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Potential Pathway of using Rubber Tyre as a Fine Aggregates in Manufacture of Hollow Blocks

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Abstract— Numerous risks and pollutants are present in our environment, and they are seriously expanding and polluting it. The effects of disposing of non-biodegradable waste are one example. The amount of polymeric wastes, including rubber tyres and PET bottles (Polyethylene Terephthalate), has reportedly been rising quickly in recent years. Waste rubber tyres are one of the most serious environmental hazards because of the quick rise in automobile production, which causes an accumulation of waste from used rubber tyres. Rarely are they recycled, and others are simply disposed of or piled up. Due to this, numerous initiatives have been made to recognise the untapped potential of rubber made from used tyres in new developments in civil engineering. The interesting thing about these rubber materials is that they are cut into pieces and used to replace aggregate. By using them as building materials, it also has the added advantage of conserving the naturally obtained aggregates, which are in short supply because they are used in greater quantities to make concrete. In light of this, our study will examine the use of rubber tyres to replace some of the aggregate. The performance of the hollow block produced by incorporating scraps of used rubber tyres as aggregate replacement in varying ratios is examined in this paper. Although there are many projects on replacing aggregate in concrete with rubber, this paper focuses on replacing rubber in hollow blocks. As a result, after curing for 3, 7, and 28 days, various percentages of replacement rubber are cast and tested for their compressive strength. When aggregate was substituted for rubber, the test results were noted and analysed. The findings are reached after a series of tests and discussions.

Keywords: Environment, aggregate replacement, hollow blocks, rubber tyre waste

I. INTRODUCTION

In recent times, the disposal and handling of non-biodegradable waste has become a chaotic problem in the waste management process. And one such material is rubber waste, which includes worn-out tyres and other rubber materials. Based on the data provided by the Environmental Protection Agency (EPA), it states that almost 270,000,000 tonnes of waste tyres are produced each year. All of these wastes will eventually end up in landfills and dumps, which are extremely expensive and have been decreasing in number in recent years. The rubber tyres are bulky, with a void space of almost 75%, which makes them difficult to compress, thereby making the landfill unstable and ultimately breaking their covers. They also affect the groundwater table and reduce its level. As a result, the dumping of these wastes into landfills creates a significant amount of pressure on the local government bodies in charge of handling them.

Rubber has excellent durability, elasticity, and flexibility properties, which makes it an ideal material to manufacture tires. Interestingly, these properties also make them difficult to breakdown and decompose. Hence, there is a need to find an alternative to dumping them in landfills.

Transforming these rubber tyres into useful products is a moral way to protect the environment in which we live. This involves the shredding of rubber types into various different forms, such as shreds, chips, and crumbs. There are several types of scarp rubber tyres, including asphalt rubber, asphalt rubber blend, granulated crumb rubber modifier, crumb rubber modifier, and vulcanised rubber. These products can be used as fillers, but they are bound to low percentages, so they are used only in low-end products. An attempt to recover the constituent parts in these rubber products by thermal decomposition was found, but they were ultimately dropped because their commercial scale method was not resolved satisfactorily.

After analysing all the results, recycling was the best method for utilising these rubber wastes. It is the process where worn-out products and their effluents are collected and treated for use in

making a new product. Because of the scarcity of raw materials and the higher transportation costs associated with their acquisition, any industrialist will look for ways to recycle the waste generated by the process. Thus, the recycling process reduces the shortage of raw materials and also provides us with a healthy environment free from pollution.

Hollow blocks have increased in popularity due to their properties to reduce construction costs, the good bonding of mortar and plaster due to their rough surface, being more durable, and so on. In today's modern world, we aim for sustainable development, which uses a variety of materials from industrial waste and other waste in the construction industry. There are many types of systems available, which can be categorised depending on the flexibility and resistance to cracking, such as rubber-filled concrete (RFC), stress-absorbing membranes (SAM), stress-absorbing membrane interlayers (SAMI), two-layer systems, and three-layer systems.

