      | 91.5%      |
| RBFNN  | 98%        | 96.5 %     |

|   |   |
|---|---|
| <p>(a) (b)</p> <p>(c) (d)</p>   |   |
| <p><b>Figure 1 Image Samples (a) Forest-Training (b) Forest-Testing (c) Street Training (d) Street Testing(Source: MIT database Urban and Natural Scene categories)</b></p> | <p><b>Figure 2. The Block Diagram representation of proposed work</b></p> |





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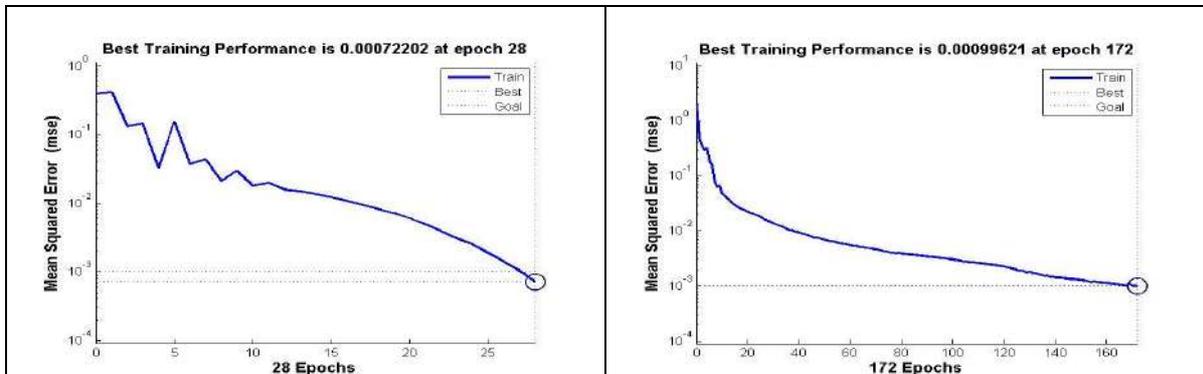


Figure 3.RPNN Training converging graph of level-1 (a) Daubechies decomposition (b) fractal decomposition

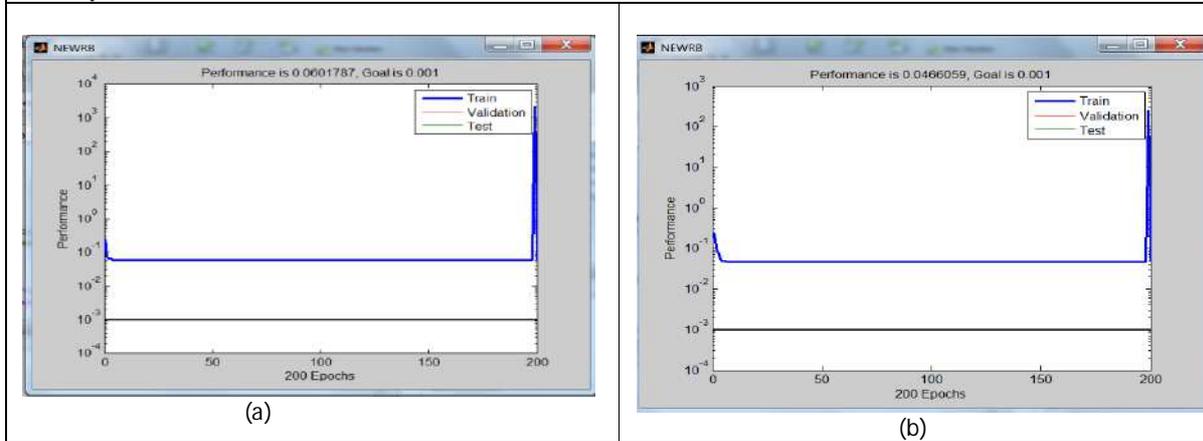


Figure 4.RBFNN Training converging graph of level-1 (a) Daubechies wavelet decomposition (b) fractal decomposition.





## Vehicular communication using IBOOS

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### ABSTRACT

Vehicular Cloud Computing is significant due to its unique features and applications, such as standardisation, efficient traffic management, road safety, and infotainment, VCC is made up of various circulated vehicular mists (VCs), which are framed on-the-fly by powerfully incorporating underutilised vehicular assets such as figuring force, stockpiling, and so on. Existing life-as-a- service (IDaaS) proposals are unsuitable for usage in VCC due to limited processing resources and installed vehicle gadget capacity limits. We propose an improved ciphertext-strategy characteristic- based encryption (CPABE) plot as a first step. VCC is a novel hybrid technology that has a significant impact on traffic management and road safety by utilising vehicular resources for decision making, including as computer, storage, and the internet.

**Keywords:** VCC, CPABE, IDaaS, RSU, IBOOS, IBS

## INTRODUCTION

Vehicular conveyed figuring (VCC), the coordination of the headways of dispersed processing and vehicular associations, is gaining thought in light of its capacities of supporting a movement of novel, significant, and more over tricky applications for working on driving security, saving energy, overhauling the traffic, and so forth. Like dispersed processing giving cloud organizations, VCC can give distinctive compact vehicular cloud organizations for vehicles. Exactly when a vehicle needs to get to VCC organizations, VCC expert communities (VCCSP) regularly require the vehicle's conspicuous information to support its requesting.



**RELATED WORK**

Cloud storage is now widely used, which relieves users from the burden of local data storage. Meanwhile, experts have focused their attention on how to protect the security and integrity of outsourced data kept on a cloud storage server. The key solution introduced to overcome this problem is proofs of storage (POS). POS that can be verified by the public. Allowing a third party to check data integrity on behalf of the data owner improves the scalability of the system greatly. However, due to multiple expensive group exponentiation operations, most publicly verifiable POS techniques are extremely sluggish to compute authentication tags for all data blocks, even much slower than usual network uploading speed, and thus become the bottleneck of the POS scheme's setup phase. We offer a novel version formulation termed "Delegatable Proofs of Storage(DPOS)" in this work. Then, similar to the functionalities of publicly verifiable POS schemes, we build a lightweight privacy-preserving DPOS scheme that is as efficient as private POS schemes on one hand and can enable third-party auditors at any moment on the other. We speed up the tag generation process by at least several hundred times as compared to traditional publicly verifiable POS systems, without sacrificing efficiency in any other way. Because of the numerous advantages it provides, such as lower infrastructure costs, increased scalability, and availability, cloud computing has become widely recognized and implemented in our daily lives. Cloud storage services are becoming popular as a way to reduce the amount of data stored locally. Data is outsourced to a cloud server and may then be retrieved as needed. Meanwhile, ensuring the security and integrity of outsourced data without maintaining a local copy for data owners is a critical challenge that must be addressed. Proofs of storage (POS), also known as proofs of retrievability (POR) or proofs of data possession (PDP), is one of the most common options. The basic idea is dividing the whole data file into multiple blocks, each of which is used to generate a homomorphic verifiable tag (HVT) sent to the cloud server together with the data file. Since the first POR and PDP schemes are presented in 2007, there have been lots of efforts devoted to constructing proofs of storage schemes with more advanced features such as public key verifiability, data dynamics, multiple cloud servers, and data sharing. We concentrate on the first two characteristics: public verifiability and data dynamics support. In terms of the former, we note that most publicly verifiable POS systems create HVTs for data blocks using expensive operations. As a result, creating HVTs for medium or large data files is prohibitively expensive. For example, one of the most popular POS techniques, proposed by Wang et al., achieves data pre-processing throughput of 17.2KB/s with an Intel Core 2 1.86 GHz workstation CPU, implying that generating HVTs for a 1GB file will take roughly 17 hours. Even if the user has a CPU with 8 cores, it still requires more than 2 hours' heavy computation. Such intensive computation is unsuitable for a laptop, let alone a tablet computer or smartphone. The public verifiability of POS allows any third party to verify the integrity of data in cloud storage, relieving the data owner of a major burden. In fact, however, it is not preferable to let anyone to audit the data at their leisure; instead, the auditing work must be delegated in a regulated and organized manner [5].

**PROS: PROOFS OF RETRIEVABILITY FOR LARGE FILES**

Researchers nowadays have serious attention towards the cloud storage server which can be secured and can maintain integrity for the outsourced data, which can reduce the burden of the local data storages. Proofs of storage (POS) is a mechanism mainly used to address this issue. The cloud service scalability is improved by allowing a third party to verify the integrity of the data instead of the data owner. The setup phase of the POS scheme is slower than typical network uploading speed and most of existing publicly verifiable POS schemes are extremely slow to compute authentication tags for all the data blocks. So we are introducing a new variant called "Delegatable Proof of Storage(DPOS)". Lightweight privacy-preserving DPOS schemes are as efficient as private POS and, like publicly verifiable POS schemes, can support third-party auditors and switch between them at the same time. Compared to traditional POS systems, we can efficiently fasten the process without sacrificing efficiency in any aspect. In addition, we extend a high efficiency to support fully dynamic operations by reducing the computational time to  $O(\log n)$  and requiring only constant communication costs. In the standard model, we prove our scheme is sound and private against the auditor. Experimental results verify the performance efficiency of the scheme [2].





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### **Hybrid Provable Data Possession at Untrusted Stores in Cloud Computing Dynamic Provable Data Possessions**

It is known that nowadays, data security draws more attention than before in cloud storage systems. We have to secure data like data recovery ability, important data files possessed by users, and to ensure availability and reliability of outsourced data on multiple cloud service providers (CSP). CSPs are invariably not reliable. For integrity of replication files, we use multiple CSPs simultaneously and a new dynamic multiple replica provable data possession (DMR-PDP) is proposed. In addition, we use vector dot products instead of modular power calculation in the traditional PDP, which reduces the time storage space and importance of the tag set. A novel dynamic data structure is divided into add reversion mapping tables (DAVMTs) to solve the problem of data dynamics. Our proposal is to validate the effectiveness using practical experiments. In the cloud scenario, when a user uploads data to the cloud, the outsourced data might lose total control. The clear problem is data integrity. The PDP scheme was proposed in 2007 to verify the outsourced data's integrity. Outsourced data has homomorphic tags, which are calculated by the data owner and the data is encrypted. In the CSP, encrypted files are uploaded and the secret key is kept safe by deleting the local files on the basic premises [5]. The integrity of data is stored in the cloud, DO verifies response by sending a challenge to CSP and CSP responds to challenge, which is different from traditional integrity verification scheme. DO use sampling method with probability in the verification phase, in the PDP scheme. As the PDP scheme in [5] is applicable to static data and cannot realize the data's dynamic operation. some dynamic PDP schemes are proposed [3].

### **CONSTANT-SIZE COMMITMENTS TO POLYNOMIALS AND THEIR APPLICATIONS**

In polynomial commitment scheme a committer can commit to a polynomial with a short string which is also used by a verifier. The verifier can confirm the evaluations of the committed polynomial. In the homomorphic commitment schemes, the commitment sizes are linear in degree of committed polynomial. In polynomial commitment schemes all are constant size. The opening of commitment is also constant, even opening multiple evaluations requires only a constant amount. Hence, our schemes are useful to reduce the communication cost in cryptographic protocols. we apply our polynomial commitment schemes to four problems in cryptography: i) verifiable, ii) secret sharing, iii) zero-knowledge sets credentials and iv) content extraction signatures. For many cryptographic protocols commitment schemes are the fundamental components. A scheme allows a committer to publish a value, called the commitment, which binds her to a message without revealing it. Later, when commitment is open it will reveal the message to a verifier to check that the message is consistent with the commitment. There are three ways a committer can commit to a message. Let  $g$  and  $h$  be two random generators of a group  $G$  of prime order  $p$ . The committer can commit to a message  $m \in \mathbb{Z}_p$  simply as  $C_g(m) = gm$ . This scheme is unconditionally binding, and computationally hiding under the assumption that the discrete logarithm (DL) problem is hard in  $G$ . The second scheme, known as a Pedersen commitments, is of the form  $C_{g,h}(m, r) = gmhr$ , where  $r \in \mathbb{Z}_p$ . Pedersen commitments are unconditionally hiding, and computationally binding. This research was completed at the University of Waterloo under the DL assumption. Third, the committer may publish  $H(m)$  or  $H(m || r)$  for any one-way function  $H$ . The often used function is collision-resistant hash function. A survey by Damgard covers commitment schemes in detail[7].

### **PROPOSED METHODOLOGY**

Character Based Online/Offline Digital Signature (IBOOS) is the proposed calculation that is utilized. To build the presentation of WSNs we utilize a productive and valuable strategy called grouping. The review is worried about the safe information transmission for CWSN. To accomplish energy skill we have presented two new Secure and Efficient Data Transmission (SET) protocols. IBOOS which depends on the IBS plan and IBOOS conspire which makes improvement to the current lightweight CP-ABE plot Diffie damnation man calculation to make it more proficient design, by embracing the further developed CP-ABE. To acknowledge secure access client, the data is encoded by the worked on proposed strategy and transferred to the VC as code text. Initially, the interest of believed authority is diminished, which can diminish correspondence overhead on both confided in power and each VC. There is a focal regulator which contains the detail of content server, RSU (ROAD SIDE UNIT) subtleties and the vehicle subtleties. As many number of control server can be produced with the RSU and the accessible substance





server id will be displayed in the regarded RSU structure. The RSU can be associated with the substance server as the client required and the vehicle hub subtleties will be displayed in the RSU structure. information replication should be possible in the vehicle as the closest RSU is accessible.

### EXPERIMENTAL SETUP

For any circle, we discover the runtime of the square inside them and increase it by the occasions the program will rehash the circle. All circles that develop relatively to the info size make some direct memories intricacy  $O(n)$ . Assuming you circle through just 50% of the exhibit, that is still  $O(n)$ , Time intricacy addresses the occasions an assertion is executed. The real time needed to execute a specific code relies upon different elements like whatever the information, this will return in a fixed, limited time. In the above intricacy the least runtime to execute the program was IBOOS calculation with the average of 1250 ms, and the additional time taken to execute is Diffie- Hellman.

### CRYPTOGRAPHY COST

Encryption should be done consecutively both encryption and decoding can be parallelized. In this manner, on a VANET execution, IBOOS encryption and decoding is regularly quicker than existing technique and less time with safer is created. As the encryption strategy is more productive in the proposed technique, the RSU will be more proficient in information replication. This is estimated in number of bytes. More bytes results in safer.

### STORAGE OVERHEAD

In the part, the capacity overhead of the proposed plot is contrasted and the important plans in VANETs. Since the capacity of vehicle and RSUs are adequate, this correlation just spotlight on the capacity overhead of cloud server. so the vehicle and the RSU can be adequately utilize the capacity.

### COMMUNICATION COMPLEXITY

The correspondence intricacy of the proposed conspire is contrasted and plots. In the proposed plot, 2 rounds are just needed for  $n$  gatherings to share the messages while  $n - 1$  rounds are required. Furthermore, for imparting information to other vehicle in the gathering, the correspondence intricacy of plans should have been introduced. As indicated by the examination consequences of the capacity overhead and correspondence intricacy IBOOS results are more productive.

### CONCLUSION

In this task, we proposed a compelling information access control CP-ABE plan to divide information between various application specialist co-ops and distributed storage frameworks for vehicles in a VANET. Our plan gives both client and trait disavowals by different qualities. We additionally utilized cloud process hubs to share the computational heap of encryption and decoding to offer help for asset obliged gadgets; this methodology makes CP-ABE careful the IBOOS more appropriate for VANETs. Through the far reaching security investigation and exploratory assessment results, we show that our answer keeps up with client protection as well as is secure against different assaults. Also, our plan ensures both versatility and effectiveness. In future work, we will test our plan in a genuine climate and measure the correspondence latencies between elements.

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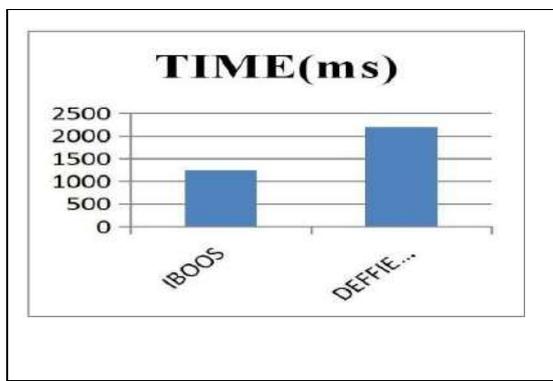


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**Table:1**

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**Fig 1: Experimental Setup**

| ALGORITHM                 | TIME(MS)    |
|---------------------------|-------------|
| <b>IBOOS</b>              | <b>1250</b> |
| <b>DEFFIE<br/>HELLMAN</b> | <b>2200</b> |

**Fig 2: Experimental Setup**





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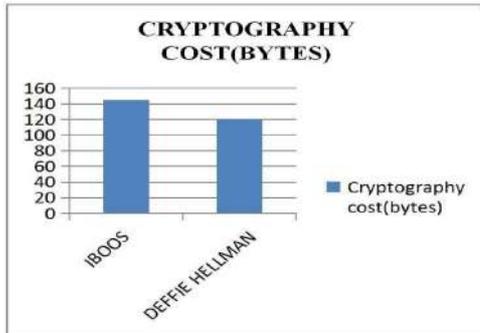


Fig. 3: Cryptography cost

| ALGORITHM      | Cryptography cost(bytes) |
|----------------|--------------------------|
| IBOOS          | 145                      |
| DEFFIE HELLMAN | 120                      |

Fig. 4: Cryptography cost

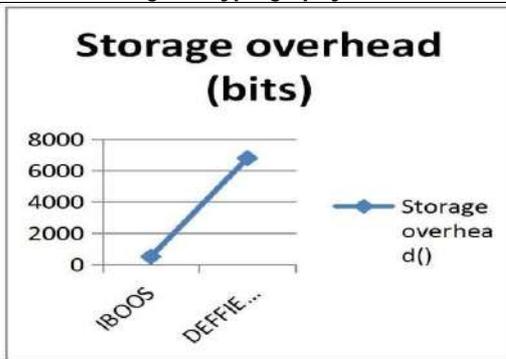


Fig. 5: Storage overhead

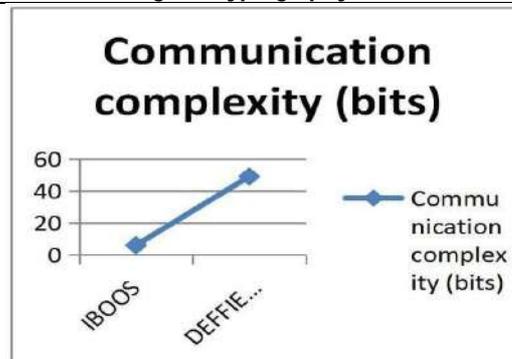


Fig. 6: Communication complexity

| ALGORITHM      | Communication complexity (bits) |
|----------------|---------------------------------|
| IBOOS          | 6                               |
| DEFFIE HELLMAN | 49                              |

Fig. 7. Communication Complexity





## Prediction of Cardiac Disease by the use of Methods from Machine Learning

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### ABSTRACT

It is impossible to live as a human being without at some point needing medical attention. Because there is such a large number of medical data available within the healthcare industry, machine learning algorithms are being used in the process of diagnosing cardiac disease. Technologies that use machine learning have the potential to reliably categorise people as either healthy or unwell. The creation of an automated system for forecasting heart attacks in human beings is now receiving an increasing amount of attention and effort. The model that has been proposed was constructed with the assistance of a Deep Neural Network and a two-statistical model. Because of this, there won't be any problems with improper or excessive fitting. The purpose of this research was to develop an understanding of how to predict the risk profile of a patient based on clinical data components. This model performs better than its predecessor on both the test data and the training data. The material included in the collection is arranged in accordance with a predetermined standard of medical practise. The system relies on classification strategies in order to make judgments about these factors.

**Keywords:** Healthcare, Heart Disease, Machine Learning, Deep neural network, Classification



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## INTRODUCTION

Heart disease is an umbrella term used to refer to a variety of conditions that have an adverse effect on the heart or to the problem that disrupts the heart's capacity to operate correctly. The terms heart disease and cardio vascular disease are often used synonymously with one another (CVD). Coronary arteries are the blood vessels that feed blood to the heart; the most common cause of heart failure is the constriction or obstruction of coronary arteries. Other disorders that might damage the heart, such as those that have an effect on the heart's muscles or valves, are also regarded to be forms of heart disease. The most common cause of illness and death among the general population is cardiovascular disease. It is generally agreed that the ability to accurately predict cardiovascular disease is the single most significant topic within the realm of data analytics. In the United States, coronary artery disease is the leading cause of the most common kind of heart attack. Men are more likely to suffer from cardiovascular conditions than women are. According to the estimations derived from the data provided by the World Health Organization (WHO), cardiac conditions are responsible for 24 percent of the non-communicable disease-related fatalities in India. Researchers have compiled a list of the several variables that contribute to an increased likelihood of developing coronary artery disease and heart disease. The elements are broken down into two distinct groups: those that can be altered, and those that cannot be altered, also known as risk factors. The following are factors that are considered to be risk factors for cardiovascular disease: high blood pressure, age, family history, smoking, sex, poor diet, intake of alcohol, and lack of physical exercise. There are some characteristics, such as age, gender, and family history, that cannot be altered, but other factors, like as smoking and alcohol use, may be modified. Meditation and other modifications to one's way of life may help mitigate the risks that are associated with one's lifestyle.

## RELATED WORK

Early on, a variety of different frameworks for predicting cardiovascular illness using machine learning approaches were created. Early on, algorithms such as back vector machine, K-nearest neighbour, and Artificial Neural Network were created in order to forecast the presence or absence of a cardiac illness. These algorithms may also be used to diagnose cardiac disorders. According to a survey, ANN-based models are the ones that are most often utilised in the prediction of heart disease. Learning the values or weights of parameters from training data was accomplished by using Levenberg-Marquardt (LM), scaled conjugate gradient (SCG), and Pola-Ribiere conjugate gradient (CGP) algorithms in the majority of the research projects that used ANN for the diagnosis of cardiac disease. In spite of this, for the purpose of this investigation, we made use of newly suggested optimization methods known as (SGD). Since the DNN is more deep than the ANN, its accuracy may potentially be improved. DNN helps to improve the model's overall performance. Using tenfold cross validation, Ashok Kumar Dwivedi built a model to test the effectiveness of several Artificial Neural Network, and then evaluated which approach was the most effective based on the accuracy loss and amount of time that each algorithm required. According to his findings, the accuracy of the Naive Bayes algorithm was 83 percent, the accuracy of the Classification Tree was 77 percent, the accuracy of the KNN was 80 percent, the accuracy of the Logistic Regression was 85 percent, the accuracy of the Support Vector Machine was 82 percent, and the accuracy of the Artificial Neural Network was 84 percent respectively. According to the findings of the research that was conducted, Logistic Regression provides a higher level of accuracy when compared to other algorithms[2]. In order to forecast the development of heart disease, ChalaBeyene used methods from the field of data mining. In order to compute, he used the WEKA programme. WEKA lessens the need for manual coding, which in turn makes the process simpler and more straightforward. The pre-processing of data, regression, clustering, classification, association rule, and visualisation are all critical aspects of data mining, and WEKA has the tools you need to do these tasks[6].





## PROPOSED SYSTEM

The use of machine learning and other approaches may be helpful in illness prediction. The 2-DNN serves as the foundation for the diagnostic system that we design. The issue of over fitting or under fitting was one of the primary concerns that the diagnostic system was designed to address and resolve. In order to prevent both over fitting and under fitting, feature selection is used. The network is fed the training data so that it may learn. In order to evaluate how well the network is working, the testing dataset was distributed across it. The DNN that has multiple hidden layers has been utilised, which is the reason why the proposed model has higher performance than ANN. 2-DNN is being developed with the goal of enhancing the accuracy of the categorization of cardiac condition prognosis. The proposed system architecture is shown in figure 1.

### Feature Selection

When you are developing your model, the first and most significant step you should do is to choose the features. The process of picking the characteristics that contribute the most to the prediction variable or output, either automatically or manually, is referred to as feature selection. If you have characteristics in your data that are not relevant, the accuracy of your models may suffer, and your model may begin to train based on features that are not relevant. The issue of over fitting may be avoided by selecting the appropriate features. The chi-square test is utilised for feature selection in the model that has been suggested. During the process of removing unnecessary features, we calculate  $\chi^2$  statistics between each non-negative feature and class. The  $\chi^2$  model carries out the  $\chi^2$  test, which evaluates the degree to which the characteristics are dependent on the class. As a result, the model is able to exclude those characteristics that are more likely to be independent of class. Mainly because these characteristics are often disregarded as unimportant when classifying things. The score obtained from the  $\chi^2$  test is used to rank the characteristics. The value of the threshold is used to determine how the characteristics are chosen. The threshold value that has been suggested for the model is 0.05.3.2.

### Deep Neural Network

A neural network is a collection of pattern-recognition algorithms that are loosely based on the structure of the human brain. Neural networks are used in artificial intelligence. The vast majority of deep learning techniques make use of neural network topologies; this is one reason why deep learning models are sometimes referred to as deep neural networks. The number of hidden layers of a neural network is typically meant to be referred to when using the word "deep." Deep neural networks may have many more hidden layers than traditional neural networks, which only have one hidden layer to begin with. The output may be produced by neural networks, which also have the potential to learn on their own. Because the input is only saved in its own network and not in its database, the loss of data does not influence the functioning of the system. The network is able to gain knowledge from previous experiences and use it in the case of a situation that is similar. Even if a single neuron does not react or there is a gap in the input, the network is able to identify the problem and continue to create the desired result. They are capable of working on numerous things simultaneously without negatively impacting performance. Within the framework of the model being suggested, a deep neural network with two hidden layers is built. Within the output layer is where you'll find the Sigmoid activation function.

In the hidden layer, the Relu activation function is used, and accuracy assessment measures such as binary cross entropy loss are utilised, in order to analyse the performance of the models. The dataset was obtained from the machine learning repository at UCI, and inside the repository, it was organised into testing and training datasets. When separating a data set into a training set and a testing set, the vast majority of the data is applied to the training set, while just a fraction of the data is applied to the testing set. You may reduce the consequences of data inconsistencies and get a better understanding of the properties of the model if the training and testing data are consistent with one another. The processing of a model with the help of the training set is followed by testing the model with the help of the test set by making predictions using the model. It is simple to verify whether or not the model's prediction is accurate since the data in the testing set already has known values for the characteristic that you wish to forecast. Only the performance of a model can be evaluated with the use of testing data. There are a few





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different names for training data, including AI training data, training set, and learning set. It is the data that is fed into an algorithm in order to teach it. The testing data are used in order to evaluate the quality of the training provided by your algorithm and to estimate the characteristics of the model. Sklearn's train test split approach is used to classify both the training dataset and the testing dataset in the system that has been suggested. Twenty percent of the data is used for the purpose of testing, while the remaining eighty percent of the data is utilised as training data.

#### Data set collection and description

The Cleveland heart disease dataset, which can be found in the machine learning repository at UCI, is the one that is utilised here. This dataset is used for the purpose of academic study. There are 303 instances and 14 characteristics included in the dataset. The dataset consists of 8 attributes that are categorised and 6 attributes that are numeric as shown in Table 1. The age category of the items that are included in the dataset ranges from twenty-nine to seventy-nine years old. Research conducted on a regular basis has consistently shown that individuals with an age higher than 65 are very unlikely to develop a heart disease. The typical symptoms of angina are brought on by a decrease in blood flow to the muscle of the heart. Stress of the mind or the heart might bring on symptoms of atypical angina. There is no connection between asymptomatic and heart disease. The value of an individual's TRESTBPS, which is their blood pressure while they are at rest, has mmHg as its unit of measurement. Serum Cholesterol refers to the overall amount of cholesterol that has been accumulated. The level of cholesterol known as LDL is regarded to be "bad." The presence of high levels of LDL causes the arteries to become more constricted. HDL is regarded as the "good" kind of cholesterol. It has been shown that having a high HDL level lowers the chance of having a heart attack. The fasting blood sugar value of a person is denoted by the acronym FBS. If the FBS is at or below 120 milligrammes per deciliter, then the value is 1. If the FBS is more than 120 milligrammes per deciliter, then the value that is given to the characteristic is 0. An improper response to the insulin that is released causes a rise in the amount of sugar in the blood, which in turn raises the risk of developing cardiovascular disease. The Maximum Heart Rate Achieved reading indicates the highest possible rate of a person's heartbeat that they have reached. An increase in heart rate of 10 percent results in an increase of at least 20 percent in the likelihood of cardiac mortality. If there is no pain, the EIA will be recorded as 0, but if there is pain, it will be recorded as 1. When someone has angina, they will often feel pain in the middle of their chest, and this pain may even travel to both of their shoulders. The length of time that ST-segment depression is present is an essential factor to take into account, given that recovery from the peak stress will result in a positive ECG stress test. The value represented by the SLOPE variable is the slope of the ST segment. The length of the activity test, measured in minutes, is what shows whether or not someone has thalassemia. When doing an ECG stress test, an abnormal result is regarded to be one in which the ST segment depression is more than 1mm between 60 and 80 milliseconds.

#### Algorithm:

Begin: Import the packages

Initialization: Initialise df to the dataset, x to the input selected attributes, y to output class label

And test columns to the input data's

Function print\_chi\_square\_result

Pass In: Threshold value and p value

Pass Out: Whether the attribute is important for prediction or not

If (p value less than the threshold condition meet)

Attribute is important for prediction

Else

Attribute is not important for prediction

Function test independence

Pass In: Input attributes output class label and threshold value

P value, Expected value are calculated using in build contingency function

Call: print\_chi\_square\_result





For(each iteration)

Call: Test independence

Split the testing and training data

Function sequential

Create two dense hidden layer with Relu activation function

Create output layer with sigmoid activation function

Function Compile

Pass In: loss, optimizer and evaluation metric

Pass Out: accuracy for different batches

Evaluate in build function evaluates test data in accordance with Train data

Function Plot:

Pass In: Accuracy values, title, x-axis name y-axis name

Pass Out: Accuracy graph

End

## EXPERIMENTAL RESULTS

The suggested model for the prediction of heart disease using a deep neural network was built with a high degree of precision. There will no longer be a concern with either under fitting or over fitting. On both the testing data and the training data, the suggested model demonstrates the highest level of performance. For the model with chosen characteristics, the suggested model achieves an accuracy of 85%, whereas the model without selected features only achieves 77.5%.

$$\text{Accuracy} = \frac{\text{True Positive (TP)} + \text{True Negative (TN)}}{\text{True Positive (TP)} + \text{True Negative (TN)} + \text{False Positive (FP)} + \text{False Negative (FN)}} \quad (1)$$

$$\text{Precision/Sensitivity} = \frac{\text{True Positive (TP)}}{\text{True Positive (TP)} + \text{False Positive (FP)}} \quad (2)$$

$$\text{Recall} = \frac{\text{True Positive (TP)}}{\text{True Positive (TP)} + \text{False Negative (FN)}} \quad (3)$$

$$\text{Specificity} = \frac{\text{True Negative (TN)}}{\text{False Pegative (FP)} + \text{True Negative (TN)}} \quad (4)$$

$$\text{F1 Score} = \frac{2 * \text{Precision} * \text{Recall}}{(\text{Precision} + \text{Recall})} \quad (5)$$

The parameters used to estimate the heart disease are accuracy, sensitivity, recall, specificity and F1 score as shown in Eq. (1). Eq. (2), Eq. (3), Eq. (4) and Eq. (5). The accuracy measurement can measured using box plot for heart disease with related to depression as shown in Figure 2 and Figure 3. Figure 4 represents the histogram analysis of attributes that are used for prediction.