The recycled rubber from waste is a potential material in the construction field due to its properties, which include sound and heat insulating properties, light weight, elasticity, and energy absorption. They are replaced for the fine and coarse aggregates by weight using different percentages[1-4]. The defoaming agent is examined in concrete with a high ratio of rubber replacement in the coarse aggregate. The results state that, although the defoaming agent reduced air to a greater extent, an increase in compressive strength was not found[5-9]. The statistical data proved that despite a huge loss in strength, they can still be used in areas where medium-to-low compressive strength is required. As a result, using rubber from scrap tyres in concrete is another application for used tyres[10]. The rubber-replaced concrete's compressive strength depends on the quantity and size of the added rubber materials. According to the findings, compressive strength decreases when rubber particles are small and there is a lot of rubber added. With increasing rubber waste content and smaller rubber particle size, the compressive strength declines. The cement matrix's porosity is increased by the addition of rubber waste as an additive [11–13].

II. MATERIALS USED

A. Cement

The cement used in the production of these hollow blocks is a locally available ordinary Portland cement (OPC). OPC are classified into three types, namely grades 33, 43, and 53, depending upon the strength they achieve at the end of 28 days. In this experimental analysis, grade 53 cement is used. The cement was tested to match the properties proposed by the Indian Standards, IS: 4031 (1988) and IS: 12269 (1987). Table 1 displays the results of the various property tests.

Table 1. Properties of Cement

Properties	**Value**
Specific gravity	3.25
Fineness	2%
Standard consistency	34%
Initial setting time	35 min
Final setting time	6 hours

B. Waste tyre rubber:

Scrap tyres are obtained from local recycling units, where they are readily available as a source of rubber. The rubber obtained from the scrap tyres is not identical in its dimensions. Therefore, they are made into similar and homogeneous sizes before they are used in the casting of hollow blocks. The obtained rubber can be categorized into three main categories: ground rubber, crumb rubber, and chipped rubber. In the above-mentioned categories, chipped or shredded rubber is used here as a partial replacement of the coarse aggregate in the hollow blocks. Initially, the rubber particles are made into sizes with high irregularity. The further processing of the rubber particles allows them to produce the desired sizes, which range from 0.42 to 4.75 mm. Figure 1 shows the rubber obtained from the scrap tyres, and Figure 2 shows the required size of the rubber, which ranges around 4.75 mm [14-15].

Figure 1. Waste tyre rubber

Figure 2. Size of rubber 4.75mm

Table 2 and Table 3 conveys the physical and chemical properties of the waste tyre rubber respectively.

Table 2. Physical Properties of waste tyre rubber

Properties	Range
Specific Gravity	1.06-1.1
Specific Heat	0.28-0.35 cal/gr/°C
Molecular Weight	$3x10^5$ - $1x10^5$
Hydraulic conductivity	0.2-0.85 cm/s
Thermal Expansion	5.9 - $7.9x10^4$ /°C
Thermal Conductivity	$0.330\text{-}0.515x10^3$g-cal/s/cm/°C
Dynamic Viscosity	500-250000mPa
Ductility	80-158mm
Flammability	582°F
Thermal insulation	0.0838-0.147 cal/m-hr-°C
Moisture absorption	2-4 %
Stability temperature	200°C
Heat temperature	150-316°C
Density	7.51 bs/cu.foot

Table 3. Chemical properties of waste tyre rubber

Properties	Range
Angle of friction	15-32°
Cohesion	349-394 N/mm^2
Total Organic Carbon	22.7-3.1 ppm
Turbidity	254-00 NTU
Gradation	50-300 mm
Softening Point	38-125°C
Breaking Point	12-30°C
Colour	Black
Penetration	15-25000.1 mm
Chemical Degradation	100-300°C
Mechano-Chemical Desperation	100-200°C

III. MIX DESIGN

The raw materials involved in fabricating the waste tyre rubber hollow blocks are OPC cement, crusher powder, waste tyre rubber, fine and coarse aggregate, and water. Table 4 shows the various mix proportions for different percentages of replacement.

Table 4. Mix Proportion for various percentage of replacement of tyre

Ingredients	Mix Proportion (%)						
Crusher chips	55	50	45	40	35	30	25
Crusher Powder	35	35	35	35	35	35	35
Cement	10	10	10	10	10	10	10
Tyre	0	5	10	15	20	25	30

The hollow block measures 400x200x200mm. The ratio of mix proportions adheres to 1:1.506:3.27. This mix ratio enables us to obtain any desired number of blocks in a single moulding process. Primarily, the crusher powder, crusher chips, and cement are mixed together with the preferred water-cement ratio. The waste rubber is also used as a partial replacement of coarse aggregate in the desired percentage (i.e., 5%, 10%, 15%, 20%, 25%, and 30%). The varying ratio of waste rubber material used in this mix design is shown in Table 5.

Table 5. Ratio for the replacement of the fine aggregates

Percentage of rubber replaced on fine aggregate	Volume of rubber material (Kg/m3)	Volume of crusher powder (Kg/m3)	Volume of crusher chips (Kg/m3)	Volume of cement (Kg/m3)
0	0	3	4.00	0.50
5	0.05	2.875	4.00	0.50
10	0.10	2.75	4.00	0.50
15	0.15	2.50	4.00	0.50
20	0.20	2.425	4.00	0.50
25	0.25	2.35	4.00	0.50
30	0.30	2.25	4.00	0.50

A total of 21 blocks are casted and cured, three of which are conventional hollow blocks. The conventional hollow blocks are cast to compare the differences in the strength and material properties of conventional hollow bricks to the bricks obtained

by the replacement of waste tyre rubber[16-18].

IV. Results and Discussion

A. Compressive Strength

The minimum compressive strength of the hollow bricks, as stated by the BIS, is about 3.5 N/mm^2. This compressive strength of the hollow blocks is determined by using the compressive testing machine, which has a capacity of 2000 kN. The rate of loading used for a concrete specimen is 315 kN/min (5 kN/sec) as per IS 516. The machine applies a constant rate of loads to the hollow blocks until failure occurs. Scrutinize the loads and note the maximum load at failure.

The compressive strength of bricks is equal to the maximum load (N) divided by the average area of the samples (mm^2).

The hollow bricks that are tested for compression are the bricks that have undergone curing for 3 days, 7 days, and 28 days to record the strength at different curing stages. Tables 6, 7, and 8 show the compressive strength of the hollow bricks with a varied ratio of rubber replacement at the end of 3 days, 7 days, and 28 days, respectively.

Table 6. Compressive strength of the hollow bricks at the end of 3 days of curing

Percentage in replacement (in %)	Age of test (day)	Compression Load at failure (kN)	Compression Strength (N/mm^2)
0	3	115	1.43
5	3	114	1.42
10	3	110	1.37
15	3	107	1.33
20	3	104	1.30
25	3	101	1.26
30	3	98	1.22

Table 7. Compressive strength of the hollow bricks at the end of 7 days of curing

Percentage in Replacement (%)	Age of Test (day)	Size of Cube (mm)	Compression Load at Failure (KN)	Compression Strength (N/mm^2)
0	7	400x200 x200	135	1.69
5	7	400x200 x200	134	1.68
10	7	400x200 x200	130	1.62
15	7	400x200 x200	128	1.60
20	7	400x200 x200	123	1.54
25	7	400x200 x200	117	1.46
30	7	400x200 x200	114	1.42

Table 8. Compressive strength of the hollow bricks at the end of 28 days of curing

Percentage in Replacement (%)	Age of Test (day)	Size of Cube (mm)	Compression Load at Failure (KN)	Compression Strength (N/mm^2)
0	28	400x200x200	157	1.96
5	28	400x200x200	155	1.94
10	28	400x200x200	150	1.87
15	28	400x200x200	146	1.82
20	28	400x200x200	141	1.76
25	28	400x200x200	138	1.72
30	28	400x200x200	135	1.68

Regular results to be described at 7 and 28 days the compressive strength of the bricks was found to be 1.68 N/mm^2 and 1.90 N/mm^{2}respectively. Three samples were tested for each compound the average of the three results of each combination is considered for comparison of results.