## CONCLUSION

Deep learning is used to construct an automated method for the prediction of cardiovascular disease. The models are first trained, and then they are verified using a test dataset. Following the construction of the neural network consisting of two hidden layers, the performance of the model is assessed with the help of accuracy assessment measures. The system that has been presented is one that is easy to use, scalable, dependable, and extendable. Through early and accurate diagnosis, the working model that has been developed may also contribute to the reduction of overall treatment costs. The use of ML algorithms gives the system the ability to forecast heart illness, and the results of the prediction are derived from an instance of the heart disease dataset. The findings of the





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experiment lead one to the conclusion that the suggested method raises the predictive accuracy standard during the process of prognosis. The results of this experiment will be helpful in determining whether people suffer from cardiovascular disease.

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**Table 1 Attributes used for classification**

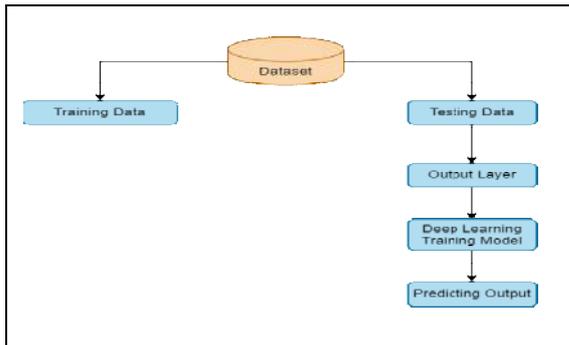
| S.No | Feature Code | Feature Description   |
|------|--------------|---|
| 1    | AGE          | Age in years  |
| 2    | SEX          | Gender of the patient   |
| 3    | CP           | Type of chest pain 0=Atypical angina, 1=typical angina, 2=asymptotic, 3=non angina pain |
| 4    | TRESTB PS    | Blood pressure continuous value in mm Hg  |
| 5    | CHOL         | Cholesterol level continuous value in mm/dl   |
| 6    | FBS          | Fasting blood sugar, 1 >=120, 0 <=120   |
| 7    | RESTECG      | Resting electrocardiographic results  |
| 8    | THALACH      | Maximum heart rate Achieved. Continuous value   |



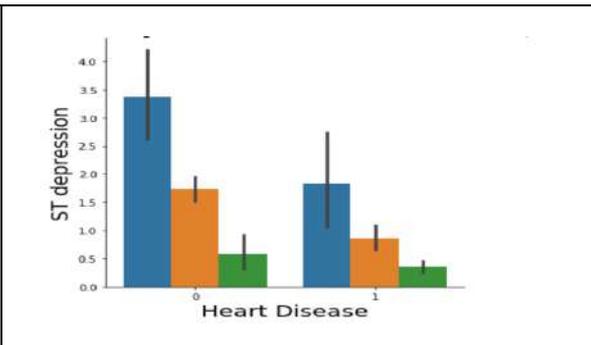


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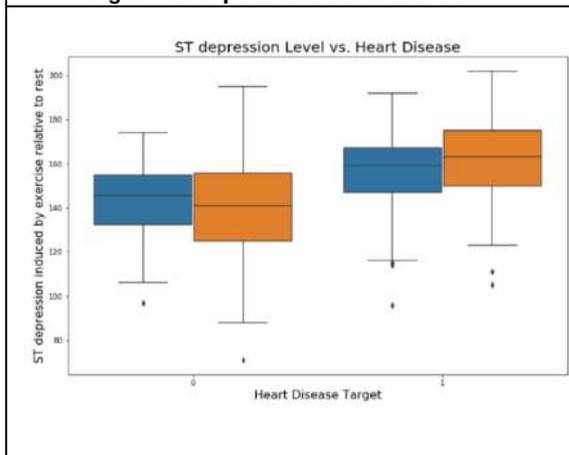
|    |          |  |
|----|----------|--|
| 9  | EXANG    | Exercise Induced Angina, 0=no, 1=yes                   |
| 10 | OLD PEAK | Continuous value , 0= unsloping, 1=flat,2=down sloping |
| 11 | SLOPE    | Slope of the peak exercise ST segment                  |
| 12 | CA       | Vessels that are coloured By Fluoroscopy               |
| 13 | THAL     | Thallium Scan, 3=normal, 6=fixed,7=reversible effect   |
| 14 | Target   | Class Attribute  |



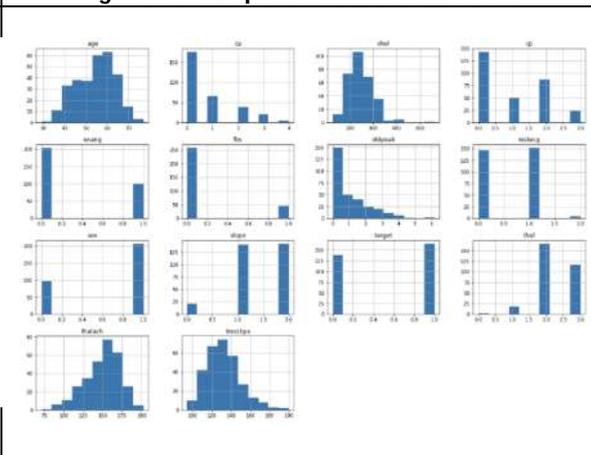
**Figure 1: Proposed model architecture**



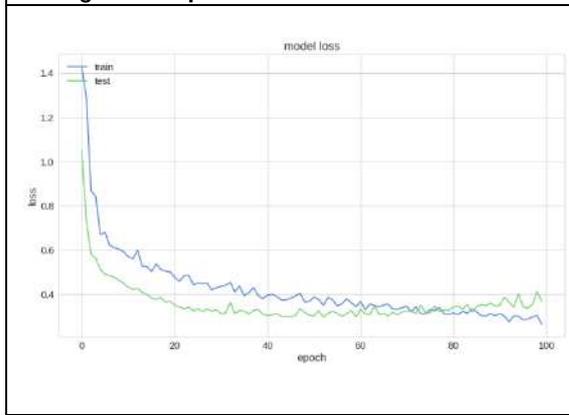
**Figure 2: ST Depression vs Heart Disease**



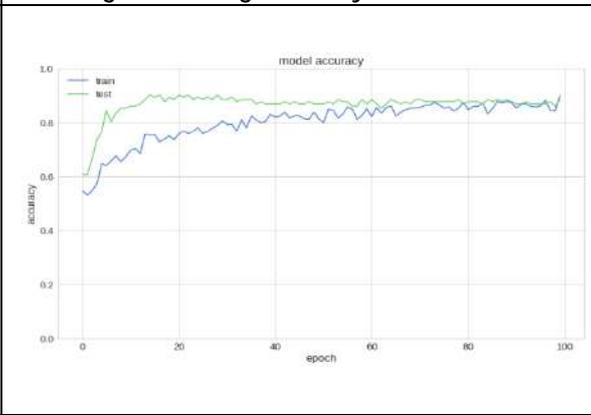
**Figure 3. Depression level vs Heart Disease**



**Figure 4. Histogram Analysis of Features**



**Figure 5. Loss vs Epoch**



**Figure 6. Accuracy vs Epoch**





## Electromyography Signal Based Prosthetic ARM for Handless Persons

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### ABSTRACT

The Prosthetic Arm is an electro-mechanical device that can be primarily used and applied in the field of disability. The whole device is the combination of electrodes governed by the EMG muscle sensor that is merged in a 3D printed mechanical design along with other smaller units. The device detects the type of muscular movement based on the voltage level provided by the EMG sensor and according to motion is performed, with the help of servomotors. The voltage level of the muscles varies depending on their movement. This phenomenon is caused by the tension that the muscles generate during their contraction. The readings collected by the sensors allow the robotic arm to interpret the movement of the muscles. Understanding of the working is done with the help of different graphical representations such as graph for hand open and hand closed position, graph for hand open, hand close and wrist rotate position and graph for hand open and index finger pointing position.

**Keywords:** Prosthetic hand, Amputee, Electromyography, EMG, Control system.

## INTRODUCTION

Any person's most valued possession is their body. The absence of a human hand is a difficult scenario that makes one appreciate the complexity of the human body. The project is driven by the goal of utilizing knowledge in the electronics area, which would primarily play a role in improving the lives of this particular impaired group of individuals. Until recently, the design of such limbs had evolved at a glacial pace. Traditional versions of such weaponry include early developments such as wooden arms. Prosthetic Arms have a long history of being passive devices that give nothing in the way of control and mobility. However, recent breakthroughs in such devices have been made. Slowly, but steadily, we are approaching advanced trans humans' integration. Design and build a



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microcontroller-based Prosthetic Arm that uses electromyography signals produced from muscle contraction to generate a variety of useful motions.

## DESIGN OF ARM

## MATERIALS

- Arduino Mega
- Servo Motors
- Electrodes
- EMG muscle sensors
- The Prosthetic Arm

## METHODOLOGY

The primary idea is to control a robotic arm with input generated from electromyography data. The input data from the muscle sensor are extracted based on the amount of muscle contraction as well as the number of contracted muscles; in other words, the higher the level of activated muscles, the greater the recorded voltage amplitude[1]. When the potentials in motor neurons are generated, this results in muscle fiber contraction. It becomes a muscle action potential when the neuron and axon cross the threshold in the Postsynaptic Membrane of the Neuro muscular Junction. Because of the difference in potentials, the muscle potential is propagated in both directions of the muscle fiber, prompting the sliding of actin filaments on myosin. On Muscle Unit (MU) contractions, a variety of fibers are stimulated by a mixture of activations and synchronizations[2]. The frequency of MU relates to contractions that relax after each activation, resulting in temporal pulses of two or more MU firing together. Muscle contractions are controlled by activations and synchronizations (MU)[3]. In the suggested arm, the wrist has six degrees of freedom, the thumb has five degrees of freedom, and the remaining four fingers. When connecting the EMG sensor to the microcontroller, the sensor requires 6V and a ground supply, according to the protocols and guidelines[4]. If the supply is insufficient, the EMG sensor is vulnerable to failure. Like wise, the operation must be based in a low-electricity area. Due to electrical interference, the field is disrupted. The information supplied by the psychological condition of the person is also a factor in the EMG sensor. the host of the event Similarly, a common ground supply must be established. structured to reduce unwelcome vibrations.

### Flow chart of the system

If different values correspond to different types of motions, the values read by the EMG sensor constitute the basic working basis for the motion of the Prosthetic Arm. Initially, the arm is in the reset position, which denotes the open hand condition, which is used as the reference position[5]. The readings differ on an individual basis, and the arm must be calibrated accordingly. The readings in the flowchart are based on the muscular movements of one of our research participants. Wrist motion is controlled by motor one; index finger motion is controlled by motor two; thumb motion is controlled by motor three, and remaining finger motion is controlled by motor four. When the EMG value exceeds 300 microvolts, all of the motors rotate by 10 degrees, causing the hand to open and the fishing lines to form an interface between the motors and the fingers. Similarly, if the value is between 300 and 380 micro volts, the hand closes due to the rotation of motor 1, which controls the wrist by 10 degrees, and other motors, which control the fingers by 170 degrees, resulting in the complete closure of the palm. Similarly, if the value is between 380 and 450 microvolts, all motors rotate 170 degrees, causing the hand to close and the wrist to rotate in a fist-like motion. If the value exceeds 450 micro volts, motor 2 rotates by 10 degrees, while the other motors rotate by 170 degrees, resulting in a fist with a pointing finger. The value is continuously read, and matching motions are done based on the nature of EMG data, as previously described. The time it takes for the EMG signal to arrive and the arm to move is generally determined by the delay parameter in the code and the sensor's processing capacity. When a microsecond timer is used to test the planned Prosthetic Arm, it is discovered to have a delay of 500ms [6].



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In order to induce affordable readings, it is vital to put EMG devices, that are recording muscle activity, within the right places. Whereas many various choices are potential here, every needs a unique signal process approach. It's going to be counter-intuitive, however thumb muscle signal is healthier visible on the alternative aspect of the arm, thus one among sensors is placed there, and every one of them are placed getting ready to the elbow (muscles have most of their body in this space, however you wish to envision wherever precisely yours are settled [9]). The information acquisition of EMG signals is fetched from the non-invasive methodology victimization surface electrodes. And additionally the signal acquisition is completed for noise rejection or filtering and therefore the signal is amplified. Following work flow is segmentation of knowledge by disjoint and overlapping segmentation. Then Feature extraction is that the method of remodeling information into numerical options which will be processed whereas protective the knowledge within the original data set are done supported time domain, Frequency domain, or Time-Frequency domain like Mean definite quantity (MAV), Root mean sq. (RMS), wave length (WL), Zero crossing (ZC), Slope sign changes (SSC), machine regressive coefficients (ARC), Frequency median (FMD), Frequency mean (FMN), changed frequency median (MFMD), Frequency magnitude relation (FR), ripple remodel (WT), Short time Fourier remodel (STFT), ripple packet remodel (WPT). Then a to a prophetic modeling downside wherever a category label is expected for a given example of computer file [10]. Management strategies of prosthetic arm supported EMG may be categorised in the main in step with the input info to the controller, design of the management algorithmic program, output of the controller.

**RESULT AND DISCUSSION**

The graphical illustration is hooked up, yet because the price of readings in tabular kind for the varied sorts of motion indicated by the arm. The character of the EMG detector signals for varied postures is diagrammatically compared. The reading obtained whereas the hand is within the open position is employed because the reference for comparison completely different hand motions. The first graph compares the character of readings between the open and closed positions of the hand, whereas the second graph compares the character of values between the reference position and therefore the closed and revolved positions of the hand. Similarly, the distinction between the reference location and therefore the inform finger. The arm is 3D written thanks to the overall advantages of a light-weight system over an outsized one, put it prior ancient arms that have a major vary of motion delay. Motions as a results of their weight. The EMG detector is that the most vital element. Servo motors' move motion as a operating tool the quality is controlled by a microchip that's housed within the Prosthetic Arm. The game of fishing the motors and therefore the fingers is connected by a line. The result's that EMG values influence different motions. Servomotors are accustomed produce motions wherever the fishing is completed. The road acts as a connection. Management is predicated on EMG - electrical activity of muscles. EMG signal is obtained by 3 uECG devices (I apprehend, it's purported to be Associate in Nursing graphical record monitor, however since it's supported a generic ADC, it will live any bio signals - as well as EMG). For EMG process, uECG includes a special mode within which it sends out 32-bin spectrum knowledge, and "muscle window" average (average spectral intensity between seventy five and 440 Hz). frequency is on a vertical axis (on every of three plots, low frequency at very cheap, high at the highest - from zero to 488 cycle per second with ~15 cycle per second steps), time is horizontal (old knowledge on the left overall here is regarding ten seconds on the screen) [7].

Intensity is encoded with color: blue - low, inexperienced - medium, yellow - high, red - even higher. For reliable gesture recognition, a correct computer process of those pictures is needed. Except for easy activation of robotic hand fingers, it's enough to simply use averaged price on three channels - sEMG handily provides it at bound packet bytes thus Arduino sketch will take apart it. These values look abundant easier. Red, green, blue charts are raw values from sEMG devices on completely different muscle teams once I am squeeze my thumb, ring and middle fingers correspondingly. For our eyes these cases clearly are completely different, however we want to show those values into "finger score" thusmehow so a program will output values at hand servos. The matter is, signals from muscle teams are "mixed": within the first and third case blue signal intensity is regarding a similar - however red and





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inexperienced are completely different. In 2d and third cases inexperienced signals are similar - however blue and red are completely different [8]. So as to "unmix" them, we've used a comparatively easy formula:

$$S_0 = V_0^2 / ((V_1 * a_0 + b_0) (V_2 * c_0 + d_0))$$

where  $S_0$  - score for channel zero,  $V_0, V_1, V_2$  - raw values for channels zero, 1, 2, and  $a, b, c, d$  - coefficients that I adjusted manually ( $a$  and  $c$  were from zero.3 to 2.0,  $b$  and  $d$  were fifteen and twenty, you'd got to amend them to regulate for your specific detector placement anyway). A similar score was calculated for channels one and a couple of.

## CONCLUSION

Due to the overall advantages of a light-weight system over an oversized one, the arm is 3D printed, put it prior ancient arms that have a major vary of motion delay. Motions as a result of their weight. The EMG detector is that the most vital element. Servo motors' move motion as an operating tool the quality is controlled by a microchip that's housed within the Prosthetic Arm. The game of fishing the motors and therefore the fingers is connected by a line. The result's that EMG values influence different motions. Servomotors are accustomed produce motions wherever the fishing is completed and therefore the line acts as a connection.

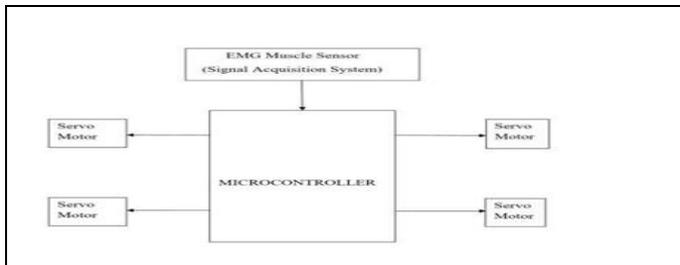
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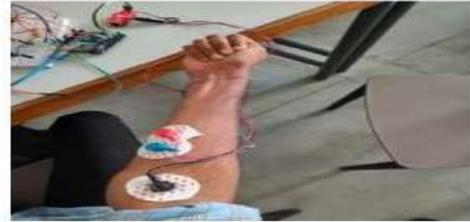




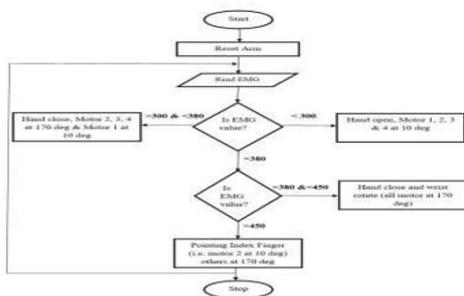
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**Figure.1** Block diagram of the proposed system



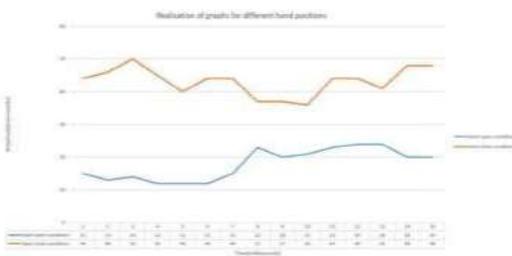
**Figure.2** Placement of electrodes



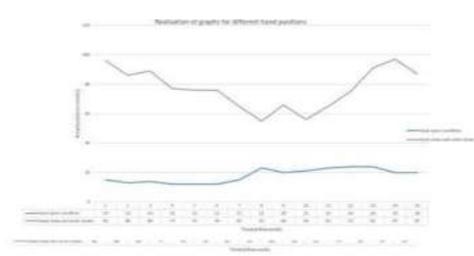
**Figure.3** Flowchart of the system



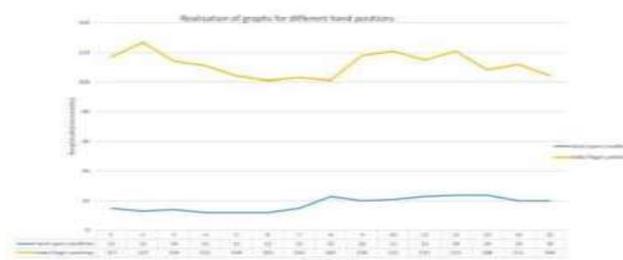
**Figure.4** 3D Design of Prosthetic Arm



**Figure.5** Graph for hand open and hand closed position



**Figure.6** Graph for hand open, hand close and wrist rotate position



**Figure.7** Graph for hand open and index finger pointing position





## IoT Based Sewage Monitoring and Management System

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### ABSTRACT

The goal of making every city a smart city in India is constantly moving towards automation. In order to make a smart city we need to take many factors into consideration, such as smart water management, smart power management, smart transportation, etc. Cleanliness and health are closely linked to sewer system monitoring. Due to the incomplete nature of manual monitoring inside manholes, a problem is handled slowly, therefore, taking more time to resolve. This paper presents the application and design function of a smart and real time drainage and manhole monitoring system that utilizes the Internet of Things (IoT). The designed system will detect gas concentration presents inside a manhole or not, and whether there is a rise in the amount of any gasses harmful to humans or not, as well as monitoring the waste level, it will provide these details to the appropriate department for action. A sewage management system based on real-time monitoring is developed using a gas sensor, a wireless fidelity module, and a microcontroller. It also detects whether humans are inside the manhole, manhole cover status, temperature level, and toxic gas level, measuring each type of gas and tracking changes to the above parameters in real-time. In the event the levels exceed the threshold, the developed system can send an alert to authorized remote workers on their mobile devices. The system assists the community in living a healthier life because it notifies the authorities in time and shows live data.

**Keywords:** Sewage system, Think Speak Server, microcontroller, Manhole cover status, Gas Toxic level, Human detection, Internet of Things .



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## INTRODUCTION

Urban foundations are largely based on underground drainage frameworks historically; it has been regarded as the lifeline of the city. Local government officials are primarily responsible for underground drainage oversight. The underground framework cannot be perfect and working likewise in such enormous urban areas, it is hard for the government to locate the exact sewer vent that is an experiencing issue. Therefore, it is essential to build a framework for dealing with underground waste without the need of human intervention. These are devices that are commonly found in a wide variety of different types of locales, from residential to industrial areas, to provide solutions for the treatment of sewage wastes [1]. A manhole lid is usually made from metal, which protects the hole from passers-by. There is a risk of accidents if the lid isn't closed properly or gets displaced; every city has experienced manhole explosions. In general, sewer gas is generated by natural decomposition of sewage and its mixtures with slurries, which results in toxic wastes that release gasses. Inhaling these gasses in high concentrations and for a long period of time can be dangerous. As a rule, septic tank gasses are primarily composed of methane, carbon dioxide, some sulfur dioxide, ammonia, hydrogen sulfide (H<sub>2</sub>S), nitrogen dioxide, and some carbon monoxide. Sensors monitor the amount of hazardous gas in the sewage environment and send out an alert if the amount of gas increases [2]. The sensor system, which interfaces with the microcontroller, can detect when there is a blockage in the drainage system and sewage starts overflowing, and this information is then sent to the appropriate authority via Wi-fi (wireless fidelity) Module.

### Related Work

Nithin Asthana et al.[3] developed an IOT based device for sewage gas monitoring system which includes Arduino UNO microcontroller, GSM (Global system for mobiles) Module, HTTP(Hypertext transfer protocol), Thing speak server.MQ series sensor used in order to find the concentration of various gasses which can be transformed using ADC. GSM can interact with Arduino for further communication. Thing speak is an IoT platform which is mainly used to hold data sent from the devices and it uses channels. Here, the sensed data transmitted to Thing speak server and graph is plotted in the allocated channels along with all readings. HTTP protocol used to update the present values on the cloud using GSM. Saiesh et al[4] this proposed system aims at enabling cause of ensuring human safety and healthy life and also it reduces the risk of government authorities. In this design, various sensors are interfaced with ATmega2560 microcontroller which receives information from all the sensors. Particularly Gas sensor, Overflow sensor, Level sensor are connected with microcontroller which sends and alert signals to monitoring stations via Global system for mobile communication (GSM). So, they can take appropriate actions according to the dangerous situation. Microcontroller monitors the present values and sent the proper information to the concern and it can be displayed in LCD . Ruheela M.A et al. [5] introduced an underground drainage monitoring system. Usually, manholes are not high-tech quality but to keep better infrastructure, these must be considered by concerned authorities. In order to keep an effective system for drains, they initiated along with Arduino as a microcontroller which Collects data sent from sensors such as DHT11, water level sensor and MQ2 sensor. Whenever the sensor reaches the threshold level, the present or respective value sent to microcontroller which sends the signal and manhole location through GPS to the officials and they can identify easily which drain is in problem and they will make further move. S.Menaga et al.[6] developed an air pollution detection system using various gas sensors and alert the government agencies about the pollution level of the area. Paper [7] describes the smart device used to reduce the risk of sewage workers. MQ4 sensor and computer raspberry pi3 helps to measure the level of gas by using LEDs. The system measures the level of gas within sewage systems and they can get a clear idea when they enter it with some precautions.

### System Specification

In our developed system we use the PIR sensor, IR sensor, temperature sensor, ultrasonic sensor and gas sensor for detecting the human presence, cover status, temperature level, waste level and as level in sewage respectively.



**Arduino Uno**

The Arduino Uno is an open source programmable microcontroller that utilizes the ATmega328P microcontroller. ATmega328P is an advanced RISC microcontroller which has some RISC features. In this board contains 14 I/O pins (of which 6 PWM pins). It can be operated between 3.3V to 5.5V. It could be interfaced with other circuits and boards.

**Wi-fi Module**

This ESP8266 Wi-Fi module is capable of interfacing with microcontroller which is used to send the sensed data from the microcontroller to the server. It has inbuilt cache memory which increases system performance. It is used to store information in the server.

**Ultrasonic Sensor (HC-SR04)**

To measure distance from an object, this device is used. Module HC-SR04 consists of transmit and receive ultrasonic signals along with a circuit for controlling them. By using ultrasonic sound waves, it measures the distance through emission of waves at the target and recover the reflected wave from the target. It calculates the distance by measuring a distance between emission and reception.

**PIR Sensor**

Receiving infrared radiation, this device can detect motion. The PIR act as digital output. When motion detected output is high or motion not detected output is low. It operates with 5V. Due to less power, inexpensive, flexible size, these are commonly used in home applications.

**IR Sensor**

It is a device to predict whether an object is present or not by emitting infrared onto the object. It senses reflected rays from an object and it gives a digital output.

**Gas Sensor (MQ2)**

Gas sensor is an electronic device which used to detect gas concentrations in the air. A gas analyzer measures gas concentrations in the range from 300-1000 parts per million, including but not limited to LPG, propane, methane, hydrogen, alcohol, smoke, and carbon monoxide. The output voltage of gas sensor increases when the concentration of gas is high.

**Temperature Sensor (LM35)**

LM35 sensor used to measure the temperature which increases the voltage across a diode increases at a known rate [11]. It has three pins such as VCC, output and GND pins. LM35 output voltage is proportional to the Celsius temperature.

**Liquid Crystal Display (LCD)**

LCDs are a combination of solid and liquid states of matter. The LCD screen has 16 characters for every 2 rows on an electronic display module.

**METHODOLOGY**

Internet of things (IoT) which is the technology used in this work. To provide fast and accurate information to the authority is essential. So, we used IOT technology to maintain error free transmission of information. Monitoring sewage levels with this system also reduces the workload of government officials. Smart systems are comprised of a variety of sensors, such as PIR Sensor, IR Sensor, Gas Sensor, temperature Sensor and Ultrasonic Sensor that are connected to a microcontroller. These sensors are controlled by microcontroller which collects all data from sensors. This value is sent to a microcontroller when the sensors reach a certain threshold value. The information and the



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exact location of the manhole are sent to the concerned department using Wi-fi. Then the workers can quickly locate the manhole and solve the problem. The LCD displays the live sensor data. Thing speak is an IoT platform which is mainly used to hold data sent from the devices and it uses channels. Here, the sensed data transmitted to Thing speak server and graph is plotted in the allocated channels along with all readings.

## RESULT AND DISCUSSION

The present status of sensors which is collected inside the manhole that will be displayed in the LCD continuously.

### Human Detection

In this figure 5.2 if any human inside a manhole the level is reached 1, otherwise the level is 0. By using this server if human fell into the manhole we can take immediate action.

### Cover Status

In this figure 5.3, If the lid is open level is 0 in the graph but the lid is closed the level is 1. We can monitor the current status of the manhole cover by continuously watching Thing speak server.

### Gas Level

In this figure 5.4, if gas concentration increases in the air, gas level get increased according to it. If it exceeds its threshold level, monitoring authority need to take actions.

### Temperature Level

In this figure 5.5 if surrounding temperature get increased meanwhile the temperature level also increases continuously. If it exceeds threshold value management need to take any action.

### Waste Level

In this figure 5.6, if the waste increases in the manhole, waste level is high in the graph. If waste level crossed above 70 management should take actions to resolve it.

## CONCLUSION

This framework provides an effective and smart solution for underground drainage problems. This system helps to ensure human safety and avoiding major accidents. It reduces the man work and time for maintenance of sewage. It produces results consecutively and we can monitor through the server using Inbuilt Wi-fi. Various parameters like temperature, toxic gases, waste level, lid status and human detection inside the manhole are being monitored and outputs and it will be very useful to take actions before any critical situation. It will improve better urban infrastructure and bring progressive modification in the society. We can develop the system in future to access the channel in the server by using any Wi-fi connection. By using this project underground drainage issues to be solved this project and organized effectively.

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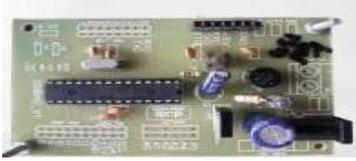
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| <b>Fig. 1 Arduino Uno</b>   | <b>Fig. 2 ESP8266 module</b>  | <b>Fig. 3 HC-SR04 Sensor</b>  |
|  |  |  |
| <b>Fig. 4 PIR sensor</b>  | <b>Fig..5 IR sensor</b>   | <b>Fig.6 Gas sensor</b>   |





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|---------------------------|---------------------------------------|-----------------------------------|
|                           |                                       |                                   |
| <p><b>Fig. 7 LM35</b></p> | <p><b>Fig. 8 LCD display unit</b></p> | <p><b>Fig.9 Block diagram</b></p> |

|                                      |  |
|--------------------------------------|--|
|                                      |  |
| <p><b>Fig.10 Hardware module</b></p> | <p><b>Fig. 11 IoT output for human detection</b></p> |

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|---|---------------------------------------|
|   |                                       |
| <p><b>Fig. 12 Cover status in IoT</b></p> | <p><b>Fig. 13 Gas Toxic level</b></p> |

|   |  |
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|   |  |
| <p><b>Fig. 14 Temperature level</b></p> | <p><b>Fig. 15 Waste level indication</b></p> |





## Fabric Defect Detection using Firefly based Particle Swarm Optimization

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### ABSTRACT

In Textile industries, automatic defect detection in fabric plays a vital role for checking the quality of the product. The main objective of this work is to develop a Firefly based Particle Swarm Optimization (FPSO) classifier for detecting defect in fabrics. The entire fabric defect detection system is developed in two phases namely feature extraction phase and feature selection phase followed by a classifier. In feature extraction phase, Discrete Wavelet Transform (DWT) based texture features are obtained from the pre-processed image. Gabor filters are used to enhance the quality of the input image and also reduce the noise. In the feature selection phase, Firefly based Particle Swarm Optimization (FPSO) is used to select the most appropriate features among all the features. Finally the performance of the selected feature subset is evaluated using  $k$  nearest neighbor classifier. The Firefly based PSO is developed by incorporating the exploitative behavior of firefly algorithm into the PSO for improving both exploration and exploitation ability of an algorithm. The performance of original and Firefly based PSO techniques is compared using the parameters like Accuracy, Error rate, Sensitivity, Specificity and F1 score. With the proposed method of fabric defect detection system 95.75% of accuracy is achieved with reduced number of features.