Figure 3. Compression test on hollow blocks

Figure 4. Compression test on hollow blocks

The following are the results of the compressive strength analysis of various proportions of hollow blocks:

In terms of compressive strength, the 5% rubber replacement in fine aggregate in the hollow block performed well. It is very much equal to the conventional hollow block. The 10% replacement of rubber in fine aggregate in the hollow block shows a minor variation in compressive strength compared to the conventional hollow block. With the 15% replacement of rubber in fine aggregate, the hollow block shows a 10% decline in compressive strength compared to the conventional hollow block. With a 20% replacement of rubber in fine aggregate, the hollow block shows a 12% declination in compressive strength compared to the conventional hollow block. With a 25% replacement of rubber in fine aggregate, the hollow block shows a 15% declination in compressive strength compared to the conventional hollow block. With the 30% replacement of rubber in fine aggregate, the hollow block shows a 20% declination in compressive strength compared to the conventional hollow block. Figure 4,5 and 6 shows the variation of compressive strength attained by the hollow blocks containing rubber at various proportions after 3 days,7 days and 28 days of curing respectively.

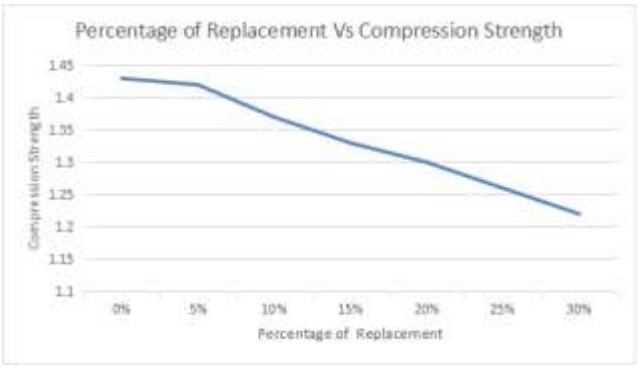

Figure 5. Graph showing the variation of compressive strength after 3 days of curing

The 5% replacement of rubber in fine aggregate in the hollow block responded well in compressive strength. It is very much equal to the conventional hollow block [19].

The 10% replacement of rubber in fine aggregate in the hollow block shows minor variation in compressive strength to the conventional hollow block.

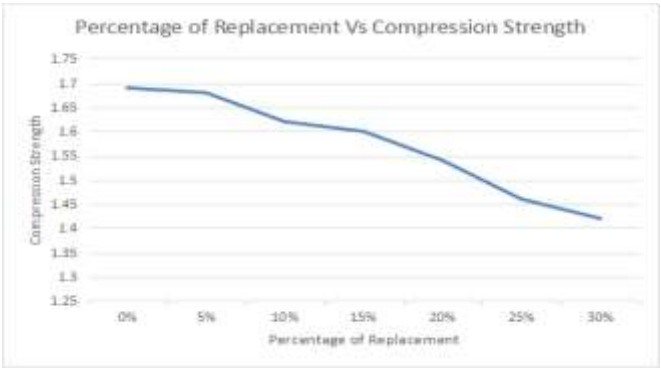

Figure 6. Graph showing the variation of compressive strength after 7 days of curing

The 15% replacement of rubber in fine aggregate, the hollow block shows the10% declination in compressive strength to the conventional hollow block. The 20% replacement of rubber in fine aggregate, the hollow block shows the 12% declination in compressive strength to the conventional hollow block.
The 25% replacement of rubber in fine aggregate, the hollow block shows the 15% declination in compressive strength to the conventional hollow block. The 30% replacement of rubber in fine aggregate, the hollow block shows the 20% declination in compressive strength to the conventional hollow block.