**Keywords:** Discrete Wavelet Transform, Particle Swarm Optimization, Firefly based Particle Swarm Optimization, Accuracy, Error rate, Sensitivity, Specificity, F1 score.

### INTRODUCTION

Defect detection in the fabric is essential for quality control in textile products. In defective fabric, the weave pattern of the fabric may differ from the original design due to the wrong mechanical movement or breakage of thread on a loom. Due to this, defective fabric selling price may drop by 45%-65%. Human experts are utilized for traditional inspection of fabrics. However, the performance and reliability of the traditional inspection techniques are low.





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Hence automation is necessary to inspect the fabric quality in the textile industry. Fabric characteristics are based on the texture and each fabric has a different texture namely uniform, random [1-6] and patterned texture [7,8]. Due to the varying characteristics of the fabric, developing a fabric defect detection system with good accuracy is still a challenging task. The fabrics can be grouped into 17 categories namely p1, p2, p3, p3m1, p31m, p4, p4m, p4g, pm, pg, pmg, pgg, p6, p6m, cm, cmm, and pmm based on the unit shape and its symmetry [9]. In the p1 group of fabric, the basic unit is repeated over the entire fabrics like plain weave fabric and in this type of fabric, pattern translation is allowed to get the texture. The non-p1 groups of fabrics involve rotation, reflection and glide reflections to get the texture. Many systems have been developed in the past years for defect detection in fabrics. Most of these methods are particularly applied for simple patterned fabrics. There are only a few systems which detect faults for complex patterned fabrics. A Gabor filter with two scales and six orientations was introduced for fabric inspection with a satisfying performance by the authors L.H. Ding et al., and Junfeng Jing et al. [10,11]. Defects in fabrics are detected by LBP based texture features [14] and a two-dimensional wavelet transform is used in the early step to speed up the system running time. GLCM based co-occurrence features are extracted from the textured fabrics and finally, classification is done using a learning vector quantization based neural network to achieve better performance [15]. Most of the above-mentioned literature deals with simple patterned fabrics. In this paper, a novel defect detection technique is proposed to cater to the complex patterned fabric. It is based on analyzing texture patterns by extracting effective statistical features from the Discrete Wavelet Transform. The effectiveness of the extracted features is assessed by the Firefly based BPSO classifier. It overcomes the problem of premature convergence in the standard BPSO classifier.

## PROPOSED METHOD

The proposed method flow diagram is depicted in Fig. 1. The detailed explanation of the various modules present in the flow diagram is discussed below.

### Feature Extraction

The concept behind feature extraction process is to transform the input image into a set of numerical values. Wavelet transform is one of the most popular transform used to extract the texture information from the complex patterned fabric. Wavelet transform has the capability of analyzing the image in both time and frequency resolution. In this work, two dimensional DWT is used for extracting features from the input image. From the implementation of DWT, wavelet coefficients are obtained as a feature descriptor. However, interpreting these coefficients for classifying objects is the challenging task. DWT of the function  $f(x)$  is given in (1)

$$W(j,k) = \sum_{n=0}^{N-1} f(x) \cdot \varphi_{j,k}^*(x) \quad (1)$$

where  $\varphi_{j,k}(x)$  represents the basis component of wavelet function, and  $\varphi_{j,k}^*(x)$  denotes its complex conjugate. In

this paper, Haar wavelet is used as a mother wavelet. For the extraction of features, the work adopts four distinct wavelets: BiorSplines (bior4.4), Daubechies (db4), DMeyer (dmey), Haar. Wavelet selection depends on the properties of the wavelets. Using these four wavelet families at level 6 decomposition, 12 statistical features were extracted from the input textile images. According to the literature the decomposition level of 6 is less susceptible to noise, and the features are highly predominant at this level of decomposition. Hence, decomposition level 6 is chosen to obtain better classification accuracy.

### Firefly inspired Practical Swarm Optimization

James Kennedy et. al developed a new feature selection technique called Particle Swarm optimization [14] with the inspiration from bird flocking and fish schooling. It is most appropriate for the functions with non linear relationship and also highly related to Evolutionary Computation and Swarm theory [15]. In PSO, particle's velocity and positions are updated using equations (2) and (3) during exploration in the search space.





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$$v_i(k+1) = w * v_i(k) + c_1 * r_1 * (pbest_i - x_i(k)) + c_2 * r_2 * (gbest - x_i(k)) \quad (2)$$

$$x_i(k+1) = x_i(k) + v_i(k+1) \quad (3)$$

where  $v_i(k+1)$  and  $v_i(k)$  denotes the velocity of  $i^{th}$  particle at  $k+1$  and  $k^{th}$  iterations respectively,  $x_i(k+1)$  and  $x_i(k)$  denotes the position of  $i^{th}$  particle at  $k+1$  and  $k^{th}$  iterations respectively,  $w$  is the inertial weight,  $pbest$  is the best position of the individual particle,  $gbest$  is the best position among the particles in the swarm,  $c_1$  and  $c_2$  are the acceleration coefficients,  $r_1$  and  $r_2$  are uniformly generated random numbers within the range [0, 1]. The fireflies are attracted one another based on their intensity of flashlight. The firefly with low-intensity flashlight will be attracted to the firefly with high-intensity flashlight. The attractiveness of the fireflies gets gradually decreased when the distance between the two fireflies increased. Firefly will be updated based on the movement of the Firefly with high-intensity flashlight towards the Firefly with low-intensity flashlight. This position update mechanism has been done using (4)

$$F_i(t+1) = F_i(t) + \beta \times (F_j - F_i) + \alpha \times (rand(0,1) - 0.5) \quad (4)$$

The pseudo code of the original Firefly inspired PSO algorithm is explained in Figure 2. The Original PSO is applied to DWT coefficients. The acceleration coefficients  $c_1$  and  $c_2$  are kept constant value of 2.1. Random numbers  $r_1$  and  $r_2$  are generated randomly between the range [0 1].

## RESULTS AND DISCUSSION

The performance of the proposed algorithm is validated using TILDA textile image database and some of the sample fabric images are shown in Fig. 3. The performance of original and Firefly inspired PSO algorithm is compared using Accuracy, Error rate, Sensitivity, Specificity and F1 score. Firefly inspired PSO produces better result than the original PSO. The mathematical representations of above parameters are described in (5), (6), (7), (8) and (9).

$$Accuracy(Acc) = \frac{TP + TN}{TP + TN + FP + FN} \times 100\% \quad (5)$$

$$Errorrate(ER) = \frac{FN + FP}{TP + TN + FP + FN} \times 100\% \quad (6)$$

$$Sensitivity(Se) = \frac{TP}{TP + FN} \times 100\% \quad (7)$$

$$Specificity(Sp) = \frac{TN}{TN + FP} \times 100\% \quad (8)$$

$$F_1 \text{ score}(F_\beta) = \frac{(1 + \beta^2)(Precision \cdot Recall)}{(\beta^2 \cdot Precision + Recall)} \quad \text{where } \beta = 1 \quad (9)$$

Table 2 shows the original and FPSO algorithm comparison results.

## CONCLUSION

The main objective of this work is to design an algorithm using swarm intelligence based classifier for automatic fabric defect detection system. In this work, Firefly inspired PSO algorithm is implemented to achieve enhanced performance. The goal is to achieve high Accuracy, low error rate with minimum number of features using FPSO algorithm. In this work, Wavelet features are extracted from the four different wavelet families. The best features are





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selected using both PSO and FPSO with the extracted wavelet features. By comparing the performance of PSO and FPSO algorithm for fabric defect detection system, FPSO with Haar wavelet features yields better result than the original PSO. The accuracy percentage achieved by this FPSO algorithm is 95.75% with the average of 6 features.

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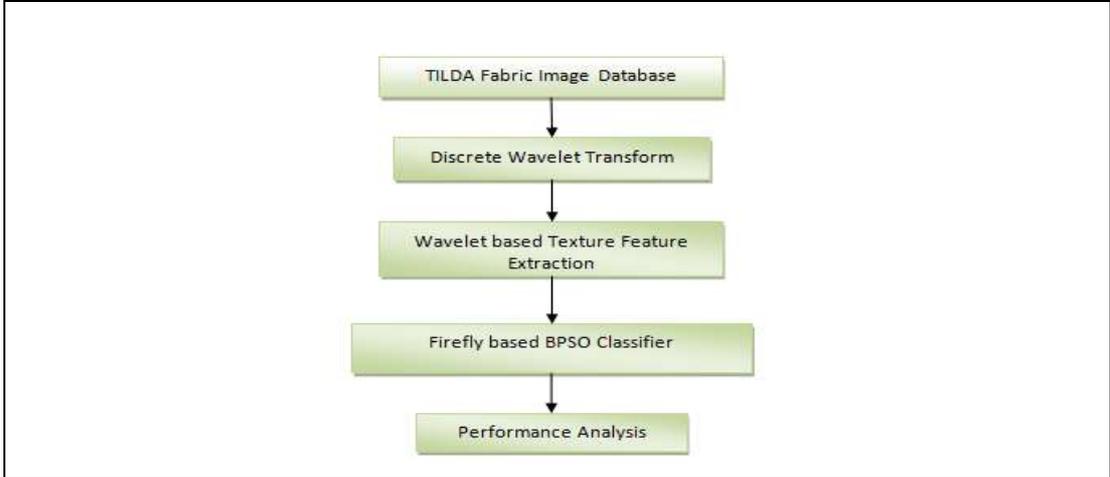
**Table 1. Result analysis of original and Firefly based PSO algorithms**

| Classifier            | Acc (%)                            | ER (%) | Se (%) | Sp (%) | F1 score (%) | Average Features |
|-----------------------|------------------------------------|--------|--------|--------|--------------|------------------|
| PSO                   | 92.25                              | 7.75   | 97.43  | 56     | 95.65        | 6                |
| <b>Wavelet Family</b> | <b>Firefly inspired PSO (FPSO)</b> |        |        |        |              |                  |
| bior-4.4              | 90.25                              | 9.75   | 99.14  | 28     | 94.67        | 7                |
| db4                   | 88.75                              | 11.25  | 98.85  | 18     | 93.89        | 7                |
| dmey                  | 94.5                               | 5.5    | 97.71  | 72     | 96.88        | 6                |
| haar                  | 95.75                              | 4.25   | 98.57  | 76     | 97.59        | 6                |





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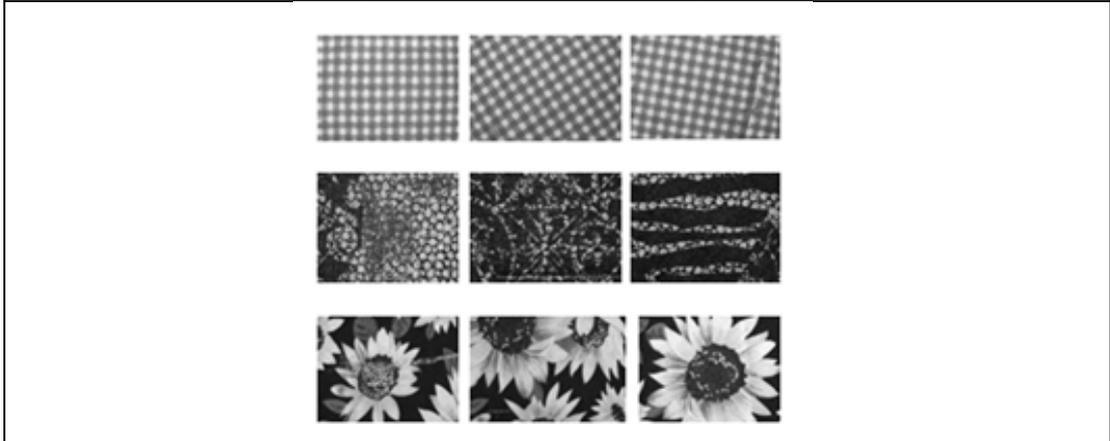


**Fig. 1 Proposed Method flow diagram**

```

    Begin
    Initialize the particles with zero velocity and random position in the swarm;
    while maximum iterations not met do
        Find the personal best solution of all the particles, pbest;
        if personal best solution is better than the previous best solution of the
        particle then update personal best position to new one
        Find the swarm best position gbest;
        if swarm best position is better than the previous best position of the
        swarm then update swarm best position to new one
        Update particle velocity and position using (2) and (3);
        if particle positions are not updated for a fixed number of
        iterations
            Update particle position using (4)
        end if
    end if
    end if
    end while
    Write the global best solution and find the performance metrics of selected
    feature subset on testing data;
    End
    
```

**Fig. 2 Pseudo code of the FPSO algorithm**



**Fig. 3 TILDA Fabric image samples**





## Mining Human Activity Patterns from Smart Home using Big Data

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### ABSTRACT

Continuous item-set mining is a generally exploratory strategy that spotlights on finding repetitive connections among information. The ardent development of business sectors and business conditions prompts the need of information mining calculations to find critical relationship changes to responsively suit item and administration arrangement to client needs. Change mining, with regards to visit item-set, centres around recognizing and revealing critical changes in the arrangement of mined item-set starting with one time-frame then onto the next. This task proposes a clever sort of unique example, in particular the Incremental FP Growth Frequent Pattern Analysis that addresses the development of an item-set in continuous time-frames, by detailing the data about its successive speculations portrayed by insignificant overt repetitiveness (i.e., least degree of deliberation) on the off chance that it becomes inconsistent in a specific time span. To address Frequent Pattern Growth mining, it proposes Frequent Pattern Growth, a calculation Power consumption and the period of utilisation are closely related to the resident's activities performed at home. For example, if the oven is in one mode, the task of this apparatus is generally expected with preparing food. The time (e.g. morning or night) of this movement may likewise demonstrate the type of food being arranged, such as breakfast or supper. Moreover, individuals frequently perform more than one action in the meantime, for example, setting up their very own food and listening to music or watching programs over Television, which implies numerous apparatuses are operated together. Frequent item-set mining is a widely exploratory technique that focuses on discovering recurrent correlations among data. The steadfast evolution of markets and business environments prompts the need of data mining algorithms to discover significant correlation changes in order to reactively suit product and service provision to customer needs. Change mining, in the context of frequent item-sets, focuses on detecting and reporting significant changes in the set of mined item-sets from one time period to another. The discovery of frequent generalised item-sets, i.e.,

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item-sets that 1) frequently occur in the source data, and that spotlights on keeping away from item-set mining followed by post handling by taking advantage of a help driven item-set speculation approach. To concentrate on the insignificantly repetitive regular speculations and hence lessen how much the created designs, the revelation of a shrewd subset, to be specific then, is tended to too in this work.

**Keywords:** calculation Power, Frequent item-set mining, FP Growth Frequent, business environments.

## INTRODUCTION

According to the survey, digital transformation plays an integral role. Most of the houses are equipped Smart meter, smart technology, clustering, aggregators, FP growth with the smart devices like smart TV, Oven, Smart light, AC, smart meters etc., 2) provide a high-level abstraction of the mined knowledge, issues new challenges in the analysis of item-sets that become rare, and thus are no longer extracted, from a certain point.

## RELATED WORK

In the existing framework an exhaustive review of conventional information mining issues, for example, successive example mining with regards to ensuring information can be found. A few ideas and issues emerging from conventional consecutive example mining and the mining of unsure information. The issue of consecutive example mining has been all around contemplated with regards to deterministic information. It can look at a combinatorial unstable number of middle of the road after effects. The vast majority of the recently evolved successive example mining strategies, for example, advancing information, investigate an up-and-comer age-and-test way to deal with decreasing the quantity of possibility to be analysed. Be that as it may, this approach may not be proficient in mining huge succession information bases having various examples or potentially long examples. The low exhibition and backing of the example development approach might prompt its further augmentation toward less precision mining of different sorts of regular examples, like incessant bases. Liu et al., [11] proposed pseudo projection calculation which is in a general sense unique in relation to those proposed previously. This calculation utilises two distinct constructions, for example, exhibit based and tree-based to address projected exchange subsets and heuristically chooses to fabricate unfiltered pseudo projection to make a separated duplicate as indicated by elements of the subsets. This work to assemble tree-based pseudo projections and exhibit based unfiltered projections has been work for projected exchange subsets which makes calculation both CPU time proficient and memory saving. This calculation becomes the incessant item-set tree by profundity first pursuit, whereas expansiveness first hunt is utilised to assemble the upper piece of the tree if fundamental. This calculation is tried on genuine world datasets, like BMS-POS, and on IBM counterfeit datasets. This calculation isn't just productive on inadequate and thick data sets at all degrees of help edge and furthermore outputs are saved in the ensuing mining processes.

The burden of this calculation is it diminishes the multi-pass competitor age process in the main stage by disposing of separated things to decrease the quantity of applicants. Likewise this work recoils the information base filtered in each pass and it requires some investment. Li et al., [11] proposed a separated things disposing of system (IIDS) calculation for utility mining. This calculation found a high utility item-set with less number of up-and-comers which work on the exhibition of the example mining. This calculation shows that item-set share mining issue can be straightforwardly changed over to utility mining issue by supplanting the successive upsides of everything in an exchange by its all out benefit, i.e., duplicating the recurrence esteem by its unit benefit. In this work the offer regular set mining checks the data set to ascertain the offer worth of each item-set and eliminates all futile applicant item sets and remaining contender to create. The immediate condition age is a level savvy technique and it keeps a cluster for every competitor during each pass. This calculation gives an effective approach to planned basic tasks by utilising exchange weighted descending conclusions. Anyway this calculation actually endures with the issue of level astute age and test exceptionally adaptable to extremely huge data sets. The detriment of this calculation is, it



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just helps least in describing code length with a modest number of examples. Han et al., [10] proposed a continuous example development (FP-Growth) calculation for mining incessant example with requirements. In this work the successive example tree (FP-tree) structure is an expanded prefix tree structure produced for putting away urgent data about regular examples. The example piece development mines the total arrangement of continuous examples utilising the FP-Growth. This calculation builds a profoundly minimal FP tree and applies an example development technique for information base sweeps which is normally significantly more modest than the first data set by which exorbitant data set issue of apriori and it requires numerous information base sweeps.

## METHODOLOGY

In the Proposed work here foster the two new calculations, aggregately called FP-Growth calculation, really dodges the issue of "best moving item expectation", and when joined with the pruning and approving strategies, accomplishes far superior execution. Here likewise propose a quick approving technique to further accelerate our FP-Growth calculation. The productivity and viability of FP-Growth are checked through broad tests on both genuine and manufactured datasets. FP-Growth embraces the prefix-projection recursion structure of the Prefix Span calculation in another algorithmic setting, and really dodges the issue of "best moving item expectation". The commitments are summed up as follows: Two general questionable arrangement information models that are disconnected from some genuine applications including unsure grouping information: the succession level dubious model, and the component level questionable model. Transaction DB and Profit table are contributions to the framework to find potential exceptionally used Item sets. Make UP-tree: FP-Growth calculation is made utilising disposing of negative worldwide things and diminishing worldwide hub utility. The FP-Growth algorithm has fields as Node.name which contain the name of the thing and Parent Node. In the wake of computing exchange utility and exchange weighted utility, the item-sets having less utility than predefined least limit utility are arranged. In the wake of arranging the ominous things the worldwide hub utilities have decreased. And nodes are embedded into UP tree utilising FP Growth calculation. The nearby inauspicious Item and hub utility. Discarding neighbourhood unfavourable things: Construct contingent example base of base thing section in header table Retrieve the whole way connected with that thing CPB. Contingent UP tree made by two sweeps over CPB. Local unfavourable things eliminated involving the utility of everything in CPB ways are coordinated in slipping requests. The rearranged way is embedded into a restrictive utility example tree utilising lessen nearby hub. Then again, regular example mining can't be utilised to track down high utility examples, because of its limit of treating each thing with equivalent significance without really any utilisation of thing amount data. Applications like retail locations, where everything has different benefit values and an exchange can have numerous duplicates of a thing, will play an immediate part of high utility example mining. In this situation, the examples can be deciphered as item-sets that add to most of the benefit, and can be utilised for concluding stock of a retail location. Like retail locations, utility mining additionally observes its applications in web click stream investigation, bio-clinical information analysis and versatile E-trade climate.

### Consecutive pattern

Consecutive example mining is a subject of information mining worried about observing measurably significant examples between information models where the qualities are conveyed in a sequence. It is normally assumed that the qualities are discrete, and in this way time series mining is firmly related, however generally thought to be an alternate movement. utility strategy. Identify potential high utility thing sets and their utilities structure FP-Growth calculation will dispense with the neighbourhood horrible things and Reduce neighbourhood hub utility. Pruning procedures and a quick approving technique are created to additionally work on the effectiveness of FP-Growth calculation, which is confirmed by broad investigations.





### Utility Pattern Mining

Utility example mining observes designs from a data set that have their utility worth something like a given least utility edge. The utility of an example characterises its significance and makes dug designs more important for specific applications. Principally, the premium in utility examples emerges as it permits relative significance to various things, and records for assortment of things. Consecutive example mining is a unique instance of organised information mining. There are a few key conventional computational issues tucked inside this field. These incorporate structure effective data sets and records for succession data, separating the habitually happening designs, looking at arrangements for comparability, and recuperating missing grouping individuals. As a rule, arrangement mining issues can be delegated to string mining which is regularly founded on string handling calculations and item-set mining which is normally founded on affiliation rule learning. Nearby interaction models stretch out successive example mining to more perplexing examples that can incorporate (elite) decisions, circles, and simultaneousness develops notwithstanding the consecutive requesting build.

### String Mining

String mining ordinarily manages restricted letters in order for things that show up in a succession, however the actual grouping might be normally extremely long. Instances of letters in order can be those in the ASCII character set utilised in regular language text, nucleotide bases 'A', 'G', 'C' and 'T' in DNA groupings, or amino acids for protein arrangements. In science applications examination of the plan of the letters in order in strings can be utilised to inspect quality and protein groupings to decide their properties. Knowing the succession of letters of a DNA or a protein is certainly not an extreme objective in itself. Rather, the significant errand is to comprehend the grouping, as far as its design and organic capacity. This is commonly accomplished first by recognizing individual districts or underlying units inside each arrangement and afterward relegating a capacity to each primary unit.

### Base Information Analysis

In the base data examination module addresses We can mine the total arrangement of successive item-sets, in view of the culmination of examples to be mined: we can recognize the accompanying sorts of regular item-set mining, given a base help edge the co-productive, which alludes to the assortment of things, including first or most. It can infer all incessant initiated sub graphs from both coordinated and undirected diagram organised information having circles (counting self-circles) with named or unlabeled hubs and connections. Its presentation is assessed through the applications to Web perusing design investigation and compound carcinogenesis examination to stay away from the issue of various information base sweeps and competitor produce - and-test process. The related calculation is called the FP Growth Algorithm. To get the data about the data set, it requires two sweeps in particular. Regular examples are mined from the tree structure, since the substance of the data set is caught in a tree structure. In particular, Incremental FP-Growth starts by filtering the data set once to find all successive 1-item-sets. Subsequently, the calculation makes a positioning table, in Read data-set critical item-set. The combinatorial addresses the item-set 'j' addresses the length of an item-set. If the length of an item-set is  $2(j=2)$  implies, it contains 1-item-set and 2-item-set ( $i=1, 2$ ) 'm' addresses the objective item-set length.  $m=k+1$ . Here 'm' signifies the item-set length that we will track down the rough count. (eg., if  $k=2, m=3$ ) 'k' addresses the base data size. In the base data, if  $k=2$  implies, it indicates that it contains 1-item set and 2-item-set.  $a_{ij}$  addresses the  $i$ th item-set of  $j$ th item-set to use for observing estimate count.

### Frequent Item-set List Generation

In this module the sliding window model is utilised. The sliding window ought to be partitioned into two sub-windows. The whole window is signified as 'w' and the sub-windows are 'w0' and 'w1'. The sub-windows ought to be progressively founded on the inputs. which things show up in slipping recurrence requests.





## RESULTS AND DISCUSSION

We concentrated on the agent subset determination (RSS) issue in information streams. Most importantly, we planned powerful RSS as amplifying a droning sub modular work subject to a d-rucksack limitation (SMDK) over sliding windows. We then, at that point, formulated the KW system for this issue. Hypothetically, KW gave answers for SMDK over sliding windows with a guess variable of  $1-\epsilon$   $1+d$ . Besides, we proposed a more proficient  $1-\epsilon$   $0.2+2d$  - guess KW+ system for SMDK over sliding windows. The test results showed that KW and KWh run significantly quicker than the bunch benchmark while safeguarding great arrangements. Classify using UP-Growth Classify using Apriori Unclassified Classified Classified Unclassified.

## CONCLUSION

A few techniques are proposed to diminish misjudged utility and upgrade the presentation of utility mining. The FP-Growth technique is utilised to work on the presentation by diminishing both the hunt and with the number of applicants. An Incremental FP-Growth approach will exploit the two calculations. This framework is intended to lessen the size of typical execution of any strategy that has been utilised. Additionally, utilisation of new information construction might reproduce the tree by erasing all hubs of non-incessant item-sets after checking a particular level of data set. We have proposed a digging technique for incessant things utilising the FP-Growth approach. Same strategy has been used for order of different datasets with individual elements given by explicit area.

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## Exploratory Data Analysis, Prediction and Time Series Forecasting of Omicron in India

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### ABSTRACT

Omicron has expanded its clutches to be a worldwide pandemic with severe consequences threatening the survival of human lives. Like the Spanish flu, the surge of the Omicron pandemic has been more devastating, different and more worrying than the first. The proposed work describes the situation of the outbreak of this disease in India and predicts the number of cases expected to rise in future. The project uses exploratory data analysis to report the current situation and uses machine learning algorithms and time-series forecasting methods to predict the longer-term trends. The data has been considered for the period from November 24, 2021, when the Omicron started, till the end of May 2022. The data is analyzed visually to know the current situation in a better way. To analyze the best-fit method for prediction Machine Learning methods like linear regression, K-Nearest Neighbors and Support Vector Regression. And also Time-Series Forecasting methods which incorporate Holt's Linear Model and Facebook's Prophet Model, are used. Facebook's Prophet Model is the algorithm with the highest performance for predicting confirmed cases and death cases. The observation result has been shown in the form of an application accessible on all kinds of devices which provides a better understanding of this crisis. The pandemic is spreading everywhere in the world. Therefore, it becomes more important to grasp this spread. This project is an endeavour to analyze the forthcoming confirmed cases over time.

**Keywords:** : machine learning, regression, holt's linear model , prophet model, time series analysis, prediction and forecasting





## INTRODUCTION

On December 31, 2019, China reported a new virus to the World Health Organization (WHO), which later came to be referred to as COVID-19. "CO" stands for coronavirus, "VI" for a virus, and "D" for disease. The coronavirus itself is named "nCoV-2019" was first noticed in Wuhan, China, in December 2019, then spread rapidly worldwide. The WHO declared the COVID epidemic on March 11, 2020. CoVs are classified as alpha, beta, gamma, delta and Omicron coronaviruses. Bats cause alpha- and beta-type coronaviruses, while birds and pigs cause gamma- and delta-type coronaviruses. Though alpha-type coronaviruses have mild symptomatic effects, beta-type coronaviruses are more severe since they end in serious problems, especially in respiratory systems. Comparatively, Delta variant spreads 70 times lesser than the omicron variant, which can be less able to penetrate deep lung tissue. The World Health Organization's Technical Advisory Group on SARS-CoV-2 Virus Evolution declared B.1.1.529 as a variant of concern and designated it with the Greek word Omicron. Omicron was identified as the variant of SARS-CoV-2 by the World Health Organization. The first Omicron case was detected in South Africa on November 24, 2021. Viruses constantly change through mutation, and sometimes, these mutations may result in a new variant of the virus. One such virus mutated from coronavirus was Omicron. Omicron has around 50 mutations compared to the original coronavirus discovered in Wuhan, China [1]. Many of those mutations had not been noticed in other strains. The variant is characterized by 30 amino acid changes, three small deletions, and one small insertion in the spike protein compared to the original virus. Nearly seventy-seven countries of the world reported omicron cases. The omicron cases were in most countries in reality, even if the cases were not reported yet.

A new omicron variant BA.2 is 50% more transmissible than the original omicron variant BA.1, and it affects younger people more. All coronavirus variants have the same symptoms, like fever and cough. Infection with Omicron can cause hospitalization at about half the rate compared to infection with other variants of coronavirus. There is a chance of mutation when someone gets infected with this variant, allowing the virus to keep spreading. It has to be noted that the omicron variant can cause more severe death among all variants of coronavirus. There are global efforts to seek out a cure or vaccine, with several studies underway. Scientists are also trying to know the origin of the virus and how it is transmitted. Vaccinations are very important to protect oneself from this pandemic. However, the omicron spread can be prevented by strict precautions such as wearing a mask, physical distancing and regular hand washing. Furthermore, several countries have implemented lockdown to prevent the outbreak of this virus. Omicron might be cured by monoclonal antibody treatments [2]. Therefore effective treatments can be used to treat patients by public health agencies along with healthcare providers. Machine learning techniques and logics help limit the spread of the Omicron virus by predicting the upcoming cases. It allows analysis of huge datasets and prediction of upcoming cases in the future. In this paper, the prediction of Omicron is created by Linear Regression, K-Nearest Neighbors (KNN), Support Vector Regression (SVR) and Holt's Linear Model. There are various models for Time series analysis, among those models, the Prophet model is one of the most effective models. Therefore, the prophet Model has been used, which gives the highest performance prediction results of new confirmed cases and death cases of Omicron. Other parts of our research work include data visualization, which helps better understand the confirmed cases. The dataset, visualization and prediction charts can be shown to the public by creating a user-friendly application. Here, application deployment is done by using streamlit. This application allows people to understand this epidemic situation clearly. Additionally, it provides insights into the consequences of the interventions (closing the faculties, quarantine of infected people, social distancing, and so on) to regulate the outbreak.

## MATERIALS

The Omicron variant is leading to more infectious transmissions. It is estimated that every variant is infecting more individuals worldwide. As this variant is mutated from the Coronavirus, Multiple research works related to COVID-19 analysis and prediction are discussed. The transmission model of COVID19 was modelled, and the regression curve was obtained by multinomial regression according to the daily number of COVID-19 diagnosed in Xinjiang [5].



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In the short-term prediction, the use of polynomial regression can better predict the number of new confirmed cases per day. At the same time, it is also seen that the scale of the epidemic has been well controlled with the strong intervention of the state and people's enhanced awareness of self-protection. Compared with foreign outbreaks in the same period, the level of national awareness of prevention and the timely isolation and adoption of strong control measures will profoundly impact the epidemic. However, with the emergence of other asymptomatic infected persons, the study model needs to be further optimized. "Prediction of Covid-19 pandemic based on Regression" [6]: With the help of predictive analysis and supervised learning, future COVID cases can be predicted, which could help take better preventive measures and precautions. The author used two supervised learning models, Linear Regression and Support Vector Regression, to predict the future using a time-series dataset of COVID-19. The performance of prediction and the comparison between LR and SVR is carried out, and the data used is almost Linear.

"Research Paper Classification using Supervised Machine Learning Techniques" [7]: the different machine learning algorithms are employed to classify various publications into three fields Science, Business, and Social Science. Support Vector Machines, Naive Bayes, K-Nearest Neighbor, and Decision Tree techniques have been used. In addition to the description of the employed ML algorithms, the methodology and algorithms for text recognition using the forenamed ML ways are handed. The comparative study grounded on four different performance measures suggests that except for the Decision Tree algorithm-the proposed ML ways with the complex reprocessing algorithms work well for classifying publications. "Analysis and Prediction of COVID-19 Pandemic in India" [8]: The author analyzed the progression in India and the three most affected Indian states and developed a prediction model to forecast the behaviour of COVID-19 spread in the upcoming months. The author also performed a comparative analysis of the prediction results from the SIR and Prophet models. The author concluded that with the belief that the pandemic can infect a complete 5% of India's population, the countrywide spread is forecasted to succeed at its peak by the top of Nov-20, and other control measures are not followed diligently within the coming months.

## METHODOLOGY

The objective of the proposed research study is to understand the outbreak of Omicron with the help of some visualization techniques. Also by Building Machine Learning and Time Series Forecasting models help to know the impact and spread of the Omicron that are likely to be in the near future days. This research work provides accurate forecasting of forthcoming Omicron cases in India. The project methodology is divided into five categories: data exploration, data preprocessing, data visualization, omicron prediction and time-series forecasting. The data exploration and visualization comes under Exploratory Data Analysis (EDA). Collecting accurate data and understanding the limitations of the data, are essential to realizing the situation.

### Data Exploration

The dataset needed for analysis and prediction of Omicron is collected from ourworldindata.org [3], allowing you to explore this pandemic's statistics. Data exploration is difficult at best of its time to bring insights from the collected data in this current situation. However, this website makes data and research easily accessible to achieve progress against the pandemic problems. The dataset contains more than 50 features which includes iso\_code, continent, location, date, new\_cases, death\_cases, and so on. All the significant features can be utilized to predict and forecast Omicron.

### Data Processing

Data preprocessing makes the data suitable for machine learning modelling. Several Preprocessing techniques were carried out on the dataset. The dataset contains numerical features which are non-linear and dynamic in nature. The collected data need to be preprocessed in order to obtain a consistent dataset and then extract the most relevant features. The dataset is preprocessed by removing outliers and replacing null values with their mean value. The





unwanted columns such as iso\_code and continent were dropped, which are less useful in prediction. The date column can be indexed and converted to date time series. This is done by date/time package. It is also used to add future dates in the data frame required for prediction. The processed data is split into training and validation datasets. The training dataset is used to fit and train the model, and the validation dataset is used to forecast the new values with the help of regression technique.

### Data Visualization

Data visualization tools provide an accessible way to see and understand trends and patterns in data. Visualization techniques are essential for analyzing the massive datum and extracting important features from the dataset. We have used some visualization techniques like matplotlib, seaborn and plotly. The virus keeps on growing every day. By plotting graphs, we can get to know the confirmed cases, death cases, active cases and recovered cases of Omicron. All data until April 2022 has been used for visualization. We have analyzed the daily cases all over India by plotting the data on the x-axis and the number of cases on the y-axis. These graphs show the daily confirmed and death cases from the beginning of the Omicron spread. Here the confirmed cases increase over a period of time. We have also analyzed the total confirmed cases and total death cases. It is necessary to compare the cumulative cases by country to know the impact of spread over India. It is also essential to check the correlation between columns. A correlation matrix is a tool used for feature selection. Each and every cell in the matrix defines the relationship between two variables. The correlation value nearer to 1 tells that the features are highly correlated to each other, whereas the correlation value nearer to 0 tells that the features are less correlated. Timestamp refers to the data collected over a period of time where data points are equally spread over time. A data pattern can be noticed when a certain trend recurrence at regular time periods like confirmed cases, death cases etc. The daily progress of confirmed cases and death cases is shown below. A Choropleth Mapbox is a type of thematic map which is composed of coloured polygons that uses the intensity of colour to correspond with an aggregate summary of a geographic characteristic. The Choropleth Mapbox map requires two main types of input:

- Geo JSON formatted geometry information where each feature has either an id or some value in properties.
- A list of values indexed by feature identifier.

Maps labelled with district names and the number of active and recovered cases have been shown using Chloropleth Mapbox maps. As these maps are very interactive, if the cursor is moved towards a state, it will show the state name and number of cases of that particular state.

### Prediction and Forecasting

There were various techniques used for prediction and forecasting. Each technique has its unique feature, and it can be used differently based on the dataset used. Regression analysis is a statistical analysis that defines a relationship between the dependent and two or more independent variables. The adapted used Linear Regression (LR), Support Vector Machine (SVM), K-Nearest Neighbors (KNN), Holt's Linear Model and Facebook's Prophet Model. The proposed machine learning models predict the future cases of the people affected by Omicron in India, which is causing a dreadful impact on people all over the world. This work predicts the number of new and death cases for the next 16 days and 16 weeks.

### Linear Regression

Linear Regression is a regression algorithm used for predictive analysis. This algorithm makes predictions for continuous or numeric values. It shows up the linear relationship between the independent variable (x-axis) and the dependent variable (y-axis). This algorithm helps to find how the value of the dependent variable is changing according to the value of an independent variable. There are two types of linear regression: if there is only one variable, then it is called simple linear regression. And if there is more than one variable, then it is called multiple linear regression. The mathematical equation for linear regression,

$$Y = aX + b$$





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Where, X = dependent variable, Y = Independent variable, a and b are linear coefficients.

### Support Vector Machine

Support vector machine is one of the supervised learning models used for both classification and regression problems. The goal of SVM is to make the first line of decision boundary which can segregate n-dimensional space into classes. This boundary is called a hyperplane. The hyperplane can be created by choosing the intense points or vectors. These points are known as the support vectors. The Support Vector Regression (SVR) uses the same principles as the SVM for classification, but SVR is for regression problems. Support vector regression is a regression algorithm which works for continuous variables. The main goal of SVR is to consider the maximum data points within the boundary lines, and the hyperplane must contain a maximum number of data points. The equation of hyperplane is as follows,

$$Y = wx + b$$

Then the equations of decision boundary are,

$$wx + b = +a \text{ and } wx + b = -a$$

Where, X = dependent variable, Y = Independent variable.

### K-Nearest Neighbor

K-Nearest Neighbor is based on Supervised Learning technique. During the training phase, it stores the labelled training example. KNN algorithm can be able to find the similarity between new cases and available cases. This algorithm can be used for classification as well as for regression, but mostly, it is used for classification problems.

KNN regression approximates the association between independent variables and also the continuous outcome by averaging the observations in the same neighbourhood. KNN regression is used to calculate the average of the numerical target of the nearest neighbors. The size of the neighbors can be altered, by which prediction values can be changed.

The mathematical equation of KNN is given by,

$$d(x, y) = \sqrt{\sum_{i=1}^n (x_i - y_i)^2}$$

### Holt's Linear Model

Holt's linear model is, also known as linear exponential smoothing used for forecasting data. Holt's model uses three equations that work together to generate a final forecast. The first equation is a basic smoothing equation that directly adjusts the last smoothed value for the period's trend. The trend is updated over time by the second equation, where the trend is expressed as the difference between the final two smoothed values. At last, the third equation is used to generate the final forecast. There are two parameters in this model, one is used for overall smoothing and the other for trend smoothing. This method is also called trend-enhanced exponential smoothing. The three separate equations used in Holt's linear model are as follows,

$$\text{Forecast equation: } \hat{y}_{t+h|t} = l_t + hb_t$$





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where  $l_t$  denotes an estimate of the level of the series but denotes an estimate of the trend of the series.

$$\text{Level equation : } l_t = \alpha y_t + (1-\alpha)(l_{t-1} + b_{t-1})$$

$$\text{Trend equation : } b_t = \beta(l_t - l_{t-1}) + (1-\beta)b_{t-1}$$

Where  $\alpha$  is the smoothing parameter for levels,  $0 \leq \alpha \leq 1$  and  $\beta$  is the smoothing parameter for the trend,  $0 \leq \beta \leq 1$  is a weighted average of observation  $y_t$  and one step ahead training forecast for time  $t$ , here given by  $l_{t-1} + b_{t-1}$ . The trend equation shows that  $b_t$  is a weighted average of the estimated trend at time  $t$  based on  $l_t - l_{t-1}$ , and  $b_{t-1}$  is the previous estimate of the trend.

### Facebook's Prophet Model

The prophet is a library published by Facebook based on decomposable (trend+ seasonality+ holidays) models. This model provides time-series predictions using simple parameters, and it also supports for modeling multiple seasonality. The prophet is a fast and additive model used for forecasting time series fitted with daily, weekly and yearly seasonality. The prophet is robust to null values, shifts in the trend, and handles outliers. The prophet forecasting equation is given by,

$$y(t) = g(t) + s(t) + h(t) + e_t$$

where  $g(t)$  is the stepwise linear or logistic growth curve for modelling non-periodic changes in time series,  $s(t)$  is the seasonal changes,  $h(t)$  is the effect of holidays with irregular schedules, and  $e_t$  is the error term. For a time series, the high frequency components are just noise and should not be considered for modeling. The model input always is a time series with two features:  $t$  and  $y$ , where  $t$  is the time and  $y$  is the total cases in a country.

## RESULTS AND DISCUSSION

Predicting Omicron earlier can help to reduce the immense pressure on healthcare systems and help to control its spread. In this study, the Python programming language is used to execute the algorithms. The required libraries were installed for model development. The models were utilized and developed by the Sci-kit Learn library. We have considered the time duration from December 13, 2021, to April 30, 2022, for predicting the new cases. By analyzing five months of data, we can able to predict the new omicron cases. The analysis is done by training and validating the dataset, and finally, the results are represented in the form of a graph. The dataset is analyzed and preprocessed before training, which helps to examine the disease prediction and possibility of spread. To establish a strong relationship between dependent and independent variables, correlation coefficient analysis is done. The ML models were created and trained for prediction. The following table represents the prediction done by LR, KNN, SVR and Holt's linear model. Here the prediction values of KNN were constant and fixed, which shows that this model is a failure for this dataset. However, after performing training and analysis on the data, the predicted results of Holt's linear model and the real-time results were much alike. This research study aims to predict the number of people that can be affected in terms of recently infected cases and death cases. Mostly the analysis is done on a daily basis, but we had done prediction on a weekly basis. The following charts show the predicted weekly confirmed and death cases for the next 16 weeks, which has been plotted using seaborn. In Fb Prophet forecasting, have started with the creation of a prophet instance. Its fit and predict functions were called for training and prediction, respectively. The input to the prophet model is always a time series data with two features: date (ds) and value (y). Here in our study, ds is the date of day, and y is the accumulated cases for the confirmed and deaths cases in India. This is the result of time series forecasting of forthcoming cases done by facebook's prophet model. As shown in the graph, forecasting of upcoming confirmed and death omicron cases for the next 365 days (1year) has been done using past data.





## CONCLUSION

The Omicron pandemic outbreak has devastated the whole world and led to a state of a worldwide health emergency. It has a rapid spread in more than 100 plus countries. A machine learning-based prediction system has been proposed for predicting the risk of Omicron by utilizing the time series model for epidemic analysis. Time series models are competent in predicting the current situation of the Omicron outbreak. In this study, our work aims to have a deep understanding of Machine learning and Time-series forecasting models, which can be used in real-world situations. This also deals with visualization, and exploratory data analysis of the trend or pattern of Omicron spread in India. Supervised Machine Learning regression models for the Omicron virus was developed using LR, KNN, SVM, Holt's Linear Model and Facebook's Prophet Model. It was found that Facebook's Prophet model worked best among all prediction models. Our analysis suggests that Omicron-related hospitalization will not continue in the future. The proposed model can help to minimize the pandemic effects by providing accurate results, which can further be extended and validated with other machine learning and deep learning models. The proposed model can be improved by validating models using multiple datasets. However, becoming unsocial, maintaining community distance, and disciplined lockdown execution are the key factors to minimizing and stopping omicron pandemic effects.

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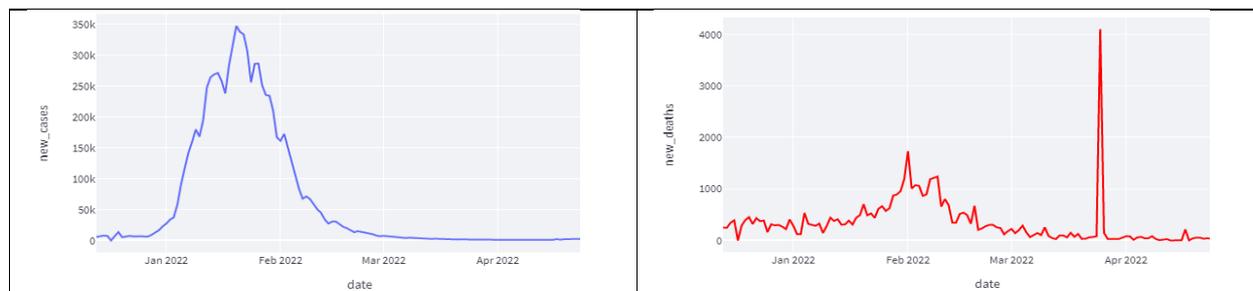


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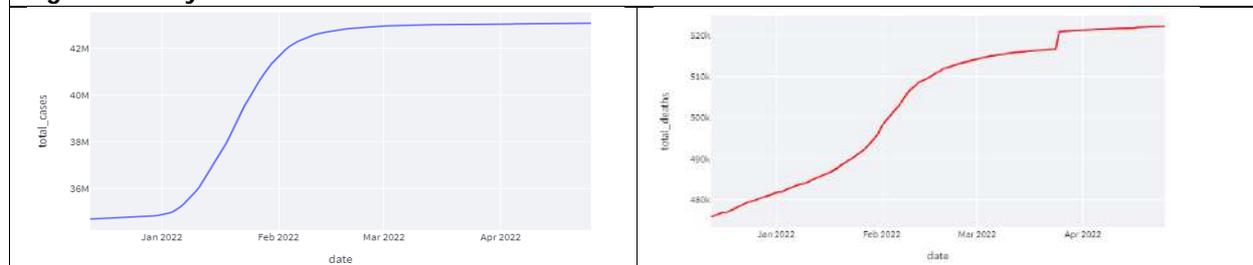
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**Table 1: Prediction of Omicron Cases Using MI Models**

| Date       | Linear Regression | K-Nearest Neighbors | Support Vector Regression | Holt's linear model |
|------------|-------------------|---------------------|---------------------------|---------------------|
| 01-05-2022 | 5375              | 7286                | -31198                    | 829                 |
| 02-05-2022 | 4290              | 7286                | -33811                    | 767                 |
| 03-05-2022 | 3205              | 7286                | -36512                    | 706                 |
| 04-05-2022 | 2120              | 7286                | -39304                    | 644                 |
| 05-05-2022 | 1034              | 7286                | -42190                    | 582                 |
| 06-05-2022 | -50               | 7286                | -45170                    | 520                 |
| 07-05-2022 | -1135             | 7286                | -48249                    | 458                 |
| 08-05-2022 | -2220             | 7286                | -51427                    | 397                 |
| 09-05-2022 | -3305             | 7286                | -54708                    | 335                 |
| 10-05-2022 | -4390             | 7286                | -58094                    | 273                 |
| 11-05-2022 | -5475             | 7286                | -61588                    | 211                 |
| 12-05-2022 | -6560             | 7286                | -65191                    | 149                 |
| 13-05-2022 | -7645             | 7286                | -68908                    | 87                  |
| 14-05-2022 | -8730             | 7286                | -72739                    | -26                 |
| 15-05-2022 | -9815             | 7286                | -76688                    | -35                 |
| 16-05-2022 | -10900            | 7286                | -80758                    | -97                 |



**Figure 1. Daily Confirmed new and death Cases**



**Figure 2. Total confirmed and death cases**



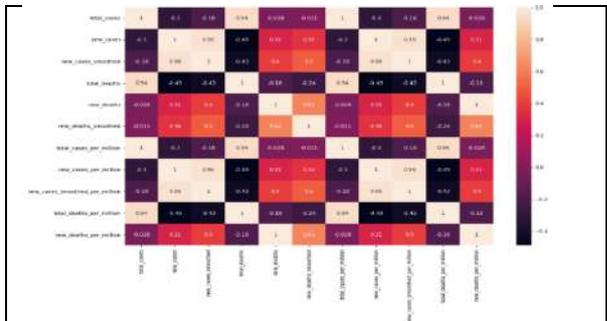


Figure 3. Correlation matrix (heatmap)

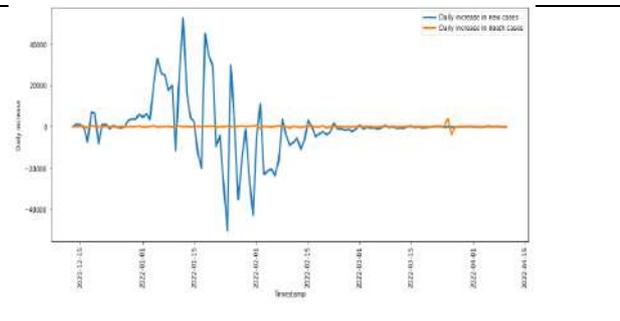


Figure 4. Progress of Omicron cases

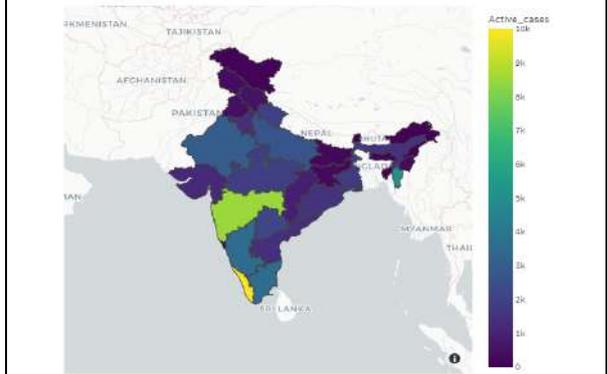


Figure 5. Active cases and Recovered cases of Omicron in India

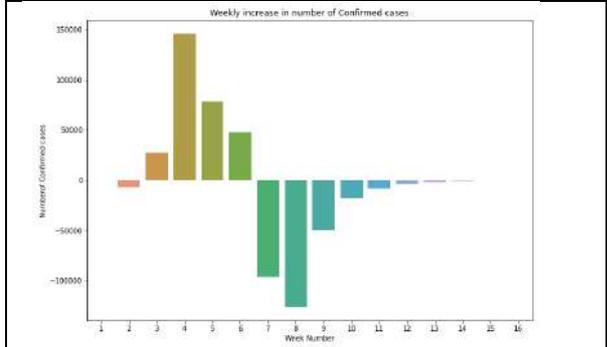
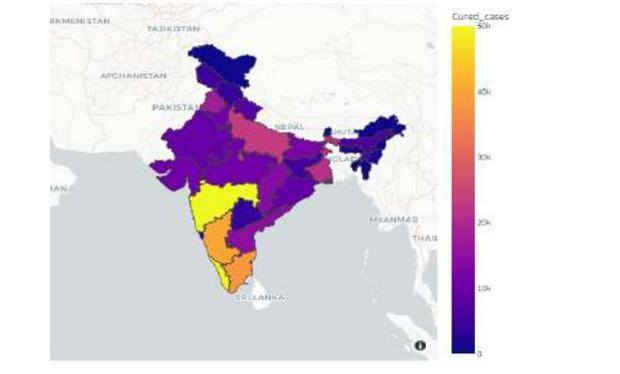


Figure 6. Weekly predicted confirmed cases and death cases

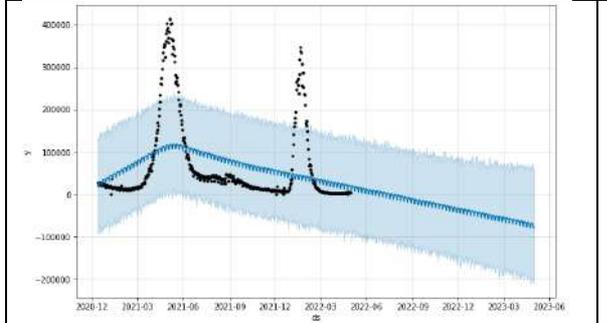
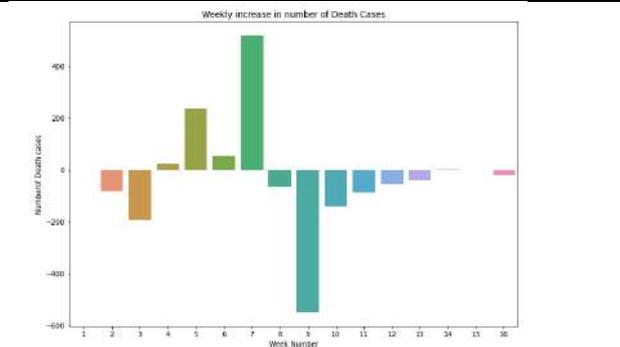
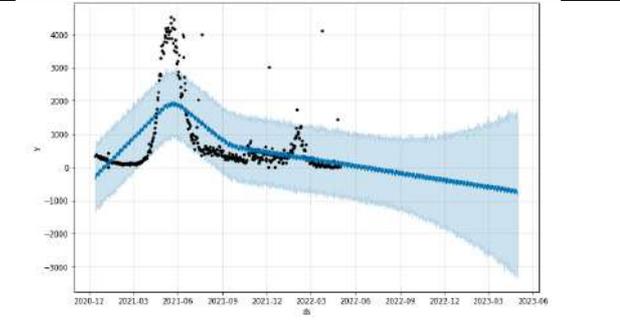


Figure 7. Forecast of new cases and new deaths





## A Survey on 6<sup>th</sup> Generation Li-Fi Technology

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### ABSTRACT

Li-Fi technology which transmits data and position between devices through the light. Li-Fi is a wireless communication technology system that is capable of transmitting data at high speeds over the visible light, infrared spectrum and ultraviolet. In the present era, we are using led lamps in visible light to transmit the data. The global ecosystem and companies are supporting the Li-Fi technology for the next generation which is ready to go for seamless integration. All around the world, Li-Fi technology is being developed by numerous organizations. Also, we briefly discuss the working and application of this technology.

**Keywords:** Li-Fi Technology, LED, Data transmission, Visible light.

### INTRODUCTION

Imagine a world where we can connect to a high-speed internet just by flicking on our light switch, a world Li-Fi, also known as "Light Fidelity" is a wireless Optic networking technology, which uses light emitting diodes (LEDs) to transmit data. In 2011, professor Harald Haas made a global talk on visible light communication (VLC) at the TED (technology, entertainment, design), -Li-Fi technology is similar to Wi-Fi — the technical key difference between Li-Fi and Wi-Fi is being that Wi-Fi uses an antenna to transmit data through radio frequency in order to induce voltage. Li-Fi, when we say theoretically it transmits speed up to 100 Gb/s. Li-Fi has the ability to safely function otherwise susceptible to electromagnetic interference like aircraft, hospitals, and the military is an advantage for it. This Li-Fi technology is being developed by several organizations across the globe.





## PRINCIPLE

Li-Fi, a Visible light communication system (VLC) and the speed of the system is very high. Li-Fi uses standard LED's to transmit data which also has high speed up to 224 gigabytes/sec. On the basis of illumination, data transmission can be done for this technology bright light emitting diodes are the essential devices for this system. The on/off activity is done in LED's which permits the data transmission in the form of binary code even the human eyes cannot recognize the transform and also bulbs appear in stable intensity.

## WORKING

Li-Fi is a fully networked communication which is bidirectional and has a high speed of wireless data using light. Li-Fi consists of several wireless network light bulbs. A light is streamed from a led light bulb when electric current is applied. LED is a semiconductor device, which emits bright light that can be changed at an extreme high speed also at different rates, the signal will be sent by modulating the sunshine. The signal received by the detector interprets the changes in intensity level (the signal) as data. Also, when the LED is ON, it transmits a digital 1 and when LED is OFF it transmits 0 digital. Though we cannot see the intensity modulation, the communication will be flawless as other radio systems, it allows the user to be connected when the Li-Fi is enabled. following by this method we can transmit the data from LED light bulbs and back at high speed.

## VISIBLE LIGHT COMMUNICATION

Visible Light Communication (VLC) is an optical wireless communication technology, when the sunshine source emits at the visible wavelengths between 400 and 800 (780- 375nm) The VLC is an infant stage. there's a growing demand for an alternate wireless communication technology due to the crowding of the frequency (RF) bandwidth. this might end within the adoption of VLC technology on a worldwide scale. Because the VLC technology is based on LEDs, it doesn't face distortions or spectrum deficits and will transfer data at tremendous speeds.

## FEATURES OF LIFI

Li-Fi technology provides 1000 times greater data density compared to Wi-Fi. It's bi-directional communications that use the medium of sunshine. Li-Fi light is present everywhere. it's one amongst the safest technologies that may transfer confidential matter. It eliminates many health hazards caused by frequency (RF) waves. The actinic radiation spectrum is big, liberal to use and it's unlicensed. The diode is named a photodiode, which is employed as a receiver which might turn light into electrical signals. The Li-Fi system would be of low cost because it requires a smaller number of components and installation. No additional power is required for this technology, moreover LED illumination is already efficient. The employment of sunshine cannot interfere with any electronic circuitry and hence the technology could be a safe hazard. Hacking is negligible compared to Wi-Fi since the range of information transmission is confined to a particular area. Li-Fi works well in transmission and propagation in water whereas the RF cannot be ready to do transmission and propagation in water. Using low interference, high device bandwidth and high intensity optical output we will receive very high-speed data.

## LIMITATION OF LI-FI

Li-Fi technology like several other technologies has some limitations which are enumerated below: a) the key demerits of Li-Fi is that by an opaque material the factitious light, data transmission, will be obstructed, then the signal is going to be cut out. b) It works given that there's line of sight between the transmitter and receiver [11]. c)A. Sarkar and G. S. Gundu said that the Reliability is from another source of illumination like sunlight and normal bulbs from the shortcomings of the interface [7, 13]. d) The major challenge is how the receiver will transmit data back to the transmitter [13]. e) Li-Fi uses high frequency and has an issue in coverage area 400-800THz, which limits the coverage area to very short distances (practically, 500Mbps over four feet and 120Mbps over 65 feet) [12].

## APPLICATIONS OF Li-Fi

### SECURITY

In a conference room, the access area of each channel depends on the range of the light pool, and at the same time can be penetrated by multiple druggies present within that terrain. When we're using Li-Fi, each stoner present in



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the operation terrain can admit advanced data rates than would be the case with an original Wi-Fi channel. In the case of Wi-Fi, each stoner or group of druggies directly competes for access to bandwidth that slows the download of pets as further connections are there. By discrepancy, in the case of Li-Fi that provides a lesser number of available access points, each source of light provides full channel data rates with smaller contemporaneous druggies. Thus, with minimum preventives to avoid leakage from windows, doors, etc. Security is unnaturally enhanced as compared with Wi-Fi.

**Dense Urban Environment**

Thick civic surroundings cover larger areas with artificial lighting, which can give high data rate access for druggies as the druggies move through that terrain. For illustration, in a hostel corridor or event hall a number of druggies can admit a high data rate at any point. Also, high speed wireless communication would be available in every room since the light swells cannot propagate through walls. This results in hindrance-free wireless communication

**Augmented Reality**

Exhibitions conducted in museums and galleries are elucidated with artificial lighting. Li-Fi technology enables lighting to provide localized information. So that a visitor's camera or mobile phone can be used to download further information regarding the object being viewed from the light.

**Underwater Communication**

In the case of Wi-Fi, it's impossible to speak through water as radio waves are quickly absorbed in water that forestalls underwater radio communications, but light can penetrate for large distances. Therefore, Li-Fi can enable underwater communication.

**Transportation Systems**

Now-a-days headlights and tail lights of cars are steadily being replaced with LED versions. when we use car-car communication using li-fi offers development of an anti-collision system and exchange of information about driving conditions between vehicles. Traffic lights are also using LED lighting, so it provides the opportunity to manage traffic systems. It enables the car system to download information and optimal network and update the network regarding conditions recently experienced by individual vehicles available on the network.

**Sensitive Data**

Every hospital has a large amount of data and a huge collection of equipment that may cause electromagnetic interference (EMI). So, in this environment security and EMI sensitivity are both EMI sensitivity and security of data are issues. The use of Li-Fi is helpful in enabling the better deployment of a more secure network of medical instruments, patient records, etc... Wi-Fi signal is banned inside operation theaters because it might block signals for monitoring equipment like MRI equipment. However, Li-Fi can be beneficent for robotic surgeries [8,9].

**Medical Applications**

Li-Fi technology can be implemented in hospitals where using Wi-Fi is unsafe due to radiation

**Aviation**

Aircraft cabins already have LED lights which can be used to provide high-speed Internet access [10].

**Advantages**

- Li-Fi allows transferring data to the network at speeds up to 1 GB / s, which means 100 times faster than the speed of transfer to Wi-Fi. We can profit from high transmission up to 224 GB within the laboratory, so that we can download 20 HD movies in a flash of a second. This is because Li-Fi is contained in a small area, and at that time, radio signals are spreading.





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- In Wi-Fi networks for data transmission, it is necessary to expand the allowable frequency band, which is limited and paid, and in Li-Fi networks, the additional bandwidth will be allocated free of charge and does not require a licensing procedure, which will simplify the use of the technology of the Li-Fi.
- Visible light doesn't pass through the walls, so VLC technology is potentially more dependable than traditional Wi-Fi, in terms of conserving the sequestration of data transmission. Unlike radio- frequency technologies, the network compass uses Li-Fi technology which allows you to fully cover the unrestricted target room with a signal (for illustration a room, an office, a hall.) and won't go beyond it.
- In the area of 10 square measures, by using the technology of Li-Fi, the experimenters of the Fraunhofer Institute of Telecine have formerly transmitted data at a speed of 800 Mbit/s.
- According to Professor Haas, indeed in the distribution of LED light we can get an internet connection more directly is another advantage of this new technology.
- Li-Fi is largely effective because of the LED lights consume low energy [6]

### Drawbacks

Despite the fact that there are many advantages, now Li-Fi technology is still a new technology, which is at the beginning of the study. Hence, this technology has some drawbacks, which can also make it possible to prevent the use of Li-Fi in practice.