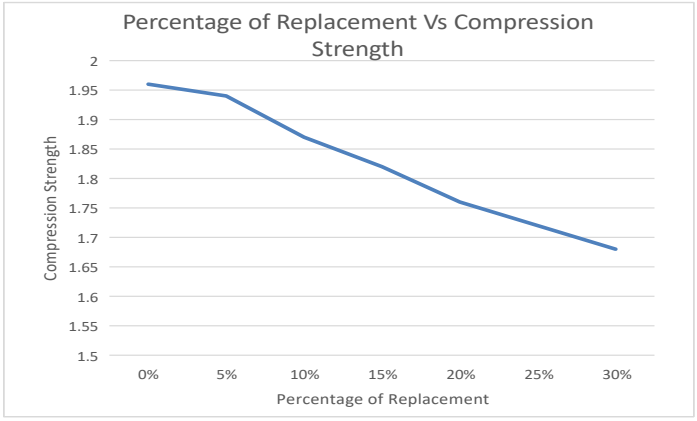

Figure 7. Graph showing the variation of compressive strength after 28 days of curing

Replacing waste tyre rubber up to 5% in the fine aggregate of hollow block masonry is affordable. Thus, it can be used for both load bearing and non-load bearing structures. Replacing 10% in the fine aggregate is suggested for minor loaded area and recommended for non-load bearing walls. Replacing 15% to 30% is not comfortable for load bearing structures and hence it can be used for compound walls, flooring for the ground and pavements for garden [20].

V. CONCLUSION

Out of all the tests that were performed and the statistics that were analyzed, replacing the rubber obtained from scrap tyres up to 5% in the fine aggregate is highly commendable. They show the best results and also make hollow block masonry very affordable. Replacing 5% of the fine aggregate with the rubber suits is appropriate for both load-bearing and non-load-bearing structures. When we replace them with 10%, the test results show that they are not ideal for load-bearing structures. They are suggested for non-load-bearing walls and areas where the applied load is minimal. Results state that replacing the rubber by more than 10% is not capable of supporting load-bearing structures. So, replacement percentages ranging from 15%–30% are much preferred in the construction of compound walls, pavement for gardens, and flooring for the ground. Based on the data presented above, it is possible to conclude that a replacement percentage of 5-10% is highly effective. In addition to the above-mentioned properties, they also reduce the production cost of the hollow blocks, thereby making them very affordable. As a result, utilising the rubber obtained from waste tyres will be a very good and effective method of producing hollow blocks in a cost-effective and environmentally friendly manner.

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Feasibility Study on Concrete with High Volume Fly Ash

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Abstract— This study mainly inspects the production of durable and environment friendly concrete by utilizing Fly Ash [FA]. This fly ash is the byproduct occurred from the coal based thermal power plants as cementitious material. High Volume Fly Ash [HVFA] Concrete is topic of discussion as it utilises FA as cement replacement to greater extent [more than 40%replacement]. Owing to their pozzolanic properties, FA is examined as partial replacement of cement with varying proportions [40%, 45% and 50%by weight] in this study as HVFA concrete. The grade of concrete adopted to observe the performance of HVFA concrete is M30 and were tested for analyzing their strengths-compressive ability, strength on the flexural capacity and their split tensile strength, after curing the molded samples 7 days,28 days and 90 days respectively.

Key Words— Coal Ash, Environmentally friendly, Cement Replacement.

I. INTRODUCTION

Concrete is observed as the second major material consumed per capita in the world after water ,by approximately consuming 560 kg per person in a year. The prime component of this concrete is Portland cement depletes the environment by consuming the natural resources for their production and by emitting 5-7% of carbon [1 ton of CO2 for 1 ton of cement produced]. Being major element in achieving the strength of the concrete, various researches have done to investigate the results in replacement of this cement, either fully or partially or by adopting the alkali activated binders or commonly known as geopolymers. Hence, there is need to implement the replacement of cement for providing greener and sustainable environment with the properties matching to the conventional cements. The material used for cement replacement mainly focused on utilizing waste from industries with alkali-based minerals such as silica fumes, fly ash, mine tailings, furnace slag, etc. One such industrial waste which contains excellent pozzolanic properties is fly ash. Fly ash is considered as waste, just because they are obtained as the byproduct from coal based thermal power plants. The disposal and handling this fly ash is nuisance due to their nature of chemical composition and particle fineness. Thus, utilizing fly ash in construction sector will be beneficial way to both environment and in economic aspect.