1. This change in infrastructure. Well-known technologies of wireless data transmission today like Wi-Fi, Bluetooth, and LTE are widely used on the basis of a solid infrastructure, and they work well and satisfy most of the users' needs. In order to become popular, Li-Fi requires a change from-the manufacturer of the auxiliary equipment, unity in the construction of the relevant infrastructure. This process needs time and money.
2. Li-Fi technology transmits data using light, then the light will transmit directly and cannot go through the obstacles, which indicates it uses light for data transmission and light is transmitted directly and cannot go through obstacles, which indicates higher vulnerability to interruptions. This means that in home conditions, the transfer of information between user and the internet will be distracted by objects data such as curtains, plants for the user can become barrier to the transfer of information between the user and the Internet.
3. In addition, under the condition of the existence of sunlight, or where there are mixed media for light, as in fog computing, it may be unable to use Li-Fi technology. In such environments, the interference is formed, the light transmission is prevented, the light is weakened, which leads to a loss of information at transfer.

## LITERATURE SURVEY

Researchers at Heinrich Hertz Institute in Berlin, Germany used a standard White - Light LED it has reached data rates of over 500 megabytes per second. [7]. Wi-Fi internet devices are used by most of the people which will be used up to 2.4-5 GHz rf to deliver wireless Internet access around our house, office, schools and some public places also... They said that ubiquitous services are quite dependent [1]. When we use Wi-Fi to cover an entire house or school, the bandwidth is limited up to 50-100 megabits per sec (Mbps). Most of the current Internet service is insufficient for moving large data files like HDTV movies, music libraries and video games. Haas said that his big idea is to turn light bulbs into broadband communication devices so that they cannot provide illumination, but essential utility [6]. He claims that data can be sent by adding a microchip to any humble LED bulb, making it blink on and off at a phenomenal speed, millions of times per second [2]. Li-Fi might be used to elongate wireless networks throughout the home, workplace, and in commercial areas. Li-Fi is prevented by line of sight, so it won't ever replace Wi-Fi, but it could augment it smoothly. Instead of trying to find the perfect spot for your home's Wi-Fi router, it would be much easier if every light in our house simply acted as a wireless network bridge [3]. They discussed a relative study on Li-Fi. They even provided an overview about the applications of Li-Fi, need of Li-Fi, future scope, design challenges for Li-Fi and also the recent developments that have taken place in Li-Fi [4]. In this internet service it is insufficient for moving large data files like HDTV movies, video games. The authors explain Li-Fi working and have They studied the electromagnetic frequency spectrum. The visible light portion is used for exchange of information which is similar to old forms of wireless communication like Wireless- Fidelity (Wi-Fi) and Bluetooth, in which data



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is transferred over the wireless medium using RF signals (radio frequency). Disadvantage of Wi-Fi is that unlike LEDs, the information cannot be transferred at a very huge range with just the turning on and off of the LED's. They revealed the design and described the working of Li-Fi Technology and the authors compared the two technologies in the present scenario and gave its applications. Wi-Fi is used widely in each and every environment but in recent times many researches are going on Li-Fi technology [5].

## CONCLUSION

Li-Fi is the upcoming and growing technology acting as competent for various other developing and already invented technologies. The Li-Fi is now attracting a great deal of attention, not least because it may offer a real and effective volition to radio- grounded wireless. The increasing number of people and their devices access wireless Internet, the air waves are becoming gradually more crammed, making it harder to urge a uniform, high-speed signal. This wonderful technology can be used practically, then maybe in the future each and every bulb can be used as something like a Wi-Fi hotspot for a brighter future. Every bulb is often compared Li- Fi and Wi- Fi technologies. and also used as something sort of a Wi-Fi hotspot to transmit wireless data and that we will proceed toward a cleaner, greener, safer and brighter future. The concept of Li-Fi is currently attracting a great deal of interest and a very efficient alternative to radio-based wireless. There are many growing numbers of people and their access to wireless internet devices.

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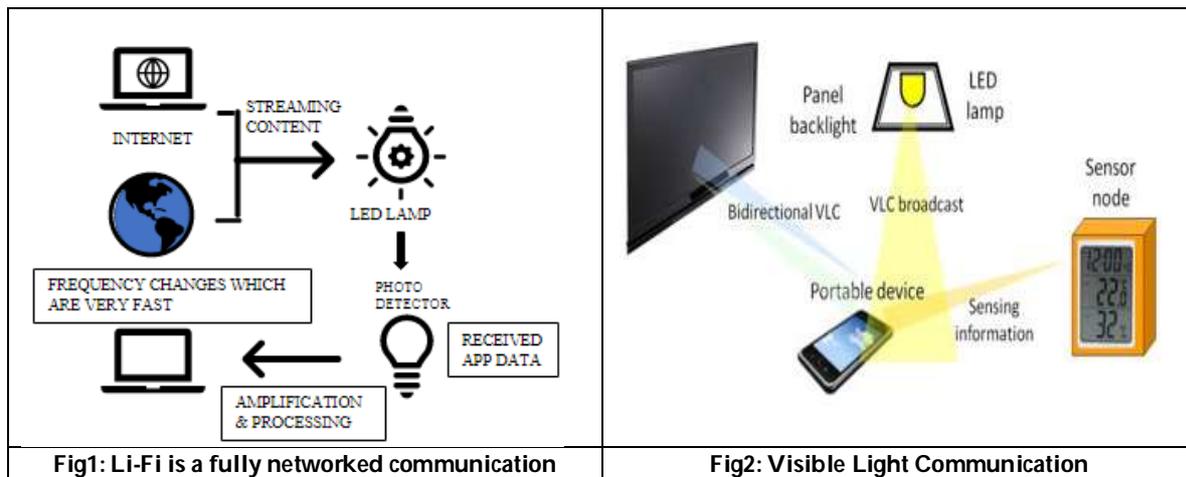
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Table 1: Comparison of Li-Fi and Wi-Fi

| Components          | Li-Fi                                  | Wi-Fi  |
|---------------------|--|--|
| Data Density        | Work with high dense domain            | Work with less dense domain                              |
| Data Transfer Speed | About 1 GBps                           | About 150 MBps to 2 GBps                                 |
| Privacy             | Protected and more secure              | RF signal needs to use secure techniques to protect data |
| Frequency           | 1000 Times frequency spectrum of radio | 2.4 Ghz, 4.9 Ghz, 5 Ghz                                  |
| Coverage            | coverage area up to 10 meters          | coverage area up to 32 meters                            |





## IoT Based Elderly Fall Detection System

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### ABSTRACT

A fall is defined as an abrupt shift in the system that causes a jolt. When it comes to old age, we must keep an eye on our loved ones to ensure their health and safety. They are at a high danger of falling because to their brittle joints. It is therefore critical to determine whether an elderly person has fallen so that aid may be provided promptly. We propose an IoT-based geriatric fall detection system for this purpose. The technology detects falls in older people using a piezoelectric sensor that may be installed on a person's hand or wheelchair. The sensor is wired to a microcontroller, which transmits the fall data continuously. The device is now monitoring that older individual for falls and sudden movement changes. If the individual did not fall and the alarm was false, the system permits the person to snooze the warning if the snooze button is pressed within 10 seconds. If the individual does not hit the snooze button, the system recognizes that the person has fallen and automatically sends an alarm through Wi-Fi (Node MCU) to the caretaker.

**Keywords:** Fall, Old age, Node MCU, Peizoelectric sensor, wi-fi, false alarm, Alert

## INTRODUCTION

Elderly falls almost invariably result in major health problems, as well as a loss of physical fitness. The most common damage in an elderly person's fall is a fracture, but there is also a chance of coma, brain trauma, and paralysis. Because of the tremendous impact, the fall process is usually the main source of damage in most fall instances. However, late medical salvaging might occasionally aggravate the condition. The falls can be classified into three categories:

- 1) Anticipated
- 2) Unanticipated
- 3) Accidental



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With the use of a sensor, the proposed work would detect the accidental and unforeseen falls of older persons and warn the caretaker. This will minimize the fear of falling of the elderly person without physical interaction and causing depressions. Medicine and Food Remainder: Elderly people older than age 65 often forgets their proper time to take medicine and foods because of their degrading memory. By research most elder lives separated from their family it is even hard to have someone to remind them every single time for their medicine and food. For this difficulty the fall detection module has a buzzer and an LCD display. At the time of taking medicine and food the buzzer will activate and remind the person to take medicine and food.

### PROPOSED SYSTEM

The proposed solution consists of a piezoelectric sensor which is attached to NodeMCU for the fall detection for elders as well as wheel chaired person. When a fall is detected the buzzer will ON and the message is sent to the caretaker through NodeMCU. In case of false alarm, the user can snooze the button within 10seconds. If the buzzer is not snoozed within 10 seconds, an alert message is sent to caretaker indicating a fall through an alert message. The time to take food and medicine will also indicate to the elderly people through buzzer and LCD display. The LCD display which is attached to the NodeMCU will display the message as "Time to take food/medicine". The pill box application is developed through MIT app inventor and it is interfaced with the NodeMCU through firebase. The pill box application helps to update the time to take the medicine.

### SYSTEM DESCRIPTION

#### Block Diagram of Proposed Solution

The proposed system's block diagram is shown in Figure 1.

#### Pill Box Application

The time to take medicine varies periodically. So the time can be automatically set by the patient through the pill box app which is developed using MIT application inverter using block coding. The display of Pill box Figure 2 depicts the application.

#### Hardware Description

The piezoelectric sensor is interfaced with the NodeMCU for detecting the fall. If a fall is encountered then through the NodeMCU the message is sent to the caretaker as "FALL DETECTED" "ACKNOWLEDGE" and also the buzzer will "ON" for 10seconds. If it is a false alarm the user can stop the alarm and prevent the message from sending to the caretaker. When it is time to eat and to take medicine the buzzer will activate for 1minute and the LCD display will display as "TIME TO TAKE FOOD" or "TIME TO TAKE MEDICINE".

#### Flowchart

In fig 3 the working process of the proposed system was explained through flowchart. In the real time data base enter the data. Then open the Arduino IDE software and check for the necessary library files included in the ArduinoIDE software. After writing the necessary codes includes the Firebase credentials and connect the USB cable to the NodeMCU and dump the necessary coding in the NodeMCU. Figure 4 shows the display of NodeMCU connection with cloud.

## RESULTS

The IoT based elderly fall detection system is implemented successfully. When there is a sudden abrupt change in movement of elderly people, the buzzer will activate indicating a fall. If the alarm is false then the elderly people will be given 10 seconds to snooze off the alarm. If the alarm hasn't been snoozed off even after 10 seconds, then the alert message will be sent to the caretaker indicating a fall. The message will be displayed to caretaker as "FALL DETECTED" "ACKNOWLEDGE" and the LCD will display as "FALL DETECTED". At the time of taking food and





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medicine the buzzer will be on for 1minute and the LCD will display as "TAKE YOUR FOOD" "TAKE YOUR MEDICINE". The time of taking food and medicine will be set through the pill box application. When the elderly person falls then buzzer will be activated, then the user will be given the time of 10 seconds to snooze of the buzzer. If the user didn't snooze the buzzer, it means the person has fallen and become unconscious to snooze off the buzzer. At this situation, the alert message showing "FALL DETECTED" "ACKNOWLEDGE" will be sent to the caretaker. Figure 5 shows the final prototype of the proposed solution. The Fig 5 shows the hardware setup of the proposed system. Figure 6 shows the message sends to the care taker when the elderly person had fallen.

## CONCLUSION

The prototype developed in this project will help the elderly people to avoid the fear of falling and reduce their depression. The device reduces manual supervision and human labor by keeping track of regular medicine and meal taking actions. It is very helpful to the elderly and wheel chaired people in case of fall. The future scope of the developed prototype includes it will reduce the fear of the elderly and wheel chaired peoples due to fall and it reduces the man power by automatically reminding the elderly people to take their food and medicine.

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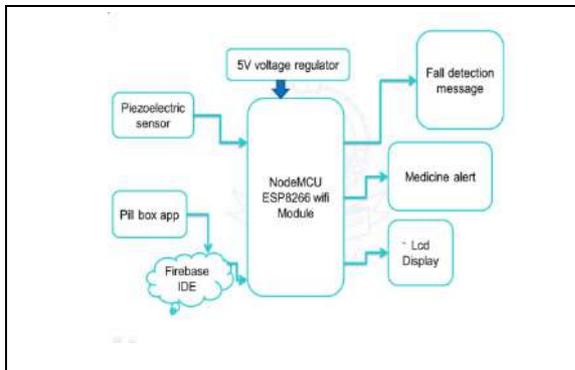


Figure 1. The proposed system's block diagram is shown in



Fig. 2. Pill Box Application

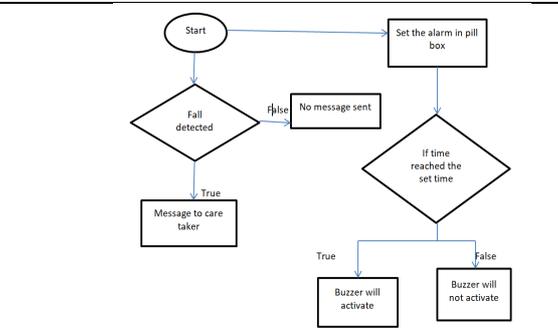
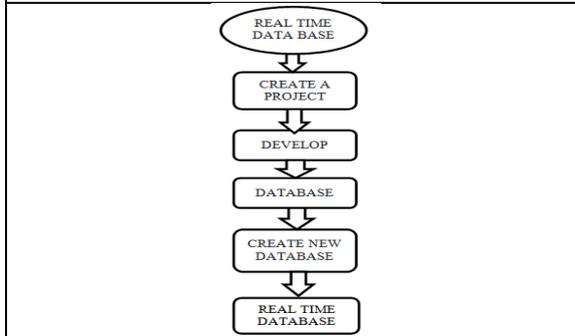


Fig. 3. Flowchart of the Proposed System

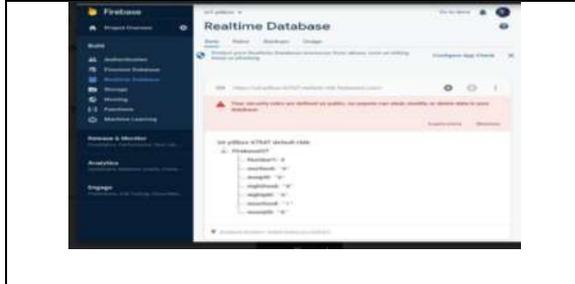


Fig. 4. Connecting NodeMCU with the Cloud

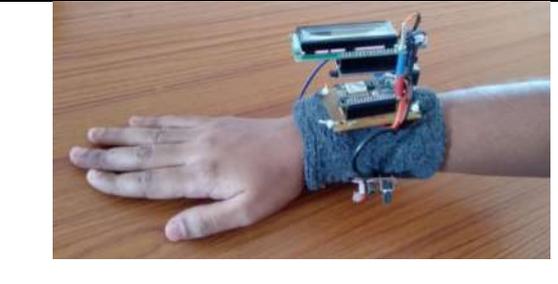


Fig. 5. Hardware Setup



Fig. 6. Alert Message to Caretaker





## Deep Learning based Education Institution's Transportation System Using Opencv and CNN

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### ABSTRACT

The Majority of schools and colleges are busy, giving more importance to academic tasks, and are concentrating less on maintenance of transportation, office records, 5S, etc. Though many institutions have a good manual bus attendance system, there is still scope for automating the transportation system. This project proposes a novel automation method for the bus attendance system to regularly ensure the safety of the students. The proposed system concentrates on face recognized attendance system with an email-based solution to assist the parents and the institution bus fare calculation of the student and population analysis. First, we adopt a real-time Deep Learning-based Face Recognition system using the Open CV, and CNN that helps to detect the individual's face through digital images. The presence or absence of the student is sent to both the parents and the institution. Experimental results and real-time implementation proves that we can achieve it with 99.38% of accuracy for face recognition.

**Keywords:** Face-Recognition, Attendance Recording, Open CV. Population analysis, Admin.

### INTRODUCTION

One of the usual security procedures seems to be the evaluation criteria discern whether or not a person is present in a room or location. Every individual who enters the bus must first go through a series of authentication procedures. For security reasons, it could be used for monitoring every tasks in the space. The confirmation method for detecting



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the presence of a person in a bus is still in flux. The procedure differs depending on whether a name and signature are printed in the attendance list, or biometric verification technology, like fingerprint and face scanner, are utilized. The biometric verification approach has emerged as one of the most promising. However, the biometric authentication technique utilized is ineffective and time consuming to complete. The user must insert a finger in the fingerprint scanner, whereas the user must change their facial orientation to meet the scanner's placement in the face scanner. Authentication technique with face recognition using a web camera was proposed in this study. In both schools and organizations, marking attendance would be a common practice. In educational institutions, attendance seems to be a critical aspect both for students and professors. Keeping track of student attendance in a classroom may be a difficult task. Manual and automatic attendance systems are the two types of attendance systems that exist. The roll call technique, wherein a teacher records presence by calling out the pupils' names one by one, is the most frequent manual attendance approach. The approach is outdated, and in the event of a big class, this can take up to 10 minutes per day and provides the most opportunity to proxy attendance marking. Signing an attendance sheet or record is the second approach. These procedures take more time, and if they are left ignored, they may easily be changed or faked. In comparison to traditional authentication techniques, modern biometric approaches are beginning to emerge as is among the promising ways of verification. The conventional method of verification is marking a person's name, address, and, signature on a piece of paper and granting access to a real or virtual environment by the use of a password, PIN (user id), smart card, card swiper, token, key, or other means. Passwords and PINs are difficult to remember, and they can be easily steered in many circumstances. Use of facial recognition as a biometric authentication mechanism is one of them.

**RELATED WORKS**

As technology advances, automatic attendance tracking using RFID tag is implemented [1]. Each student does have a particular tag which is scanned to indicate attendance in these systems. The system's flaws include extensive hardware requirements, a tag for each student, proxy attendance via tag exchange among classmates, and just single social contact for marking attendance. Due to the image processing in attendance systems, like scanning of fingerprint, iris scanning, and facial detection have all been used to create automatic attendance systems. A biometric attendance system based on fingerprint scans is the first time proposed biometric method for attendance[2]. Every scholar does have a distinctive fingerprint that is scanned to record attendance. The system's drawbacks include the ability to only mark one attendance at a time and the requirement for substantial human-machine contact during the progress. Attendance system that scan iris eliminated need for fingerprint cards as a proxy. This technology records attendance by scanning the iris[3]. Individuals in a large crowd or surroundings are frequently recognized using face recognition. Facial recognition is also being used by institutions to track attendance. Face recognition, fingerprint, and iris scanning-based attendance systems have the disadvantages of consuming time, needing additional Human-Machine Interaction because only single student may register attendance at a time, and being impracticable to utilize in big courses.

The significant computation required during classifier training is one of the remaining flaws in the face detection approach. This difficulty was solved by Minh-Tri Pham and TatJen Cham [7], used statistical techniques for minimizing the time necessary for training. The findings were fairly impressive in terms of decreasing the necessary processing time. A number of the most prevalent facial recognition-based attendance systems have already been investigated. To track attendance, Jayant [4] employed hybrid facial recognition algorithms. FACECUBE was used by of ualagba in [5] for attendance marking. D'Souza et al. used a histogram facial recognition algorithm to construct an attendance marking system [6].As a result, it's critical to create an intelligent attendance system that can accurately record attendance without the need for human interaction. Because it is a non-intrusive methodology, pictures can be acquired from a distance, it is a cost-effective option, there is no danger of proxy attendance is recorded, and it is a user-friendly yet dependable way, a biometric system is among the most practical solution in designing attendance systems. In this project, we used video from a camera and face matching to construct an automated attendance system that tracked students' attendance.



**Amudha et al.,****EXISTING SYSTEM**

IoT and RFID are relatively new technologies there is only a small body of earlier work that uses an IoT attendance tracking system. This proposal presents a new Internet of Things (IoT) paradigm for the RFID attendance framework. The concept improves on the time-consuming traditional attendance tracking mechanism now in use. Reduced student truancy and absenteeism continue to be a major management goal for all schools. The Attendance Procedure: A student's or staff member's ID will fall within the RFID reader's range within the classroom (or workplace). When the data are received at the reader, it is sent to the server, where it is processed in their entirety.

**Existing Methodology**

- Radio Frequency Identification (RFID)
- Calling names or signing on paper
- Handwritten records method

**DISADVANTAGES**

- Time-consuming
- Inefficient.
- Less accuracy
- Less sensitivity
- It extract the reduced number of features

**PROPOSED METHOD**

Face recognition-based Automated Student Attendance system is a highly specialized system that automates the whole system of student attendance registration. The attendance of the students is taken and the message of being present or absent is sent to the parents via mail. Attendance with bus fair amount is sent mail to the parents. If the college bus seat is filled, a message will be displayed from the LCD (seat filled).

**ADVANTAGES**

- Efficient attendance marking
- Less time consumption
- The system has automated attendance
- It consumes low power

**CNN Architecture**

This paper shows how to classify images using a deep neural network and HOG feature extraction using the K-means segmentation technique, and then classify them using an SVM classifier for greater accuracy. The following are the benefits of the suggested system:

- 1) The suggested CNN approach reduces the number of steps required for preprocessing.
- 2) An extra shape feature was retrieved from the HOG method to improve accuracy.
- 3) The SVM classifier lowered the amount of effort required and increased the system's resilience.

**SOFTWARE DETAILS****IMAGE PROCESSOR**

An image processor handles picture capture, storage, preprocessing, segmentation, representation, recognition, and interpretation before displaying or recording the result. The block diagram below depicts the basic technique involved in an image processing system. Picture acquisition via an imaging sensor in combination with a digitizer to digitize the image is the first stage in the process, as shown in the figure. The picture is then enhanced, before being provided as an input to the subsequent operations in the preprocessing stage. Typical preprocessing tasks include improving, eliminating noise, separating areas, and so forth. The process of segmentation divides a picture into its components or objects. Segmentation normally produces raw pixel data that consists of either the region's boundary





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or the pixels within the region. The act of translating raw pixel data into a form that can be processed by a computer is known as representation. The extraction of essential traits that distinguish one class of things from another is the subject of description. Based on the information supplied by the object's descriptors, recognition provides a label to it. The process of interpretation entails attributing meaning to a group of identified items. The knowledge of a problem domain is added. The knowledge base, which also drives the interaction between the modules, directs the operation of each processing module. A single function does not necessitate the presence of all modules. The image processing system's composition is determined by the application. The picture processor's frame rate is usually approximately 25 frames per second.

### **IMAGE PREPROCESSING**

The input picture in the preprocessing step may be of varying sizes, contain noise, and be in a variety of color combinations. These settings must be adjusted to meet the process's requirements. Picture noise is more evident in portions of an image with low signal, like shadows or underexposed images. Filtering algorithms are being used to remove noise of all kinds, including salt & pepper noise, film grains, and etc. The filter that is utilized is the Weiner filter. For proper output, the image acquired will be processed in the preprocessing module. Several algorithms are used to accomplish the preprocessing. This should be carried out on all photographs to improve the end outcome.

### **FEATURE EXTRACTION**

Statistics is the study of data collection, organization, analysis, and interpretation. It covers every aspect of it, including survey & experiment design and data collecting strategy. This is the purpose of statistics. The picture's statistical properties include mean, variance, skewness, and standard deviation. To assess texture, the Gray-Level Co-Occurrence Matrix has been employed (GLCM). The gray-level spatial dependence matrix (GLSM) is another name for the gray-level co-occurrence matrix (GLCM).

### **CLASSIFICATION**

Link among classes and data is categorized, that should be properly understood to classify the data into distinct groups or sets. The computer must be educated first for doing this. Training is essential for categorization success. Techniques for classification were created in the beginning. Features are qualities of data components that are used to categorize them into different groups<sup>1</sup>). The image classifier is a discriminant, pitting one class against another. 2) The discriminant value is highest in one group and lowest in another (multiclass) 3). For one class, the discriminant value is positive, whereas for another it is negative (two-class).

### **CONCLUSION**

We created a clever, single-input, multiple-output attendance management system based on facial recognition algorithms in this project. This solution solves the issues that arise with standard systems. In this project, we developed a sophisticated single-input, multiple-output attendance management system using facial recognition algorithms. We eliminate the above challenges in this project by showing an automated face recognition attendance technique that involves receiving photographs in real-time, detecting faces in the image, cropping the image, and comparing it to a database. In this paper, we propose a system for unsupervised car parking. This system gives an alert when the car is parked at an incorrect angle. It is detected with the help of an IR sensor. The information is sent as an email with the help of IoT and displayed in LCD. A deep learning-based attendance system is proposed which helps to record attendance. All the details of attendance are sent to the college management server. To improve system efficiency, the procedure is repeated a few times, and the final findings are recorded in an excel file. Because it works in the background and requires little to no contact, this automatic attendance system saves time. This technology also reduces the amount of human effort and pressure placed to accurately mark attendance and increases security. The proposed automated attendance system using facial recognition is an excellent example for recording attendance in car parking. This technique also helps to eliminate the possibility of proxies and pony attendance. A great number of biometric systems are available in today's society. Face recognition, on the other hand,





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proves to be a feasible choice due to its high accuracy and little human interaction. The goal of this system is to provide a high level of security.

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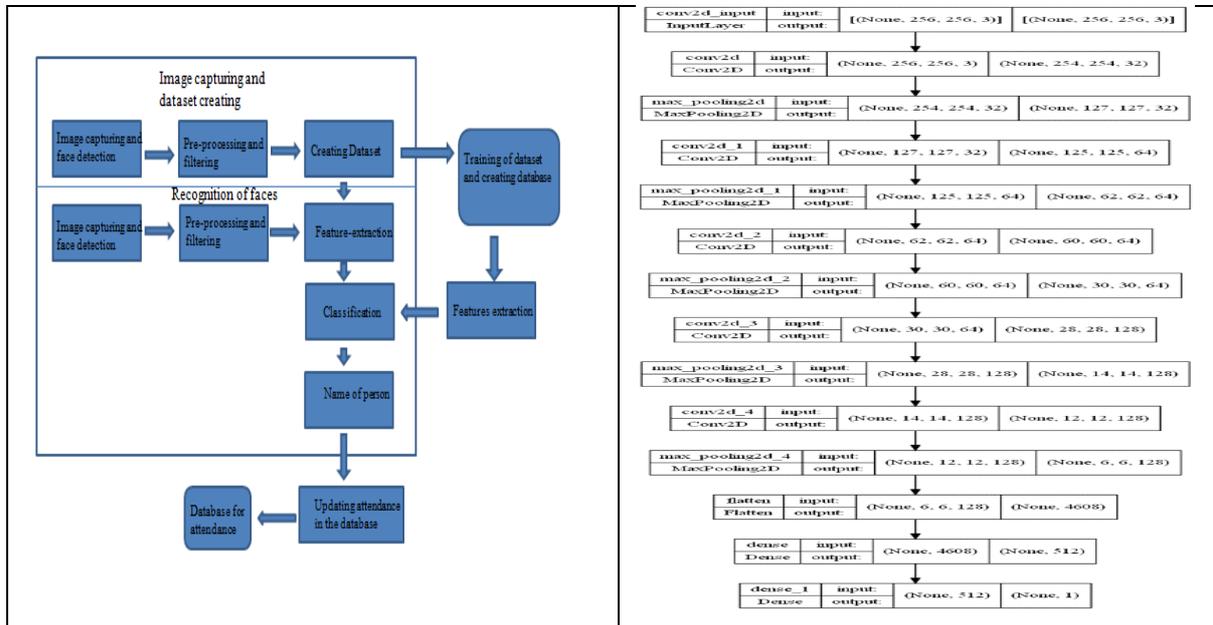


Fig. 1 Proposed Block Diagram

Fig. 2: CNN Architecture

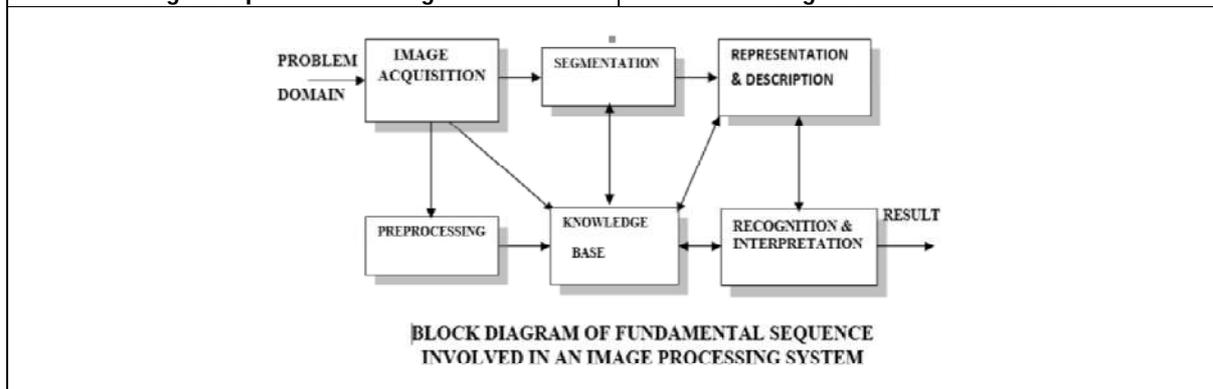


Fig.3. Block Diagram Of Fundamental Sequence Involved An Processing System





## Detecting Brain Tumour by Applying Gray Level Spatial Dependence Matrix (GLCM) and Bat Algorithm

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### ABSTRACT

Brain is the regulative unit in our body. It guides the functions like remembrance, storing information, sight, hearing, perception, character, trouble, etc. the main cause of brain tumors is the abandoned progress of brain cells. Various medical services have realized brain tumors because of the second foremost dispute that causes an oversized range of human deaths over the world. Finding the brain tumor at an early stage offers a chance of effective therapy. Utilizing Magnetic Resonance Imaging (MRI) impressions are recognized as a lot of careful and a lot of consistent pictures in comparison to computed axial radiology images. There are various procedures to detect brain tumors or lumps. The leading competent and functional algorithms are mentioned during this paper when learning a variety of applicable thesis. Initialized brain images, segmentation, attribute extraction, clump and diagnosis of the lump are the approaches in most of the research.

**Keywords:** Utilizing Magnetic, brain cells, Imaging (MRI)

### INTRODUCTION

The brain is a superior organ in the human body which commands the entire functionality of other organs and helps in decision making. It is primarily the control center of the sense organs and is responsible to accomplish the daily voluntary as well as involuntary activities of the human body. The tumor is a tissue growth inside our brain that multiplies in an unrestrained way. Over 3,540 children get diagnosed with a brain tumor at the age of 15. The right way of understanding brain tumor and its stages is an important task to prevent and to carry out the steps in curing the illness. To do so, magnetic resonance imaging (MRI) is widely used by radiologists to analyze brain tumors. The result of the analysis carried out in this paper reveals whether the brain is normal or diseased by applying the deep learning techniques.



**Santhiya et al.,****LITERATURE SURVEY**

Liu Jet et al., Tumor volume is considered useful in predicting disease progression and response to treatment, and estimating the need of changes in treatment strategies. These include muscle strengthening, no tumor development, edema, and edema and tumor compounds. We have modified the ambiguous communication framework of plant differentiation in this article and the method requires limited user interaction in standard clinical use.

Madabhushi A et al., The repair work is obtained by bias and the outcome of suspension. We demonstrate this bias both in terms of quality and quantity using two different methods of adjustment homogeneity. With respect to the bias, the suspension is independent to the method of adjustment homogeneity used. The effect of this bias due to the correction was also reflected in the images of magnetization transfer ratio (MTR), which are naturally assigned to standard goods.

Benoit-Cattin H et al., We present the verification agreements used to evaluate these different repair programs both in terms of quality and value. Finally, the availability and usability of the presented methods are discussed. Magnetic resonance imaging (MRI) is a powerful non-invasive method of studying soft tissue structures and structures. It is characterized by the good quality of all data sets obtained. Such data usually include a set of 2-D (2-D) images or a three-dimensional isotropic volume (3-D).

Fletcher-Heath LM et al., Separation of tumors in the brain on MRI(magnetic resonance imaging) is important in medical diagnosis because it shows the facts related to the anatomical structures and abnormal tissue that may be needed to plan treatment and follow-up. We create a hypothetical image to determine the main area of the plant. This picture gives a complete view of the plant. After that, we grow the first region to separate the whole plant. This method is automatic and independent of the operator. It separates different plants without needing its own specific tissue boundaries. This process is based on the preceding definition of a plant boundary while the method we suggest in this paper focuses on automatically locating plant regions.

Prastawa M et al., Although many other methods of tumor differentiation depend on the intensity enhancement produced by the gadolinium contrast agent in the T1-weighted image, the formula preferred here does not require advanced image Channels. Only input is required for the T2 MR image separation process, but we can use any unmodified image channel for advanced tissue separation. The dividing frame is made up of three sections.

**PROPOSED METHODOLOGY****MRI PRE - PROCESSING**

Image processing usually involves eliminating low frequency, background sound, normalizing the intensity of non-individual images, removing the display and hiding parts of the images. Image processing is a way to improve image data before computer processing. The next steps for pre-processing include remodeling and disassembling the pieces within the volume, separately for all full flow drawing methods. Typical measures of pre-existing MRI of the brain, associated fractal features and stiffness are excluded. In the next step, different combinations of elements (feature sets) are used for tumor classification and segmentation. Personal labeling of plant regions for supervised stage class training. Qualified stage dividers are then used to predict tumor or non-tumor components in an unknown brain MRI.

**BIAS FEATURE EXTRACTION**

Feature removal is a special way to reduce Dimensionality. If the input in the Algorithm is too vast to be analysed and seemed to be infamous (e.g. the same measurement on both feet and meters) then the input will be changed to lesser representation set of elements (also called elements vector). Converting the inputs into a feature set is called a feature output. If the extracted elements are strictly selected it is found that the selected components will withdraw





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the relevant information from the input information to perform the required function by this lesser representation on behalf of the full size input.

**BAT BRAIN TUMOR SEGREGATION AND CLASSIFICATION FROM NON-TUMOR TISSUE:**

The SVM searches for a subspace that separates members and non-members of a given class in place of the maximum size feature. The input to the bat algorithm is a subset that is selected between the information processing step and the extraction step. In the GRAY LEVEL SPATIAL DEPENDENCE MATRIX (GLSM) character functions are used as graph kernel, RBF kernel polynomial kernel, etc., Out of these kernel functions, the Radial Basis Function (RBF) appears to be helpful, because non-map vectors are inserted in the area of the highest feature. By separating tumor / non-tumor tissue and structure, MRI pixels are taken as samples. These things are represented by a set of feature values extracted from different MRI methods. Factors from all approaches are included in tumor classification and stages. A modified GRAY LEVEL SPATIAL DEPENDENCE MATRIX (GLCM) modified formula is trained to separate the tumor from non-tumor tissues.

**GRAY LEVEL SPATIAL DEPENDENCE MATRIX (GLSM) HOMOMORPHIC ALGORITHM FOR SEGMENTATION IS AS FOLLOWS:**

- Find the blocks in the image below, from the top left corner.
- To rot the blocks below using two levels of 2-D RED LEVEL SPATIAL DEPENDENCE MATRIX (GLSM).
- Obtain Gray Level spatial dependence Matrices (SGLDM) or Gray Level Spatial dependence matrices.
- In small 2-level belts the top of the small rotten picture blocks are 1 in the range of 0, 45, 90 and 135 degrees by  $\theta$  and scale.
- In these co-occurring matrices, the following nine Haralick features of the second mathematical order called the wavelet spatial dependence Texture (WCT) features are excluded.

**BAT BRAIN TUMOR SEGREGATION USING STRUCTURE PREDICTION:**

At this stage, the proposed method of classification of specific brain tumor components, i.e. complete tumor, tumor context, and functional tumor, is evaluated. This approach is based on its new invention in the systematic integration of the deep path and the prediction of the local structure in the work of classifying medical images.

**PARAMETER ANALYSIS**

A GLSM Homomorphism category, which does not consider interaction on nearby data point labels. In contrast, DRFs and MRFs consider this interaction, but do not have the attractive features of common practice such as the Radial Basis Function. Comparative recognition, Spatial-consistency .Learning: parameter measurement. Brain tumor classification using structural prediction. In this activity, we present current photographic challenges in the context of big data. We are reviewing our efforts to develop a data management system to plan large fMRI data sets, and to introduce our novel algorithms / methods. A new method was developed to overcome these challenges. Multimodal MR images are subdivided into large pixels using algorithms to alleviate sample problems and improve sample representation. The parameters A and B are estimated from training data represented as pairs where

$\langle f(\gamma_i(x)), t_i \rangle$  is the real-valued bat algorithm response (here, distance to the separator), and t denotes a related probability that  $y_i = 1$ , represented as the relaxed probabilities:

$$t_i = \frac{N_{++} + 1}{N_{++} + 2} \text{ if } y_i = 1, \quad t_i = \frac{N_{--} + 1}{N_{--} + 2} \text{ if } y_i = -1,$$

where  $N_{++}$  and  $N_{--}$  are the number of positive and negative class instances. By using these training scenarios, we can solve the following development problem to quantify parameters A and B:





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$$- \sum_{i=1}^t [t_i \log \log O(t_i, \gamma_i(x)) + (1 - O(t_i, \gamma_i(x)))]$$

### Data Collection

A set of data collection training and a set of test data. Input such as MRI images of the brain to detect a brain tumor. The Dataset used at work has only images that are far enough for the model to be trained and as a result have low accuracy. Increasing the size of the database can increase the performance of the model and thus solve the problem.

## ANALYSIS OF RESULTS AND DISCUSSION

A GRAY LEVEL SPATIAL DEPENDENCE MATRIX (GLSM) Homomorphism classifier, which does not consider interactions in the labels of adjacent data points. Conversely, DRFs and MRFs consider these interactions, but do not have the same appealing generalization properties as Radial Basis Function. This section will review our GRAY LEVEL SPATIAL DEPENDENCE MATRIX (GLSM), an extension of RBF that uses a brain tumor framework to model interactions in the labels of adjacent data points.

## CONCLUSION AND FUTURE WORK

In the medical field, diagnosing tumors on MRI scans is a time-consuming task and may not be worth the huge amount of data. Instead of manual identification, image processing and machine learning methods can be used to identify a tumor in photographs. Therefore, this model helps to understand the development of a system that will process image processing and brain tumor using a machine learning method. Also show the location of the plant in the highlighted area of the image. We use super-pixel-based visualization models to reduce computational costs, improve spatial fluctuations, and solve the GLSM data separator training problem in brain tumor differentiation. Also, we are developing an affinity model that penalizes spatial instability based on model level issues studied in training data. Finally, our structural denoising based on symmetry axis and continuous features is shown to effectively remove false positive circuits. The training and validation was done in an MR image database with a high resolution that can be added and the result compared to the BAT model algorithm in-depth reading Alex net. The performance of all bat algorithm models is tested with the help of memory performance metrics, accuracy, F-results specification, and overall accuracy.

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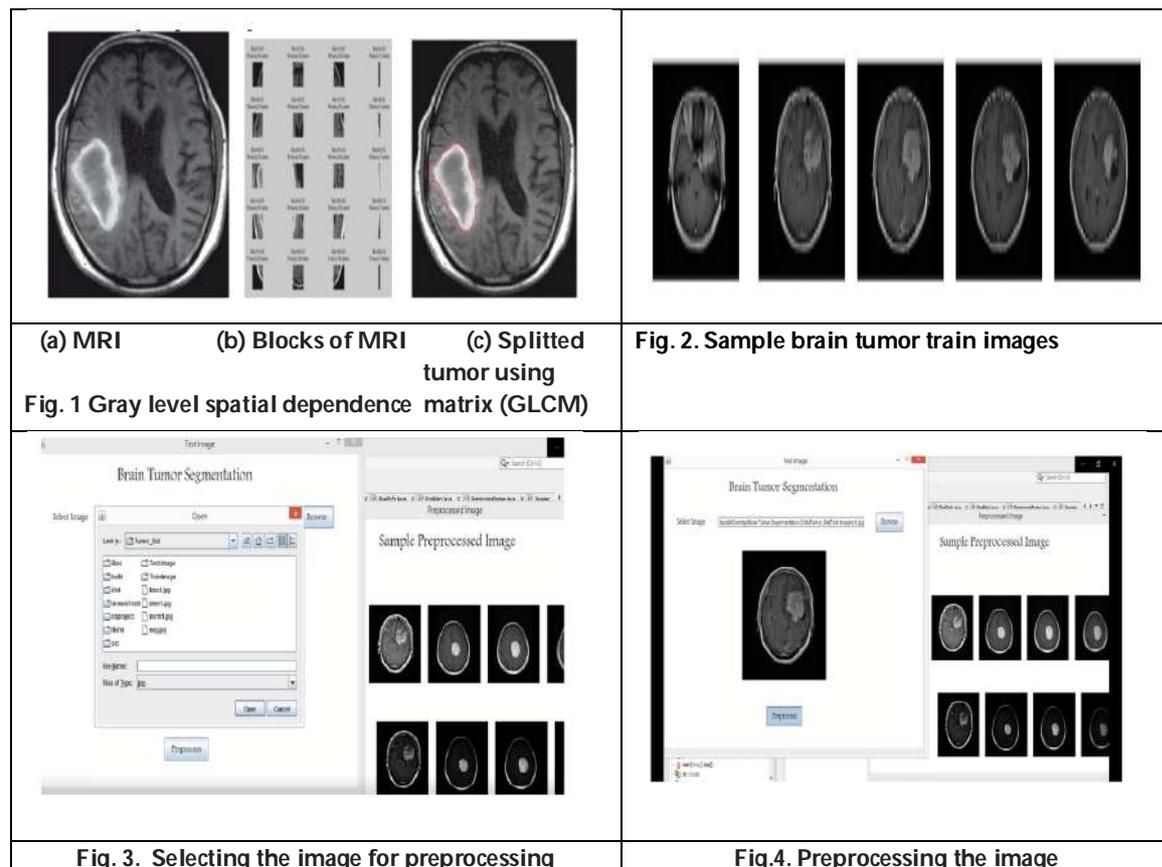
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## Automatic Soil Quality Analyser for Enhancing Agriculture with IoT

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### ABSTRACT

Agriculture assumes crucial part in the financial improvement of our country. The harvest yield fundamentally relies upon soil fruitfulness and pH level. Manures are ordinarily suggested considering the supplement present in the dirt. To suggest a reasonable manure level, the dirt supplement examination is significant which is done generally utilizing research center strategies. Manual techniques for estimating soil supplements are tedious. Numerous ranchers for go performing soil testing in the research center and developing a similar yield on the land constantly, so the soil loses its fruitfulness. It becomes important to make a more brilliant agri business practice through the Internet of Things (IoT) to address this test. Soil supplement examination utilizing remote sensor organizations (WSN) empowers different applications like remote observing of soil ripeness, investigation, giving a determination of harvests, and building water system choice emotionally supportive networks. A framework has been proposed to embrace accuracy farming utilizing a Wireless Sensor Network, which empowers remote observing of soil fruitfulness and different boundaries specifically soil NPK, soil moisture, and the soil pH. This information is sent to the Thing Speak cloud and the relating values are shown utilizing a portable application. The rancher might wish to grow a particular yield in view of monetary interest. The proposed programming framework has the knowledge to suggest an appropriate compost for the yields which works on the nature of the dirt and the ideal development of the harvest along with the dataset comprises of the plant accommodate themselves to the appropriate PH, NPK values and fertilizers.

**Keywords:** Internet of Things, PH,NPK, Soil quality





## INTRODUCTION

Farming is the beginning of food creation. Soil is an asset in farming. The physical and compound states of soil assume a significant part in the creation cycle. One of the important instruments for ranchers to further develop crop efficiency is soil quality investigation. In such a manner, soil testing assumes an imperative part in crop development. Ranchers can add natural and inorganic supplements to the dirt to the right extent. Yield expansion predominantly relies upon the dirt Macro nutrients to be specific Nitrogen (N), Phosphorous (P), and Potassium (K). Over and under-provisioning of the compost can incredibly diminish the creation rate and results in the mediocre nature of horticultural items. As the populace builds, the interest for rural creation increments. To increment efficiency, computerizing rural practices is fundamental. As of late, the improvement of the natural checking framework has been executed in numerous applications to help individuals in their work and lessen cost and time. Soil is the real supplement hotspot for plants and fundamentally affects the plant development cycle shields to its quality. Soil quality is still up in the air by the physical, substance, and organic boundaries of the dirt. The worth of soil NPK, moisture and pH is perhaps the main element in deciding soil quality.

### The Existing System

Soil quality analysing refers to the qualitative analysis of soils and is well recognized as a scientific means that for fast characterization of the fertility standing of soils and predicting the nutrient demand of crops. It conjointly includes testing of soils for alternative properties like texture, structure, pH, ion Exchange capability, water holding capability, electrical conduction and parameters for melioration of with chemicals deteriorated soils for recommending soil amendments, like mineral for alkali soil and lime for acid soil. There square measure chiefly 2 sorts of soil testing strategies.

- A. Soil testing in laboratory
- B. Mobile soil testing

### Soil Testing In Laboratory

This methodology involves soil testing in laboratory. It's going to take weeks or days to check the soil. The individuals take soil samples and provides them to the laboratories for soil testing. [2] They discover the NPK values of soil by victimisation qualitative analysis.

### Mobile Soil Testing

During this sort individuals do the take a look at and provides suggestions on the tests concerning, the fertilizers and it's done once per crop. Therefore this methodology isn't appropriate for effective crop production and it doesn't offer the correct results. The subsequent 3 strategies square measure used for police work the soil fertility. They are 1. Qualitative analysis two. Conduction and three. Electro chemical detector strategies. These square measure value effective and cannot offer the correct results. In projected work [1] pH made up our minds by victimisation digital image process technique. Fifty soil samples were collected and their pH made up our minds by victimisation digital image process technique. Soil colours square measure the components of visual sensory activity property wherever digital values of red, inexperienced and blue (RGB) offer a clue for spectral signature capture of various pH in soil. For the capturing pictures, camera was used. In [2] IoT Enabled Soil Testing system, takes readings from soil wet detector and humidness detector and store it during a cloud server and graph is drawn as per the variations. Within the projected system, it determines the crops that square measure appropriate for the actual soil sort. It'll analyse wet content, temperature and humidness in soil at real time and it'll conjointly recommend the crops supported determined pH of soil. This method is projected to assist the farmers to extend the assembly and also the suggestions square measure created through the mobile application. In this paper [3] a standalone device is projected that follows same procedure for measure the Soil Macronutrients. The soil macronutrients square measure detected exactly victimisation Photodiodes, lightweight Emitting Diodes, data converter (ADC) and FPGA. This may result into a lot of correct proportion of Macronutrients. To calculate varied environmental parameters in [4], the author cautioned a mobile robotic outfitted with one-of-a-kind sensors. To implement the whole operation, it incorporate Raspberry Pi



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two Model B hardware. Feature of this new clever mobile mechanism can perform enterprise like police work moistness in soil, piss birds, spreading pesticides, going forth and reverse, and changing electrical high-powered motor ON/OFF. The tool is equipped through a camera module, to song the moves at the right life. Digital pictures to estimate soil wet of six soils in [5]. Soil classification and characterization victimisation laptop vision and detector network approaches. In our analysis paper six sorts of soil is taken into account and BPNN is employed to classify and characterize the soil. The author think about HSV color area for determine the wet. The most finding on this analysis is physical feature vector like texture and color isn't adequate classify and characterize the wet levels. Therefore on increase the performance detector is employed. From the experiment eighty nine.7 nothing accuracy is achieved.

### Proposed System

The main component of this system is microcontroller. The Node MCU with ESP32 Wi-Fi shield is the micro - controller, sensors like PH sensor, NPK sensor, temperature and humidity, soil moisture sensor are used for the proposed system. The proposed work proffers low cost and trouble free to manipulate. The data is collected from sensors and it is uploaded to Thingspeak cloud and by using data the graph is drawn and based on the ph value we can determine the suitable crops needed for particular soil type then with the help of NPK sensor we can analyze the the NPK values and suggest the farmer that how much of fertilizer is needed for particular crop .We can make use of this system in multiple purposes by connecting different devices like, water pump and we can control it by using our mobile phone with internet connectivity. The microcontroller used for this system is Node MCU(ESP32) WiFi module and the various types of sensors

1. Soil moisture sensor
2. Temperature and humidity sensor
3. PH sensor
4. NPK sensor

The system is low power consuming and easy to operate. The data is monitored with accurate date and time. The system is designed in such a way that we can communicate with our proposed system in real time and give suggestions to the farmers at any time.

### Node MCU (ESP32WiFi module)

ESP32 is a series of low-value, low- power gadget on a chip micro controllers with incorporated Wi-Fi and twin-mode Bluetooth. It is an integrated version of the popular Esp8266 WiFi system on a chip that operates first on a system. The Esp8266 EX is integrated with a 32-bit Tensilica processor standard digital peripheral interface, antenna, switches, RF balun, power amplifiers, filters and power management modules. It achieves extra low power consumption and reaches a clock speed of 160MHZ. It has power saving architecture with three modes of operation, sleep mode, active mode and deep sleep mode. The real time operating system (RTOS) and WiFi stack about 80% of the processing power to be available for user application programming and development

### Soil Moisture Sensor

A soil pH sensor is a gadget that actions the ongoing pH of the dirt. It distinguishes the pH worth of the dirt by embedding two treated steel tests upward into the dirt. The pH scale goes from 0 - 14 with 0 being incredibly acidic, 7 being unbiased and 14 being basic. The sensor has an IP68 defensive case and is fixed with High-thickness epoxy gum which can keep dampness from entering the bodies inside part. The Soil PH Sensor has 4 pins as need might arise to be associated with RS485 or MAX485 Module. The four hued wires are Yellow, Blue, Black, and Brown. The sensor is reasonable for Suitable for horticultural development, modern creation, nature observing, creature farming, and sewage treatment.

### Temperature and humidity sensor

The DHT11 is associate degree ultra-low-cost and basic digital temperature and wetness sensing element. It uses a semiconductor device to live the encompassing air, an electrical phenomenon wetness sensing element and spits out



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a digital pin. This sensing element is straightforward to use, however needs a while to grab the information. Draw back of the DHT11 sensing element is for each two seconds only we will get new information from it, shown we tend to mistreatment the libraries, readings of sensing element are often up to two seconds recent.

**PH sensor**

The soil hydrogen ion concentration sensing element may be a device that measures this hydrogen ion concentration of the soil. It detects the hydrogen ion concentration worth of the soil by inserting 2 chrome steel probes vertically into the soil. Soil hydrogen ion concentration refers to this hydrogen ion concentration of the soil that plays associate degree crucial role within the growth of plants. Plants will grow usually during a big selection, however varied plants have their appropriate hydrogen ion concentration. Cheap management of the soil hydrogen ion concentration worth is contributively to the healthy growth of crops. The soil sensing element has high accuracy, quick measure speed, stable output, and may be wide utilized in varied soils.

**NPK sensor**

The soil supplement content are often handily calculable utilizing NPK Soil sensing element and Arduino. Estimation of soil content N (nitrogen), P (phosphorus), and K (potassium) is vital to make a decision what proportion further supplement content is to be additional to soil to increment crop maturity. The dirt maturity is distinguished utilizing NPK sensors. a big a part of soil manure is element, phosphorus, and metal. The data on the dirt supplement focus will assist USA with sorting out concerning healthful inadequacy or overflow in soils accustomed embrace plant creation. Soil NPK sensing element may be a smallest expense, speedy responsive, high accuracy, and convenient sensing element that works with Modbus RS485. The advantage of this sensing element over a customary discovery technique is that it offers exceptionally fast estimation and knowledge is deeply precise.

**Block Diagram of the Proposed Work**

The system consists of varied hardware and code tools for soil nutrient analysis and suggestion. The detector measures the soil fertility in terms of N, P, and K. The detector below goes a chemical process once inserted into the soil, that results in a amendment in associate analog deflection voltage. The analog deflection voltage is then born-again into a digital price. The measured values of such voltage deflection ar mapped and N, P, and K values. By exploitation another detector, we have a tendency to conjointly live the hydrogen ion concentration of the soil, thereby we are able to scale back the usage of excess quantity of water that damages the crops. The soil wetness detector is employed to visualize the wetness content of the soil. Currently gathered information from the soil is collected into the ESP32 microcontroller. The microcontroller (ESP32) transmits the info to the issue Speak via Wi- Fi that is ultimately sent to the cloud wherever the info is hold on within the info. Issue Speak info may be a MySQL-based distributed info as a service that delivers aggressive application information. M2multiple databases ar created for storing the perfect detector analog values, and for process intermediate results and these values ar displayed during a multiplatform application. issue Speak is ASCII text file programming written in Ruby which allows purchasers to talk with internet sceptered gadgets. It works with data access, recovery, associated work of data by giving an API to each the gadgets and social organization sites. The system consists of hydrogen ion concentration detector, NPK sensor, wetness detector, Soil wetness detector, Node MCU (Esp32) wireless fidelity protect. during this system the hydrogen ion concentration detector measures the hydrogen ion concentration price of the soil and soil wetness level and if the hydrogen ion concentration price is below seven acidic and on top of seven is basic and price is seven suggests that neutral and it's ideal for several plant supported the hydrogen ion concentration price will able to provide instruction to the farmers that vegetable can provide high productivity in this specific soil. With the assistance of NPK detector we are able to analyze the NPK values and recommend the farmer that what quantity of plant food is required for specific crop. The info scan from detector is send to the IoT Cloud Server (Thingspeak.com). During this cloud server we are able to produce a channel either in public or in camera on that information is displayed with correct time and date. A Temperature, Humidity, soil wetness level graph is drawn in figure 7.



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## RESULT AND ANALYSIS

The outputs from the sensors square measure with success sent through the RS485 module to the ESP32 controller board. This signal is processed within the microcontroller and it's sent to the base of operations cloud and hold on. The device takes regarding 150s to show the right price, till then the worth fluctuates. The hold on knowledge in base of operations is employed to show the soil price within the Mobile Application that is developed victimisation React Native. Victimisation these values, the acceptable plants which might be mature square measure displayed within the application, alongside the fertiliser recommendation. The IoT enabled Soil Testing system, pH price and soil wetness of soil is reliable and capable for observation agricultural parameters. The output is viewed in serial monitor of the Arduino IDE additionally as login to Thingspeak.com Cloud server. The table 1 demonstrates the N (N), metal (K), Prosperous (P) necessities of varied agricultural crops. The nutrition's, pH values and Fertilizers necessities for regarding twenty totally different crops square measure collected. The NPK and pH values square measure at first collected from the soil before planting the crops and also the soil is known as appropriate for the crops. If there's any deviation within the nutrients and also the pH values the suggestions of fertilizers for the crop is sent to the farmers helping the mobile applications.

## CONCLUSION

Soil quality instrument takes readings from soil wetness device, humidness device, PH device and NPK device and store it in an exceedingly cloud server and graph is drawn as per the variations in soil wetness, temperature and humidness level of the soil then the pH and NPK values is given as message to the farmers. The sensors and microcontroller square measure with success interfaced with the cloud. The info is hold on with success and might be accessed remotely. All observations and experimental established proves that this can be an entire answer to check the soil health parameter. User will have access to the info and might understand if there square measure any deviations with reference to pH price and soil wetness. Implementing this technique can enable users like farmers to watch and improve the productivity of the vegetables. The writing is completed by victimisation Arduino IDE, and for storing the device knowledge in cloud server known as Thingspeak.com by victimisation WiFi. This work is extended by adding advanced engineering technologies provided new approaches for soil testing with value effective manner.

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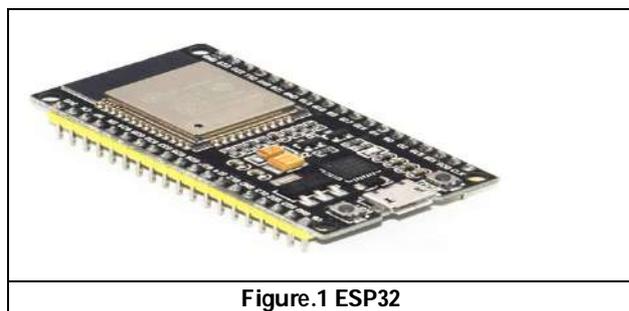


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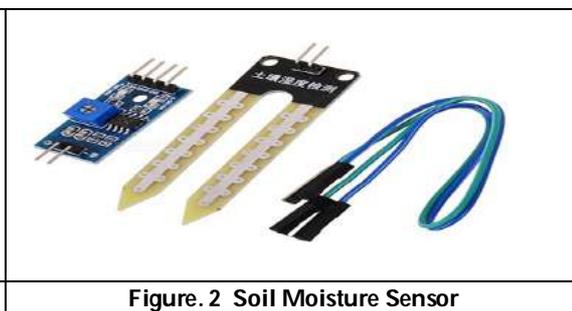
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**Table 1 Nutritions, PH, fertilizers requirements**

| Requirements    | Rice                                     | Tomato                             | Carrot                                 | Onion                              | cabbage                       |
|-----------------|--|------------------------------------|--|------------------------------------|-------------------------------|
| Nitrogen (N)    | 120                                      | 100                                | 100                                    | 100                                | 100                           |
| Potassium (K)   | 160                                      | 178                                | 146                                    | 160                                | 150                           |
| Phosphorous (P) | 25                                       | 25                                 | 10                                     | 18                                 | 18                            |
| PH Value        | 6  | 6.2 – 6.8                          | 6-7                                    | 6.2 – 6.8                          | 6.2 – 6.5                     |
| Fertilizers     | Cow dung, green manure, Ammonium sulfate | Compost, animal manure, Epsom salt | Urban farm fertilizer, herb fertilizer | Ammonium sulphate, Herb fertilizer | Food compost, decaying leaves |



**Figure.1 ESP32**



**Figure. 2 Soil Moisture Sensor**





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Figure. 3 DHT11 Sensor



Figure.4 Soil Hydrogen ion Concentration Sensing Element



Figure.5 Soil NPK sensor

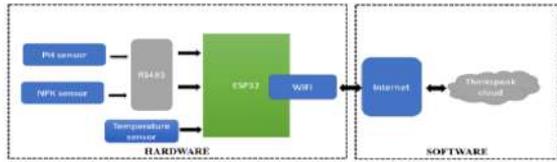


Figure.6 Block diagram

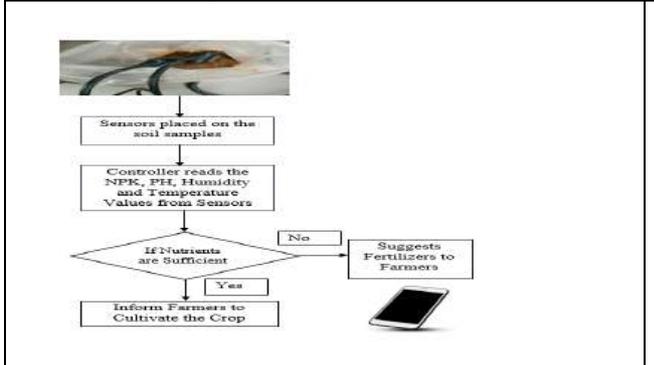


Figure. 7 Flow diagram

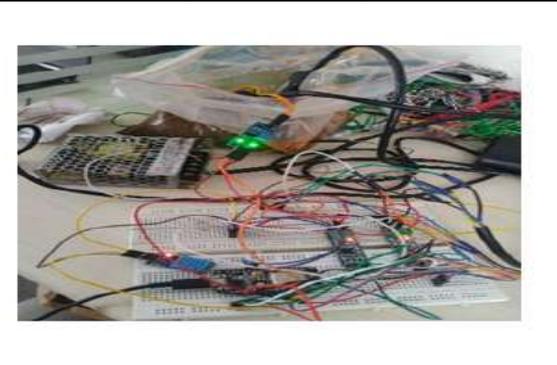


Figure. 8 Hardware Setup



Figure. 9 Temperature readings in Thingspeak



Figure.10 Humidity readings in Thingspeak



Figure.11 PH Values in Thingspeak





## Optimized Ensemble Clustering Technique to Detect the Fake News in Social Media

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### ABSTRACT

There is a rapid increase in the internet usage along with the advent of social media websites like Facebook, Twitter, Instagram led to huge information sharing across the world. But not all the information that is shared on social media platforms is reliable. Fake news costs a lot in terms of people's life and money. Categorizing the particular text as misinformation or disinformation is really a difficult and much needed task. In this paper, we propose a model which uses machine learning techniques like GLoVE word embeddings and advanced ensemble approach like stacking for automatic detection of the fake news articles. Based on different textual properties, we train the system and make the model to learn and evaluate their performance.

**Keywords:** Ensemble approach, Fake news detection, GLoVE, Online fake news, Stacking.

## INTRODUCTION

There is huge information sharing in social media websites witnessed flourishing of news channels. The news channels greatly gained from the universal usage of social media websites and so they can give streamlined news in real time to people. Initially the news channels dispersed the news only through the newspapers and magazines, but the impact of digital form of news like online news platforms, e-papers, blog posts and other digital media formats [1] made the accessibility much easier. This helps the people to get the latest news (both real and fake news) at very fast rate from any corner of the world. News referrals from Facebook accounted for almost 70% of network usage to news portals [2]. The social media websites play a vital role in spreading awareness among people. It allows the users to suggest their ideas and post their views on the various topics like politics, education, science and health etc.

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Not only in the positive means but also the social media websites are used for propagating negative ideas by certain entities commonly for their own economic benefits [3, 4] and in many cases for making opinions favorable for a sector, misinformation and disinformation. This trend of information manipulation is generally called as fake news. Such proliferation of fake articles in the internet and social media websites which broadcasts fake news has led to many issues in politics and also in boarder disputes, riot control, defense sector and sports inc[3]. Another great example of fake news proliferation is seen in case of spread of corona virus and the home remedies which are not accepted by health organizations. This caused misleading to the people. Following the demonetization of Indian currency in 2016, fake news like spying technology in the currency had been shared on various social media websites. And such area affected by fake news is the financial markets, where a rumor can have disastrous consequences and can bring the country's market to a halt. It is evidenced from many financial scams that occur across the world. There are lot of real time examples where people have reacted preposterously to news which is later realized to be fake. As the ratio of fake news increases gradually every day, it automatically impacts the authenticity of the news. So it is important to take a decision to maintain the authenticity of the news posted in social media. In this paper, various features of the news were analyzed including the depth, size, breadth and similarity of true and false articles. Mostly the previously done literature had used specific datasets especially political domain datasets. In our system, we use both supervised and unsupervised learning algorithm. This helps to detect the fake articles from any domain. We used GLoVe word embedding for feature extraction and machine learning advanced ensemble method. This advanced ensemble method such that stacking helps to reduce error rate. Also it enables the training phase of the model much efficient.

## Literature Survey

Various computational techniques are used to detect the reliability of the news content. This includes websites like "Politifact", "Snopes" and "The Quint" etc. which check the reliability of the facts. Similarly there exist a huge number of databases created and maintained by researchers and domain experts to categorize the list of fake websites [5]. But the problem is the specification of domains in that websites, mainly politics excluding other domains like sports, science and technology. S.Vosoughi et al. [6] analyzed the spreading of fake news article in comparison with true news on the internet and social media platforms based on diffusion. Ahmed et al. [7] involved the extraction of textual features such as n-grams from text and to train different Machine learning models. It included the study of the effect of n-grams size on total performance. I used various value of n like n=1 (unigram), n=2 (bigram), etc. The models used here are K- Nearest Neighbor (KNN) which depends on the similarities between the words, Support Vector Machine (SVM) which is based on the hyper plane, Logistic Regression (LR) to determine the target value. But the drawback is that when the number of n in n-grams increased, then the overall accuracy decreased. Shu et al. [8] acquired better accuracies by the combination of the features such as linguistic with auxiliary information like user social activity on social media platforms and the trueness of the previous text shared by them. They used various data mining algorithms for features extraction. Primarily we focus on network analyses and linguistic approach. Wang et al. [9] analyzed various textual features and used metadata for training machine learning models.

The neural network used Soft max activation function for the processing the input text and to estimate the fake article. The auto tuning of the hyper parameter is done using grid search. The study by Riedel et al. [10] used stance detection system assigning four labels and term frequency for extracting linguistic properties. Four labels used are agree, disagree, discuss and unrelated. The classification is done by the technique called Multilayer Perceptron Classifier (MLP). Iftikhar Ahmad et al. [11] used different machine learning algorithm using ensemble methods like Bagging and Boosting along with the Voting Classifier. The Voting classifier has three learning models including Logistic Regression (LR), Naïve bayes and KNN models. The Bagging algorithm used 100 decision trees and Boosting is done using XGBoost and AdaBoost. Rishibha Sharma et al., [12] used machine learning algorithms like Global Vectors for Word Representation for word embedding and extracting the linguistic feature and LSTM neuralnetwork for the classification to detect the real and fake news articles. The system is based on theco-occurrence of the word and word frequencies.





## PROPOSED SYSTEM

In our proposed system which is shown in Figure 1, we are aggregating the efficiency of fake news detection by introducing an advanced ensemble technique like stacking along with many linguistic feature sets extracted using GLoVe to detect the reliability and authenticity of the news. Also it classifies as true article or fake article. The novelty of our proposed system is the use of ensemble technique like stacking along with GLoVe. The dataset used in this research are available online and can be extracted from the internet. The steps involved in the proposed system are given below.

Step 1: Data cleaning and Exploration phase

- Filter the article's unwanted variables like author name, date, URL and category.
- Remove the article with no subject / article having less than 25 words.
- Remove the stop words like "is", "are", "that" etc. which creates noise to the input data.

Step 2: Extraction of linguistic features using GLoVe

- Represent the textual characteristics into numerical value (vector format).
- Obtain the relationship between the similar words and determine the co-occurrence of the words.

Step 3: Create the model using advanced ensemble techniques

- Split the entire data into training and testing and further split the train data into 10 stacks.
- Group the 10 stacks into 2 groups and use 2 different voting classifiers.
- Create the base models using voting classifier algorithms.
- The first voting classifier has 2 learning models :
  - i. Logistic Regression
  - ii. Random Forest
- The second voting classifier has 2 learning models :
  - i. Linear SVM
  - ii. K Nearest Neighbor
- From these 2 base models, predict the final Meta model.
- Train the model
- Detecting whether the news article is fake or not using testing data.

The below figure 1 illustrates the proposed model

## ALGORITHMS USED IN THE SURVEY

### Data cleaning and exploration

The process of presetting or removing incorrect, corrupted, inappropriately configured, duplicate, or incomplete data within a data file is known as data cleaning. It is the first step involved in the data analysis. Usually the data repetition and replication can be identified with this process. Also the existence of null values if any can be tracked easily and removed for achieving better accuracy. The completeness of the data, correctness of the data are ensured. It includes both manual as well as automated tools. Manually it is done using data analysis and automated tools like Trifacta, Qlikview etc.,

### Global Vectors for Word Representation (GLoVe):

GLoVe is an unsupervised learning algorithm which is used for getting vector representations for the words (mathematical expressions for the words). Training of the system involves on the agglomerated global word-word co-occurrence on the data. The linear substructures of the word in vector space are represented in the resulted embeddings.





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### Advanced ensemble technique

The process of combining and using multiple models including classifiers or experts to generate strategically suitable solution to solve the intelligence problems is known as advanced ensemble method. It is specifically used to improve the (classification, prediction, function approximation, etc.) overall performance of the system, or to reduce the possibilities of choosing a poor model

### Stacking

Stacked generalization or stacking is a type of advanced ensemble techniques. The system is trained by combining the previous model predictions. In the stacking, the trained data is divided into different stacks (smallest data sets). Each stack is processed using different models. All of these models are called base models and from these predictions, we generate a final model. It is illustrated in the following figure 6.

### Voting classifier

The machine learning model which trains the ensemble of various algorithms and chooses the optimal methods to get the better model is known as voting classifier. It usually employs multiple classifiers to achieve high accuracy in prediction. A voting ensemble involves summing the predictions made by various classification models or averaging the predictions made by some of the regression models.

## RESULT AND ANALYSIS

The results were represented in the below mentioned graphs. Initially we used the individual algorithm and then used voting classifiers which gave accuracies better than individual algorithm. In the similar way, we included advanced ensemble method, stacking into the system which could produce better accuracies. The accuracy achieved by the individual algorithms and the voting classifiers which are using combination of algorithms before the stacking of the input data is represented in the below figure8. From this figures, we can assume that using voting classifiers could get better results. We have used two voting classifiers which combined algorithms namely Logistics Regression and Random Forest and Linear SVM and K-Nearest neighbor can produce accuracy rate of 92% and 80% respectively. Then we used the stacking method for the training data and compute a final model based on the individual base models. Here we can achieve accuracy rate which is better as compared to non stacked inputs. It is estimated that the using the voting classifier1 (LR, RF) on the stacked input data get the accuracy rate of 94% and using voting classifier2 (LSVM, KNN) on the stacked input data get the accuracy rate of 82%. It is represented in the figure9. Thus the simple algorithm could be effectively used to achieve better models by the advanced ensemble machine learning technique. Similarly the voting classifier can be used for any type of learning algorithms.

## CONCLUSION

In order to classify the news article based on their reliability requires a deep knowledge about the domain and also there is need for the experts to identify the inappropriate news articles. Around 65% of US adult population depends on the social media platforms for daily news update. Similarly the growth of social media platforms in the developing countries has been evidenced in the recent years. So the news on the digital platforms played an important role in designing people ideas and decision making. In this paper, we had implemented machine learning techniques to classify the news articles as real or fake from various domains. The process initially involves the data cleaning and extracting the linguistic features. This feature set is used as the feed to the model and the model is trained using advanced ensemble technique like stacking. In order to classify the news article based on their reliability requires a deep knowledge about the domain and also there is need for the experts to identify the inappropriate news articles. Around 65% of US adult population depends on the social media platforms for daily news update. Similarly the growth of social media platforms in the developing countries has been evidenced in the recent years. So the news on the digital platforms played an important role in designing people ideas and decision making. In this paper, we had implemented machine learning techniques to classify the news articles as real or fake



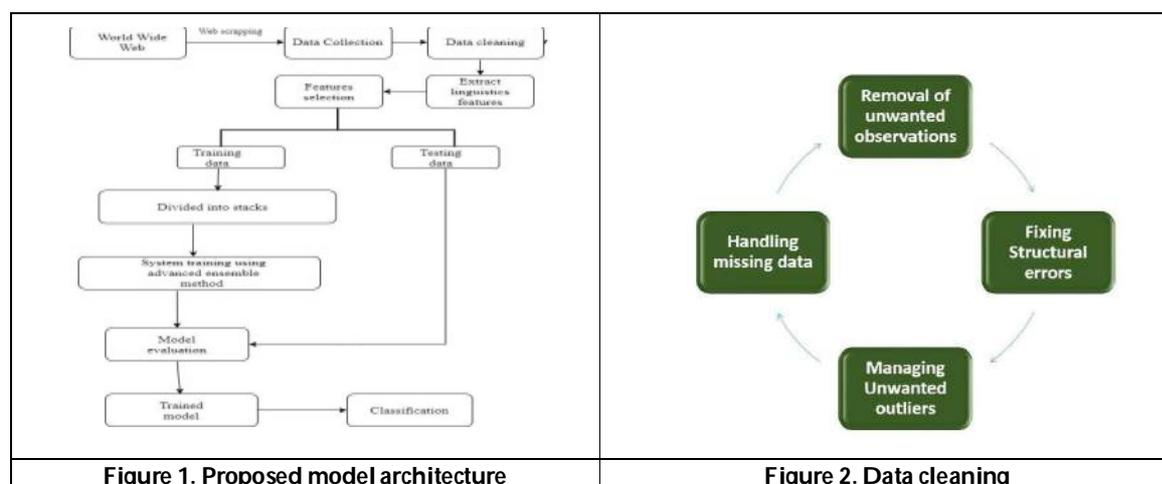


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from various domains. The process initially involves the data cleaning and extracting the linguistic features. This feature set is used as the feed to the model and the model is trained using advanced ensemble technique like stacking. We can thereby achieve the higher accuracy and better score on the performance metrics. We used the base models as the feed to compute the final Meta model. We can thereby achieve the higher accuracy and better score on the performance metrics. Fake news detection is a developing research area with only few numbers of datasets which are available in the open environment. We make use of our proposed system on an existing dataset. From the performance of our system, it is evidenced that the performance of our system outperforms the other approaches which are published by the different authors. In the future, we can further increase the accuracy rate by using different leaning methods in the used voting classifiers.

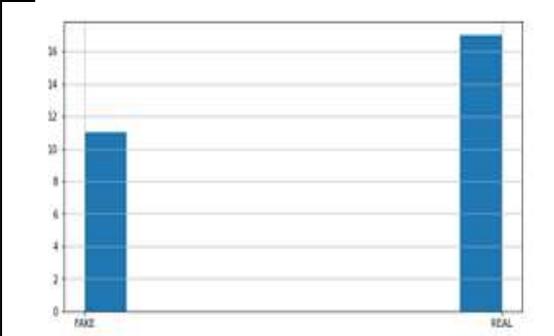
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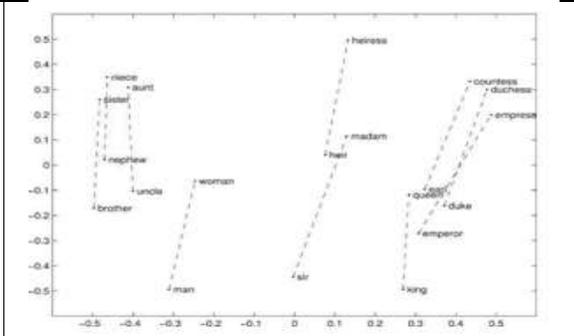




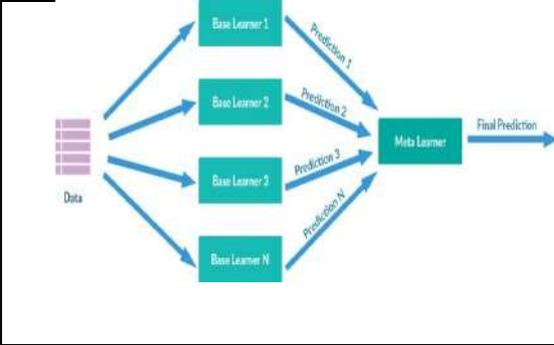
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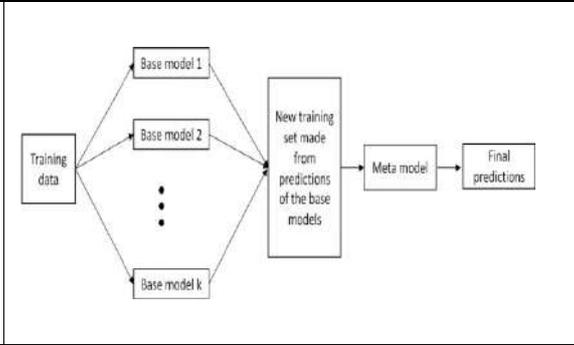
**Figure 3. Data exploration of sample data**



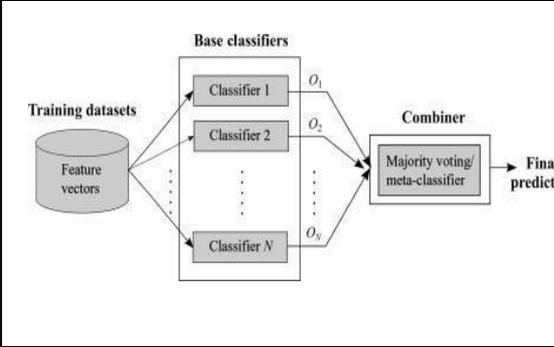
**Figure 4. Linear substructures of the word**



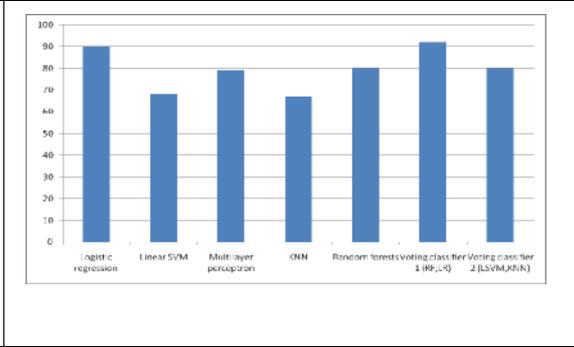
**Figure 5. Advanced ensemble method**



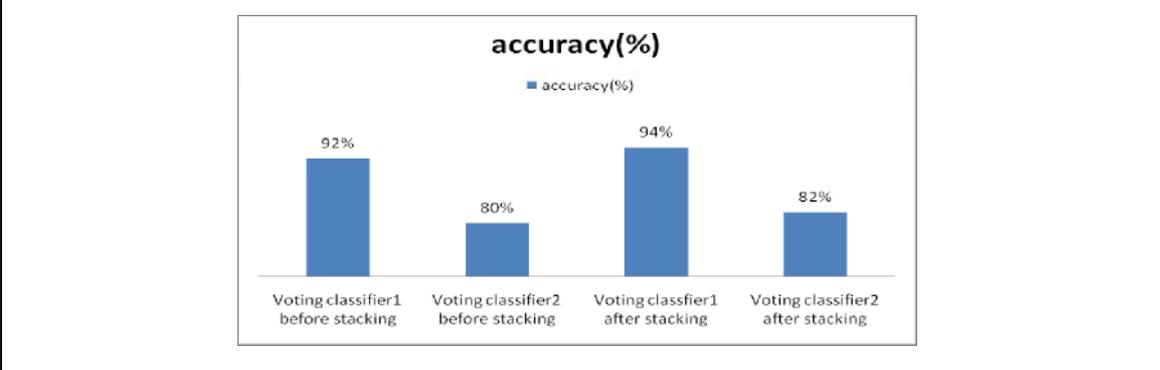
**Figure 6. Stacking**



**Figure 7. Voting classifier**



**Figure 8: Accuracy percentage of different algorithm.**



**Figure 9. Accuracy after stacking**





## Heart Disease Prediction using Probabilistic Neural Network Classifier

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### ABSTRACT

Heart disease is one of the major diseases and many people suffered due to this heart disease. Identification of heart disease plays a vital role in health-care system. In this paper we implement an efficient and accurate method to identify heart disease which is based on machine learning algorithms. Heart disease is a significant strain on the health-care system. The proposed model is developed based on classification algorithms which includes PNN and Optimization Algorithms. As a result, existing problems were addressed, and solutions to those problems were provided and implemented with the help of patients attributes like age, sex, glucose level, blood pressure and blood sugar. Based on these attributes we can predict the likelihood of patients getting a heart disease. At the end of our experiment accurate result is shown which is improved over traditional classification techniques. An efficient proposed model has been developed for diagnosing heart disease. Machine learning classifiers include PNN and Optimization Algorithms are used in the designing of the system.

**Keywords:** Optimization Algorithms, blood pressure, heart disease, major diseases

## INTRODUCTION

The human heart is said to be a complicated body organ that contains muscles as well as biological nerves. Nearly 60-80 times every minute, the human heart beats. The functioning of human heart is complex and any failure can put people's lives in risk. As a result, heart diagnosis systems have been a major focus of scientific research in recent decades. Further more, advanced heart disease diagnosis equipment will not be available always in every medical facility centres, especially in rural areas where support and treatment are few. During the pandemic situations people cannot travel to regional medical centres where high quality hospital services are affordable. As a result, medical errors and outcomes are the reason for a need of system based diagnoses, which may reduce medical deadly errors, improve patient safety, and save people's life. The causes of cardiac arrest, their consequences, and treatment



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options have all been considered in this study. An intelligent system has been implemented for diagnosing heart disease. This technique will prevent misdiagnosis, which is the most common mistake made by doctors. The heart disease dataset has been used which contains patients details. This dataset is obtained from the UCI repository. In general, a dataset is split into two sections: one for testing and the other for training. The proposed work primarily concerned with two issues: Firstly, we try to address the problem by using pre-processing techniques and then apply the effective training and testing method of the classifiers which is used to identify the result. This algorithms and classifiers provide good result in terms of accuracy and computation time. Secondly, we introduce optimization algorithm and the PNN Algorithm, which is then given as input for classifiers to improve prediction accuracy and decrease computation time.

**Literature Survey**

**Title:** Relief-based feature selection: Introduction and review

**Year:** 2018

**Author:** J. Biomed. Informat

**Methodology**

Without evaluating paired combinations, RBAs can find interactions. RBAs that are iterative have been designed in order to scale up to very large feature spaces. The difficulty and computational cost placed on modelling methodologies grows as a result.

**Title:** A systematic literature review and classification of knowledge discovery in traditional medicine

**Year:** 2019

**Author:** Int. J. Recent Technol. Eng

**Methodology**

This study looked at 5 databases and 502 publications to see if they were relevant to the use of machine learning in conventional medicine.

**Title:** The Heart Failure Epidemic

**Year:** 2010

**Author:** Medicographia

**Methodology**

Heart failure has been identified as a developing pandemic, possibly as a result of increased incidence and/or survival, resulting in an increase in prevalence. This paper focus on minimising the burden of heart failure hospitalizations.

**EXISTING SYSTEM**

The existing model used different machine learning algorithms for heart disease identification. The algorithms like Relief, MRMR, LASSO, and LLBFS are used as features selection methods. The proposed FCMIM algorithm was used to evaluate the system's performance based on the specified feature sets. The LOSO cross-validation technique was also used for best model evaluation.

**DISADVANTAGES**

- ✓ It takes more time consumption.
- ✓ Less Prediction Accuracy.
- ✓ Theoretical Limits

**PROPOSED SYSTEM**

The proposed work makes an attempt to detect heart disease at early stage. In this paper we used PNN and Optimization Algorithms. This metric is used to rank the attributes and to prune irrelevant, redundant attributes. By using this PNN method, the possibility of occurring misclassification is minimized. Initially load and pre-process the





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dataset. Once dataset is loaded and pre-processed apply PNN classification algorithm to get a better result. After implanting PNN algorithm, use fruit fly optimization technique to get efficient and accurate output. The overall classification and forecast will be used to create the Final Result. Some measures are used to calculate the performance of this proposed approach, including as,

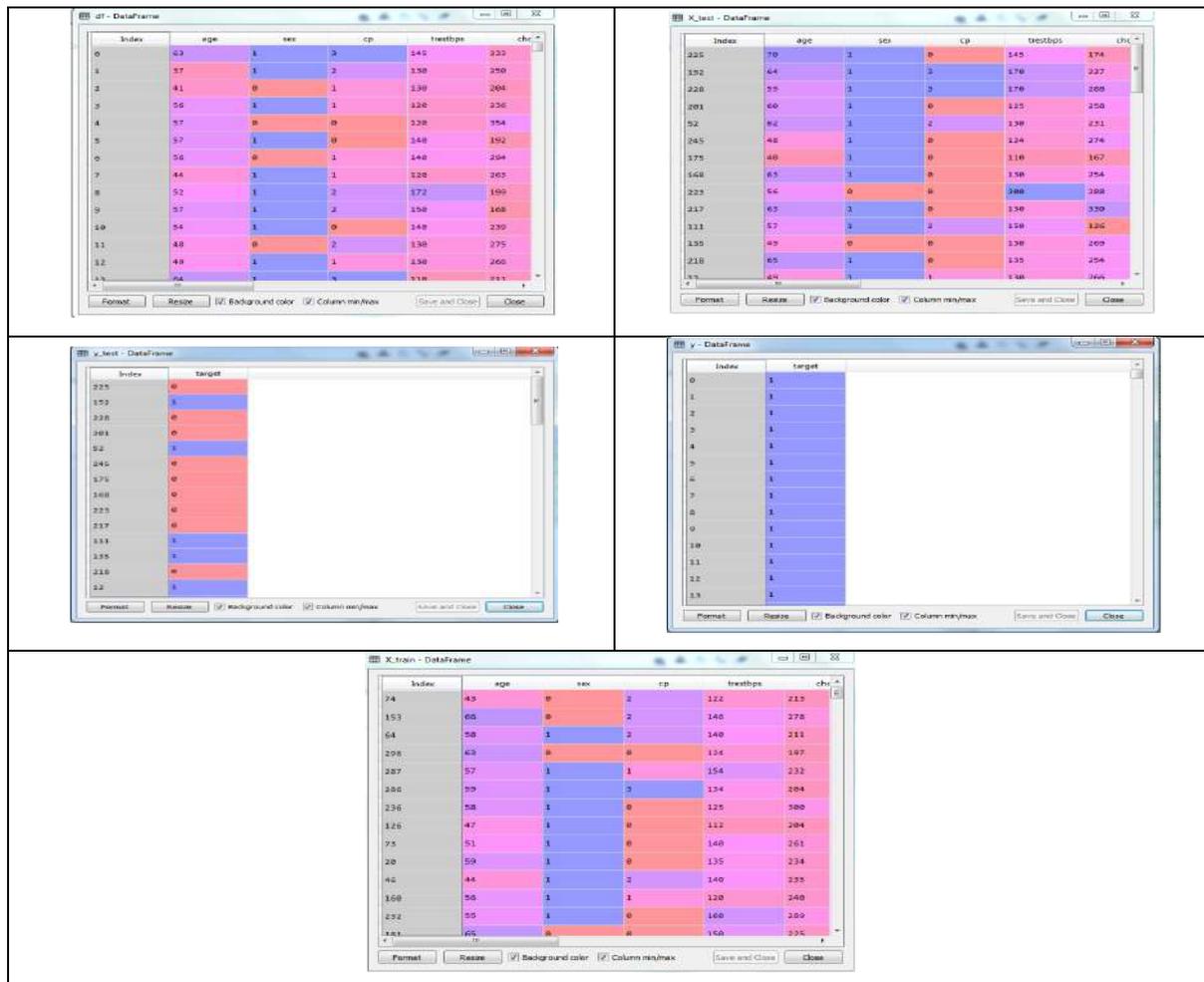
- Accuracy
- Precision
- Recall
- F-Measure

This system is feasible and faster and more accurate for diagnosis of heart disease.

**Advantages**

1. High precision
2. Independent from prior assumptions about the distribution of the data.
3. Noise tolerance.
4. Ease of Maintenance

**RESULT**





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**OUTPUT**

Fruit Fly Optimization:

BFFA

Algorithm:

best\_genbest\_valnumber\_of\_dim

100% | ██████████ | 50/50 [12:26<00:00, 16.19s/it]

7936

BFFA:

1110010111010110011111111111 0.855 23

100% | ██████████ | 50/50 [11:12<00:00, 12.82s/it]

7885

BFFA:

010101110110010101011101010111 0.86 18

100% | ██████████ | 50/50 [10:59<00:00, 13.04s/it]

8026

BFFA: 01100000011111111011011011110 0.865 19

695.4161167144775

100% | ██████████ | 50/50 [11:01<00:00, 13.03s/it]

7859

BFFA\_M: 011110101000110001111110111101 0.855 19

100% | ██████████ | 50/50 [11:05<00:00, 13.15s/it]

7658

BFFA\_M: 111010110111111111111111111111 0.84 27

100% | ██████████ | 50/50 [11:57<00:00, 12.73s/it]

7955

BFFA\_M: 01111111111001111111101111111 0.855 26

683.6583511034647

PNN (Table 1.)

**Accuracy**

The Accuracy Score: 81.9672131147541

**CONCLUSION**

This paper proposed a PNN classification algorithm along with Fruit fly optimization technique which gives the accuracy of 81.967. Compared to existing system this model gives the efficient and high accuracy.

**FUTURE WORK**

In the future, intelligent agents could be used to add extensions or modifications to the suggested clustering and classification methods, resulting in even better performance. Aside from the machine learning algorithms that have been tested, other techniques such as artificial intelligence, soft computing, and other clustering algorithms can be utilised to increase accuracy.





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**Table: 1. PNN**

| Precision    |      | Recall | F1-score | Support |
|--------------|------|--------|----------|---------|
| False        | 0.7  | 0.86   | 0.78     | 22      |
| True         | 0.91 | 0.79   | 0.85     | 39      |
| micro avg    | 0.82 | 0.82   | 0.82     | 61      |
| macro avg    | 0.81 | 0.83   | 0.81     | 61      |
| weighted avg | 0.84 | 0.82   | 0.82     | 61      |





## Machine Learning Based Epilepsy Detection using EEG Data

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### ABSTRACT

Due to the fact that most seizures in persons with epilepsy occur seldom, it is critical for the classification and diagnosis of epilepsy that the EEG be used. When it comes to adult patients, empirical interpretation of a first EEG is quite insensitive, with sensitivities between 29 and 55% [29–55 percent]. During seizure-free EEG epochs, useful EEG data is buried within the signals, out of reach of any specialised physician in this area who is trained in EEG analysis. We develop a multi-variate strategy to understand the functional connectivity of the brain at the sensor level using EEG data in order to identify individuals with generalized epilepsy, in contrast to the majority of previous studies. Eight different connection characteristics were examined using five different measures across the temporal, periodic, and time-frequency domains. After evaluating the solution using the K-Nearest Neighbour approach, the results were compared to an epilepsy group, and subsequently to a group of patients who had non-epileptic episodes. Classification accuracy (89%) was achieved for EG and HC, however substantial spatial-temporal deficits in the front central areas in the beta frequency band were found in the EG group compared to the HC group. Because of the well-documented coexistence of NEAD and epileptic episodes, the classification accuracy for EG and NEAD was only around 79%. People with specialised epilepsy may be consistently distinguished from those with HC using seizure-free EEG data, according



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to this research. Although additional study is required in this area to establish a diagnostic tool that is therapeutically helpful,

**Keywords:** Epilepsy, EEG, Machine Learning, Health care, K-Nearest Neighbour

## INTRODUCTION

Epileptic seizure identification research began in the 1970s, and different approaches to this topic have been given. The time-domain technique described by Liu et al. seeks for regular, time signatures in EEG comparable to those seen since movement disorders. The authors used EEG autocorrelation to produce a measure of pacemaker cells [1]. Seizure identification with in frequency response is based on variations in the frequency-domain characteristics of regular and transient EEGs [2]. Because the EEG is non-stationary by nature, time–frequency domain techniques such as wavelet transforms (WT) [3] are best suited because they do not enforce the quasi-stationarity condition on the information like time- and bandwidth approaches. WT gives both temporal and frequency perspectives of a signal at the same time, allowing it to reliably capture and locate transitory elements in data such as seizure spikes. Nonlinear measurements of time series complexity include correlation dimension (CD), maximum Lyapunov exponent (LLE), and ApEn[4]. These measurements aid in understanding EEG dynamics and the original chaos in brain signals [5]. ApEn is just a statistical measure that is commonly utilised in physiological features extraction, such as estimating consistency in epileptic fit data sets [6]. Diambra et demonstrated that the ApEn level lowers dramatically throughout epileptic operations due to its synchronised firing of large neurones. As a result, it is an appropriate characteristic for characterising EEGs. Employed CD to describe interictal EEG for seizure forecast and discovered that CD scores estimated from epileptic EEG data are much lower again for lesion than other parts of the brain [7].

In the last twenty years, artificial neural networks (ANN) have frequently used to categorise EEG data [12–14]. A number of alternative ANN-based techniques for epileptic seizure identification have been reported in the literature [8] employed wavelet transform to capture distinctive aspects of EEG data, which they then integrated with ANN to get a satisfactory arrangement result. Nigam and colleagues. [9] Developed a technique for automatically detecting epileptic seizures from EEG recordings by employing a multistage regressive pre-processing filter to extract two features: relative spike amplitude and spike occurrence frequency. These characteristics were put into an artificial neural network for diagnosis. [10] Employed short-time fourier transform analysis of EEG data to extract factor based on the pseudo-Wigner–Ville and smoothed-pseudo-Wigner–Ville distributions, which they then fed into an ANN for classification. For patients with epilepsy, seizure detection may help to better document seizures, which is an important marker for how severe the condition is. This, in turn, could help to distinguish between seizures and other types of events like psychogenic non-epileptic seizures [11]. SUDEP (sudden unexpected death in epilepsy) may be prevented if seizures are detected and alarms are set off. It is impossible to manually analyse long-term digital information such as subcutaneously implanted electroencephalography (EEG) hence automatic seizure identification is particularly significant in these cases. Though, smaller exploratory investigations are needed to examine the effectiveness and practicality of seizure detection devices and algorithms before larger multi-centre clinical validation studies can be conducted with many patients and seizures. A mixture of ECG, ACM, and behind-the-ear EEG for nonstop offline seizure recognition is the focus of this work.

### Background

#### Pre-processing of Data

For all bipolar channels, normalised has to be done on every segment between range from -1 to 1 for each of the four bipolar channels. This phase was carried out only for the purpose of visualisation at the beginning of this study in order to look for any potential artefacts. It has no effect on any of the connection measurements presented in this research [12]. For the purpose of representing the functional connectivity of the brain between two EEG signals  $x_i$  and





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$y_i$ , this study develops five distinct dealings in the time, frequency, and time-frequency fields. These measurements, along with their extensions, are then used to generate classification features.

#### Mutual Information

This measure of mutual reliance between 2 signals, i.e., amount of data is transferred between them, is referred to as Mutual Information (MI). It is created on the entropy and probability function of this situation. Entropy is defined as the amount of variation in a signal X throughout its length n as shown in Eq. (1).

$$G(x) = \sum_{i=1}^j p(x_i) \log p(x_i) \quad (1)$$

#### Correlation

As the name implies, this well-known metric illustrates how two signals are linked with one another when there is a temporal shift between the two signals. The cross-correlation coefficients utilised in this investigation were computed using the following formula in Eq. (2)

$$H_{xy}[n] = \frac{\sum_{l=-\infty}^{\infty} x[l] + y[l+1]}{\sqrt{\sum_{l=-\infty}^{\infty} x[l]^2} * \sqrt{\sum_{l=-\infty}^{\infty} y[l+1]^2}} \quad (2)$$

The properties of the cross correlation that are extracted: the greatest correlation value, the mean correlation value, and the correlation lag when the maximum correlation value is obtained. The properties must be noted that while computing the correlation's highest value and correlation's approximation is also considered. This is because two EEG signals may potentially be negatively correlated with one another.

#### Detection of seizures processing and characteristics of EEG data

An EEGLAB toolbox and scripts were utilised to input data into EEGLAB. The cross channel between the two ears and the channels from the left and right ears were both used as references. The data is segmented into two-epochs were the frequency ranges that were culled from the signal. MATLAB's spectrum analyser function and a short-time Fourier transform were used to create the time-frequency-power graphs for the visuals. A finite impulse response band pass filter with a 1–70 Hz frequency range and a 50 Hz frequency range stop filter were used for time-domain visualisations of the unsegmented EEG. The technique used to compute the variance has been previously explained. To ensure that the plots were devoid of artefacts and stereotyped seizures, they were carefully selected.

#### Using Support vector Machine

A patient-specific SVM classifier is trained on each patient separately and exclusively on affected role with at least six verified seizures. The classifier utilised all seizures since these individuals, regardless of signal quality or ictal changes shown in the data. Classification was done using an SVM with radial common function kernel. To adjust for class imbalance, the Synthetic Minority Oversampling Method[1] was used with three resampling rounds. The classifier was running separately with all modes, EEG & ACM, EEG & ACM, and simply EEG. Everyone's features are resampled. Each patient's data was divided into folds, one for each seizure, with fold borders corresponding to the centre point between them. Each fold included confiscation and non-seizure data. After creating a random seed for repeatability, the algorithm is skilled on one-fold fewer folds than the total amount. The other fold was used as a trial run. " Seizures and non-seizures were predicted by the classifier for each sample from the 1's windows. A single sample was foreseen to be either "seizure" or "non-seizure" while the previous and subsequent samples were anticipated to be the other. A smallest seizure duration (MSD) criterion was established once each seizure or non-seizure sample was found. To limit sensitivity and reduce FAR, we raised the MSD threshold value. In the process of obtaining the classifier's Receiver Operating Characteristic (ROC), it ranged from 5 to 60 seconds (in 5 second increments). To prevent numerous alarms for the same event, a 2-minute refractory delay was imposed after each positive detection. To accommodate for modest synchronisation errors, a projected seizure was judged accurate if it





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occurred in 50 s of the EEG onset-offset period. The classifier's sensitivity and false detection rates (FAR) were calculated for each test fold and averaged across all test folds weighted by its durations.

## EXPERIMENTAL RESULTS

The study comprised 40 patients (23 male, ages 19–77, median 43). One focal to bilateral generalised tonic-clonic seizure was documented from one sick person while in the EMU. SVM was assigned to three people who had more than five seizures. (Enobio 73 percent range: 25–100%; TrackIT 99.6% range: 93–100%). Fig. 1 depicts patient recording time. Technical issues caused the majority of closed-ear EEG loss. Technical issues lost ECG data for two non-seizures. 57 seizures were lost due to battery exhaustion, but the ECG gadget caught ACM in all seven. So the SENS ACM data was left out. All patients completed the desired monitoring time.

### Nonmotor focal seizures

Seizures begin in the temporal lobe, median duration 53 s (range 42–73 s). There were lip smacking and gazing as well as oral automatisms. The patient was conscious of four of five awoken seizures. The patient experienced an actual rise in HR, 110 BPM median peak HR, 93–121 BPM range, and significant alterations in HRV, as seen in Fig. 2 and Fig. 3, indicating potential seizure episodes and incidence of seizure patients admitted.

## RESULTS OF SVM CLASSIFICATION

The three patients' RCCs were drawn for threshold values of MSD parameters (6–60 s). First epilepsy patient within nonmotor focal seizures (patient 3) had 100% sensitivity and the EEG/ECG combo has the best sensitivity across most MSD levels. A signal indicates a seizure. HRV vary in synchronisation through seizures. Notably, most non-ictal variance or HRV oscillations are not coordinated. Fig. 4 shows patient record in 19-hour period and some seizures display movement on accelerometry. Time-domain representation of a seizure. Time-domain graphs from patient 19 through EEG (channel: T9-T10) from an epilepsy monitoring device during the same event. The pulse rate increases from 50 BPM to 100 BPM 15 seconds after the episode ends. Patient 4 experienced nine focal nonmotor seizures. EEG and ECG with a 40 s minimum seizure length threshold recognised all seizures with a 13/24 false alarm rate. Fig. 5 shows ROC signal of the personalised automated seizure detection system with a 25 s threshold gave 84% understanding and a FAR of 8/24 h. No motor seizures in patient 26. EEG and ECG with a 35 s MSD threshold found all 5/24 h FAR seizures. In certain circumstances, two MSD thresholds provided equivalent or overlapping sensitivity and FAR.

## CONCLUSION

This article investigated the efficacy of a specialised multimodal seizure detection technique that could be used both automatically and manually to examine the data. The performance of an proposed automated seizure detection using SVM based procedure employing various multi-modal combinations within ACCM, ECG, and EEG was superior to that of a uni-modal EEG method when compared to the uni-modal EEG. EEG and ECG derived characteristics may be used to augment manual data evaluation of recordings by giving an outline of seizure suspect epochs within the previously recorded data, which can be helpful in identifying seizure suspicious epochs within the recorded data.

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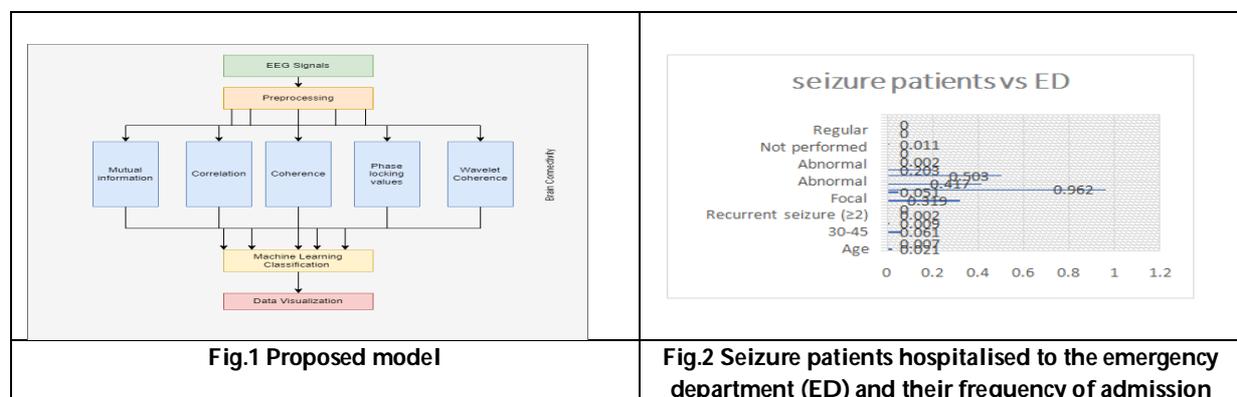


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**Table 1 Various parameters of analysing EEG**

| Variables | Predicting models                  | $P^2$ | $hf_{mod}$ | $hf_{res}$ | M    | Q      | $\Delta Z^2$ |
|-----------|------------------------------------|-------|------------|------------|------|--------|--------------|
| Step 1    | Education, age, epilepsy duration, | 0.42  | 4          | 39         | 6.93 | <0.001 | 0.41         |
| Step 2    | Picture naming                     | 0.52  | 1          | 38         | 8.21 | 0.006  | 0.10         |
| Step 3    | Education, AED number              | 0.56  | 1          | 37         | 3.41 | 0.058  | 0.04         |





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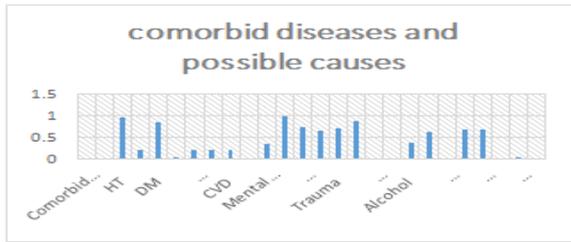


Fig 3 :The incidence of seizure patients admitted to the ED and their concomitant conditions.

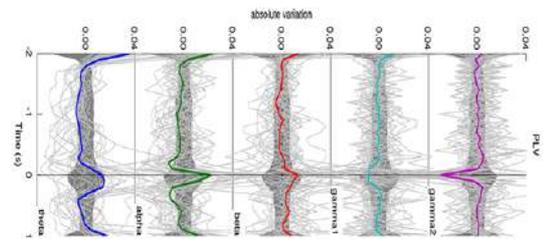


Fig 4: Patient 18 had 11 focal tonic seizures in a 19-hour period

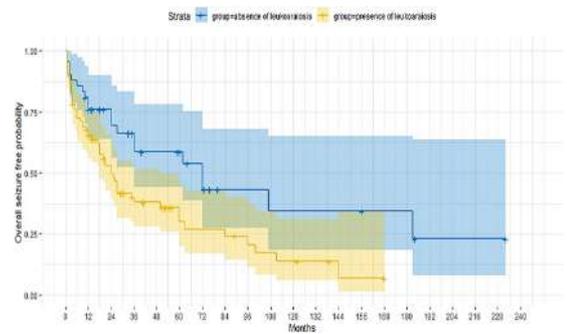
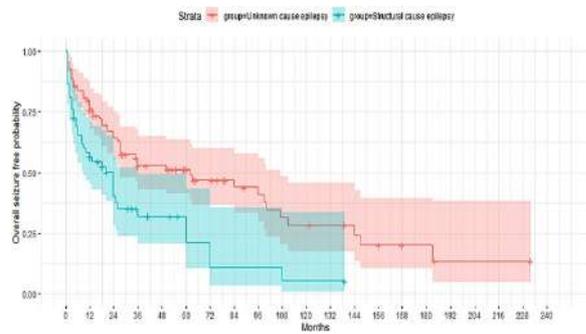


Fig. 5 ROC signal of the personalised automated seizure detection system.





## Prediction of Gas Leakage Detection System using Arduino with IFTTT

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### ABSTRACT

In our everyday lives, one of the active shielder approaches is to discover the state of matter Outpouring and excrete gas before it gets lighted. Smart gas outflow sensing elements are configured and enforced to notice gas levels and if the existence of gas is above normal outset level, it will send an alert message. To observe the discharge of gas, we are using Arduino, MQ-4 Sensor, IFTTT, and computer network connectivity. In this event that the gas spill is distinguished, naturally, it'll send SMS to the client. In the proposed system, we described that if the gas level is intersecting above the border degree set, the level of gas is indicated and it automatically sends an alert to Mobile through IFTTT. Later on, response requests will be sent to the Emergency services like a fire station. In this, the Arduino is attached with a gas sensor, and when the existence of gas is automatically disclosed it sends an alert using IFTTT. Thus, it alerts the surroundings aware of the gas detection and leakage which can save the lives of many living organisms.

**Keywords:** Arduino, ESP8266, Natural Gas, MQ-4 sensor, IFTTT.

### INTRODUCTION

The project's main purpose is to sense the outflow of LPG pistons, which is usually used in Indian households. The obtain ability of vapor determination also ceased with the use of the MQ-4 sensor, thus eventually preventing coincidence projections. Aimed at this project, open-source IoT software named "IFTTT" is used. Thus, the software program has a function to connect to Arduino and can additionally join mobile, Gmail, and neighborhood broadcasting such as twitter through an SMS and exploitation message. We can also comprise the persons within the neighborhood just in case of an emergency stage ready to assimilate third-party services through the acquaintance of cloud API which aids greater services, devices, and consumer interfaces. This allows collaborative management of a

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smart home by distinct services, clouds, and applications. In addition to this, the proximity of gases is checked and urged through alerts. Employing support of IoT, the gas spillage condition will be cautioned through the application of SMS, exploitation blast and messages will be sent to the gas association which is linked with individual areas and an instant message will be sent to the user and their nearest neighbors.

**LITERATURE SURVEY**

Agung Nugroho Jati et al., characterizes the Fume drips which is one of the major complications. One of the best solutions to summarize loss of life owed to fume outflow, mainly for detecting it early before leakage. Consuming a fume device form MQ-2 as an indicator but it is projected to daze earlier to the diverse effect. The fume instrument which is linked to a portable device and connected in four dissimilar directions. When we detect the fume instrument, that is predicted with the precision up to expectation with the accuracy that the range within 80% and the normal detachment from the fume device, the argument of spillage is around 0-10 cm. The most frequently used detector is LIDAR. The LIDAR can be abbreviated as Laser Distance and Ranging. As compared to the MQ-4 sensor, the LIDAR sensor is a more efficient sensor.

Sony Shrestha et al., describes one of the major problems faced by mankind in our everyday life. LPG which is also shortened as Liquefied Petroleum Gas, is an extremely combustible fume mainly used in warming applications. The outflow of fume may increase the risk of causing fire, lack of oxygen, or detonation. This problem can be resolved with the growth of consistent methods to perceive fume drips. Once a vapor leak is spotted, then the handler will be reported through Messages and sound so that we are able to turn off the vapor faucet. The major problem faced in the kitchen due to fire can be analyzed with the help of enthusiasm feeler. The buzzer starts peeping on every occasion when a fire is perceived.

Linxi Dong et al., describes the fume leak caused in industries which leads to accidents and thus may affect the surroundings and mankind. Through this, we are able to detect the outflow of gas on time. when the drip is small, it is hard to collect at the fixed point. However, the actual drip signals are rarely visible, making many data classification impossible. This paper proposes a method for detecting such problems by consuming the auto relationship work (ACF) of the usual meditation part. Thus, the characteristic of every normal section can be achieved by measuring the connection coefficients between ACFs. A non-concentration level is mainly intended to detect the actual-time signals, based on the characteristics of the numerical study. In addition to this, multi-sensory data is bonded with a weighted fusion process. The current method can be applied in a field with the aid of constructing a Wi-Fi sensor network (WSN). It is confirmed that the gadget recognition percentage scopes as great as 96.7 percent then on the basis of low false alarm rate, the normal location time delay is under the 30s.

Metta Santiputri et al., who designates that the LPG gas is one of the crucial products used by individuals in everyday life. Many occurrences happened because of fume overflow. The main goal of this project is to have the funds for a resolution mainly for employing devices associated with Node MCU. It keeps track of devices instantaneously. The Detecting device sends data to NodeMCU and after which the consequences are proven as attention to the user through an Android-based smartphone tool. Using this device, manipulators can predict accidents that happened owing to fume discharges so that coincidences could be avoided.

Arijit Banik et al., states that the goal of this mission is to promote a structure accomplished by robotically sensing and ending gas discharges in those previous regions. The human uses a fume instrument to detect conformity of the LPG (Liquefied Petroleum Gas) escape and uses the GSM to watch the individual about the fume outflow via messages. If the LPG in the air influences a stipulated quantity, the gasoline sensor senses the gasoline leakage and the sensor outturn goes down. The microcontroller senses this, yet senses at the same time it turns the LED and beeper on.



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This project modifies the existing workplace safety paradigm and this methodology will similarly be utilized at homes in addition to workplaces. One of the most important efforts remaining is to establish a hazardous gas detection and warning structure which is primarily based on Arduino. The dangerous gases such as LPG, Methane gas have been found. When some gasses surpass the conventional threshold level an alarm is activated directly at the incident site and a warning message (i.e. push notification) is also transmitted through the web to the approved individual with the aid of the used ESP8266 module which integrates the IFTTT Cloud. This machine-controlled detection and warning method has the benefit over the manual technique. It provides real-time response, effective emergency identification and, in effect, quicker control of the critical situation. The MQ-4 smoke sensor will provide feedback in the form of analog voltage. We have set a condition in our code that if the sensor's output value exceeds 400, the buzzer will start beeping and the red LED will light up; and if the sensor's output value is less than 400, the buzzer will remain silent and the green LED will light up. Depending on the case, two sets of practice are performed. As soon as the device notices the fume outflow, it prompts the beeper and the IFTTT to exhibit the message "Gas is leaked." The further act is to show the message as "No Gas Leak " on the mobile through IFTTT which is connected to Arduino. The IFTTT Software used here will display a IFTTT dashboard by using a API key, Wi-Fi username, and password. When the API key is uploaded in Arduino, we are able to view the serial monitor. The serial monitor displays an IP address. Once you type this IP address in your browser, the project's output will be exposed.

**COMPONENTS USED****HARDWARE**

- Arduino Uno
- IFTTT account
- MQ-4 sensor
- Jump wirings
- LED lights
- Bread board

**SOFTWARE**

- The IFTTT Network
- Dashboard for Data Analytics
- Internet connectivity
- Windows OS/MAC OS
- Chart JS

**WORKING MECHANISM**

When a gas leak is detected, the Arduino sketch is first verified and it is going to be uploaded using usb cable and after uploading we should open the serial monitor. The serial monitor is used to display the IP Address. By using an IP address, type the address in the browser. Here we are using IFTTT. Arduino is an open source software in which we are giving API key, WIFI password, username which is used to integrate Arduino IOT with IFTTT. The predominant dedication of this software is to spark off the internet alert messages to the user.

**Step 1:** This is the Official page of IFTTT. This is how the page exactly looks like. In the top right corner, we can find a variety of options that you can choose and work.



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**Step 2:** If you are new to IFTTT you should create a new IFTTT account. After creating a new IFTTT account you must sign in by using your mail id and password.

**Step 3:** After login into the account, you need to choose the service that you would like. Here I had chosen WEBHOOKS service because it used to connect with two different applications.

**Step 4:** After choosing the option as webhooks you need to select the trigger option in order to give the event name.

**Step 5:** After selecting the trigger option, you need to give the event name in the complete trigger fields.

**Step 6:** Here you need to select the options in which you can receive notifications or alert messages.

**Step 7:** After that give your preferred mail id which you would like to receive notifications. Enable the "Receive notifications when this applet runs" option.

**Step 8:** Enable the connected option button so that you would receive alerts or messages.

**Step 9:** Now we have to connect the Arduino with the IFTTT Sensor to receive alerts. For that, you have to connect the MQ-4 Sensor with the Arduino using a Breadboard. Here, we have used Red LED AND Green LED for indicating the gas concentration level above or below the threshold. Given below is the Simulation model for the Smart Gas Detection along with MQ 4 Sensor. If any gas leakage is expelled, then immediately the MQ 4 Sensor detects the gas and notifies the IFTTT about the leakage and the IFTTT Sends the alert messages through the registered mail id or mobile number. This is the working mechanism of Smart gas leakage detection using Arduino with IFTTT.

## RESULT AND ANALYSIS

In this project, IFTTT software displays about the disasters which happened in different countries with their respective years in dashboard using API key which is already given in Arduino sketch. If the gas leakage is above the threshold level it indicates RED led light and if leakage is below the threshold level, the level will be indicated using GREEN led light. It can be represented in a graphical representation. This technique further raises the global structure proficiency and makes the structure a flawless fume leak detector which provides overall citizens safeguard. Chart.js is an unrestricted open-source data visualization JavaScript library. It supports 8 types of charts. They are bar outline, line graph, field diagram, pie diagram, bubble outline, radar outline, polar graph, and disperse diagram. Chart.js extracts from HTML5 canvas and is commonly enclosed as one of the finest statistics conception lending libraries. HTML5 issue offers a convenient or strong course inconformity with compile visuals by utilizing JavaScript. It is mainly exploited to diagrams and make simple visual representation that makes us to understand easier and in an effective manner. In this, we are able to redraw as many times we want until we get a perfect pictorial representation. In order to create a class line chart, we need to epitomize it as Chart class. In discipline to work, we must pass a jQuery instance or 2d framework concerning canvas. Before drawing a chart, we requisite to resolve what type of chart is essential and make the data consequently. Records need tags, datasets, recorded values, background color, border color, border width and various other options.

## CONCLUSION AND FUTURE WORK

This project deals with the smart gas leakage detection using Arduino with IFTTT. In the proposed system, we described that if the gas level indicates the proportion plane is intersecting above the border degree set for gasoline to be indicated automatically and send an alert to Mobile through IFTTT. Later on, response requests will be sent to the Emergency services like fire stations. At the same time, a utility software program is developed inside the fuel enterprise to inform and report the leakage of gas. MQ-4 Sensor which is used to detect natural gas. In this, the Arduino is attached with a gas sensor and when the existence of gas is automatically disclosed, it sends an alert using IFTTT. Thus, it alerts the surroundings about the gas detection and leakage which can save the lives of many living organisms. In the Future work, we have decided to set up a remote system which will automatically open the doors and windows when the leakage of gas is detected. Also, it automatically powers off the electrical devices and sends alerts to the nearby police station along with their location within a specific duration of time. It additionally sends notification to the user and nearest neighbor and





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just if it's found that the load of fume reaches below threshold price. It results in that it alerts the neighbor using the IFTTT cloud software. Beeper jerks honking if outpouring or surplus of vapor has been spotted. This can save millions of people's lives and create awareness among the people about the leakage of gases or fuels.

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**Table.1. Readings for values**

| <u>COUNTRIES</u><br><u>YEARS</u> | Australia | Canada  | Italy   | China   | Russia  | France  | America |
|----------------------------------|-----------|---------|---------|---------|---------|---------|---------|
| 1990                             | 3931.9    | 3969.9  | 4064.8  | 4037.5  | 4062    | 4084.5  | 4042.8  |
| 1995                             | 3988.5    | 3911.1  | 3815.3  | 3683    | 3618.4  | 3576.3  | 3498.4  |
| 1997                             | 3437.9    | 3343.1  | 3204.1  | 2938.7  | 2891.3  | 2847.1  | 2797.6  |
| 1998                             | 2782.9    | 6423.56 | 6795.12 | 6769.66 | 7032.17 | 7253.83 | 6768.73 |
| 2000                             | 7402.26   | 7426.11 | 7694.95 | 7956.5  | 7838    | 7802.95 | 7212.59 |
| 2001                             | 7022.47   | 6627.74 | 6566.13 | 6703.25 | 6745.89 | 6766.26 | 4064.8  |
| 2002                             | 4222.5    | 4062    | 4084.5  | 4084.5  | 4042.8  | 3988.5  | 3911.1  |





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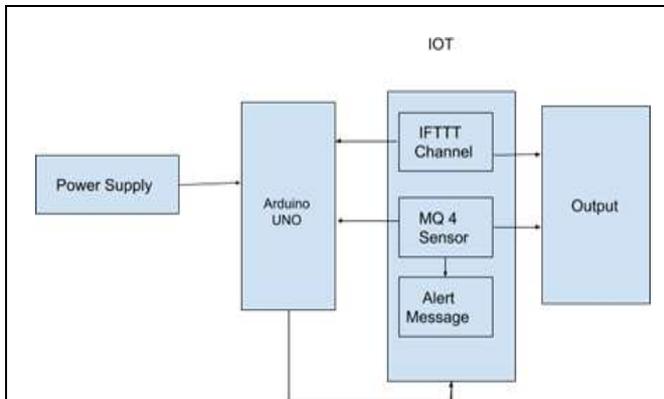


Fig.1. System Architecture



Fig.2. IFTTT Dashboard

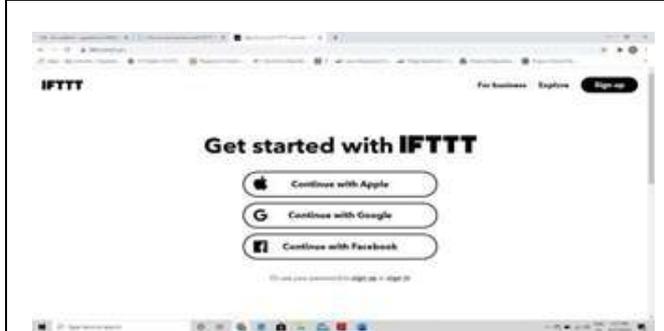


Fig.3. IFTTT Signup page

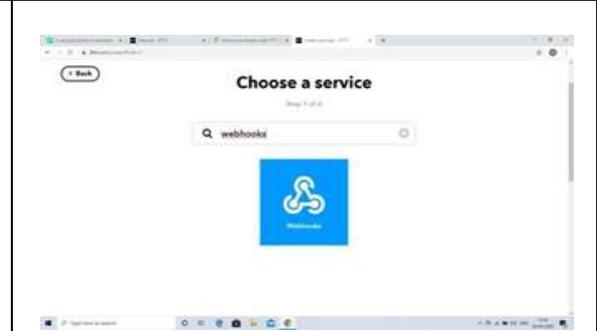


Fig.4. IFTTT Service selection page

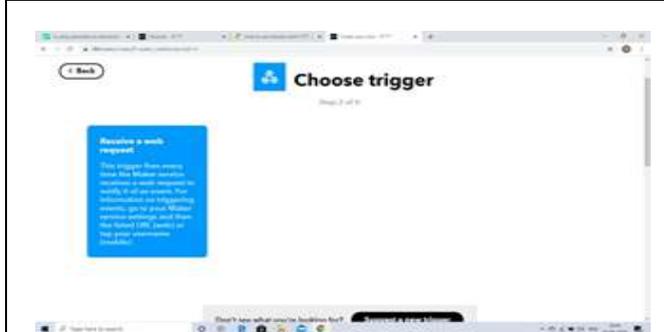


Fig.5. IFTTT Trigger Page

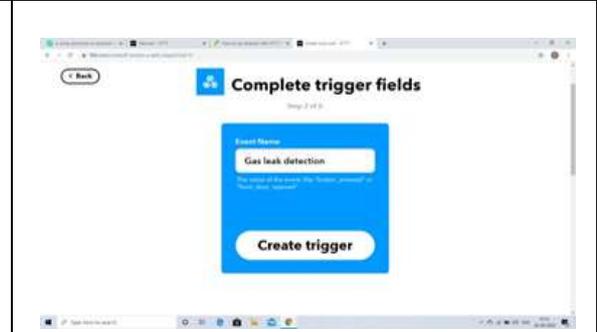


Fig.6. IFTTT Event Page



Fig.7. IFTTT Action Page

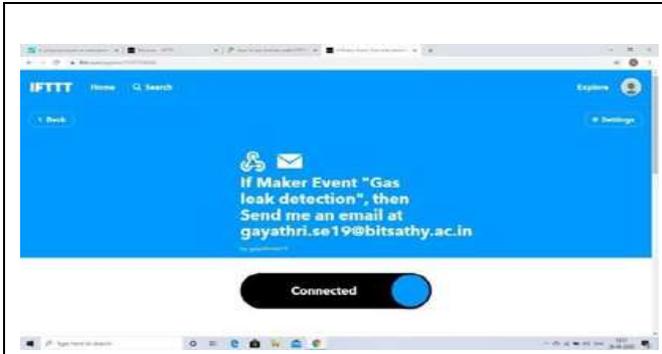


Fig.8. Notification Page

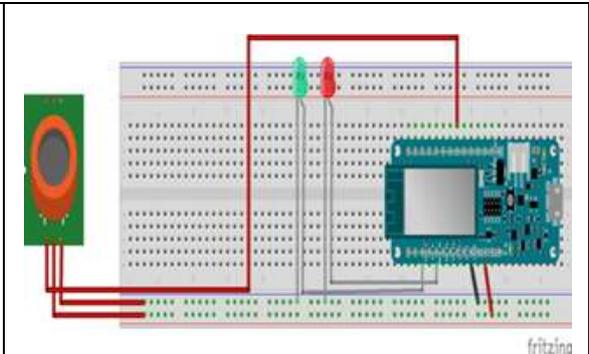




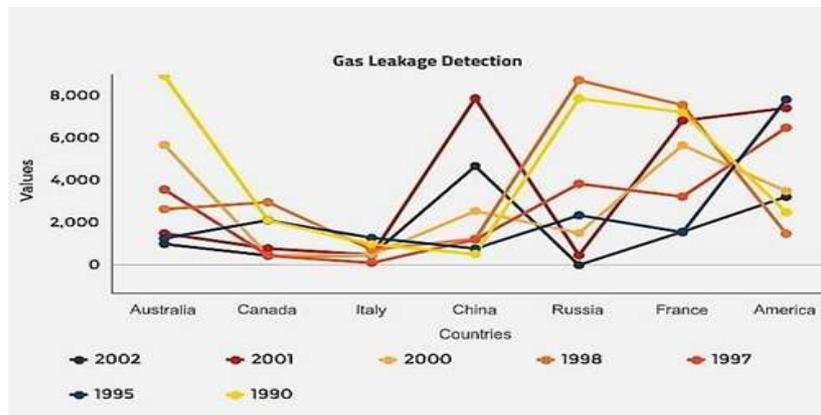
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**Fig.9.Connection page**



**Fig.10.Circuit Connection**



**Fig.11. Line chart Analysis of Gas leakage Detection**