The composition of this obtained fly ash differs on the variety of coal used and the design of boilers, but they typically contain silica and alumina in greater amounts, favouring the replacement of cement. Due to varied chemical composition, standards were created to meet the requirements to be used an alternative of Portland cement-ASTM C618-12, “Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.” This standard classifies the fly ash obtained into two acceptable classes which can be used in concrete - Class F Fly Ash have properties of puzzolan and Class C Fly Ash have the properties of both pozzolan and cement. Apart from having pros on economic and environmental aspects, using FA in concrete has other advantages also. The usage of FA improves the pump ability of concrete by reducing the friction between pump line and concrete due to their spherical nature. In addition to this, fly ash reaction with CaOH forms calcium aluminate and calcium silicate hydrate reduces the leaching of CaOH, providing increased life and durability of concrete. Due to their physical nature, fly ash provides greater workability of concrete with lower water-cement ratio when compared to traditional cement binder. Besides all these benefits, utilizing fly ash reduces the heat of hydration process than conventional cement, which reduces cracks and their formation.

II. MATERIALS USED

A. Cement

The modernization of the construction industry offers a variety of cements, out of which OPC-Ordinary Portland Cement is popularly available in market. The OPC used in this study is grade 53 and confines to specifications of IS 8112:1989. The OPC used is examined for their physical properties and are listed in Table 1.

Table 1. Characteristics of the physical properties of OPC

Physical Properties of cement	Results
Fineness	6.69

Consistency	26%
Specific Gravity	3.76
Setting Time [Initial]	25 minutes
Setting Time [Final]	11 hours

B. Fly Ash

The Fly Ash utilized in this study belongs to fly ash of Class C type and purchased from Mettur Thermal Power Station, TamilNadu, India. The properties of their chemical and physical nature is examined and are tabulated in Table 2 and Table 3 respectively.

Table 2. Physical properties of fly ash

Properties	**Values**
Specific Gravity	1.9 - 2.0
Bulk Density	1.2 g/cm^3
Fineness	2000 - 2200 cm^2/g
Moisture	Nil
Colour	Whitish grey to grey with slight black fines

Figure 1. Fly Ash

Table 3. Chemical composition of fly ash

Properties	**Percent by weight**
Silica dioxide	55.3
Aluminate	25.6
Ferric Oxide	5.2
Oxides of Magnesium & Calcium	7.0
Sulphur	0.5
Magnesium	3.2
Oxides of alkali metals	2.5
Loss of Ignition [LOI]	1.9

To ensure the particle uniformity and particle fineness, sieve analysis is conducted to calculate the fineness of the fly ash used in this study and their percentage finer are tabulated in Table 4.

Table 3. Results of sieve analysis

Sieve Size as per IS specifications [in microns]	**Percentage Finer**
600	98.2
300	96.5
150	72.3
75	25
<75	0

C. Coarse Aggregate

The coarse aggregate size adopted in this study of HVFA concrete is 20 mm and they were tested for their properties-specific gravity, test for their shapes, etc. and their results are enumerated in Table 4.

Table 4. Test results for Coarse aggregate

Test Conducted	**Results**
Water Absorption	0.7 %
Specific Gravity	2.76
Elongation Index	11.38%

Flakiness Index	16.1%
Crushing value	21.33%
Impact value	10.94

D. Fine Aggregate

Fine aggregate is the prime component present in huge quantities in concrete. River sand, which is a naturally available fine aggregate is used passing through a sieve of 4.75 mm. The fine aggregate used is as per the IS 383 and confines to Zone II. The material property tests such as Specific gravity, Water absorption ratio and Bulk Density were conducted, and the results are given in Table 5.

Table 5. Test results of Fine Aggregate

Test Conducted	Result
Bulk Density	1.2
Water Absorption	1 %
Specific Gravity	2.68

E. Water

Water is a necessary element which induces chemical reaction which leads to hydration product when it gets reacted with cement, forming gel-the calcium silicate hydrate gel in the concrete. The binding action of the gel-like formation from the hydration of the cement maintains the strength of the concrete. The water usage should be minimum and must be adequate for the hydration process of the cement. Any additional water during the hydration process will only lead to the creation of capillary pores, when the concrete hardens. Thus, there is a need to prepare the cement with the sufficient consistency for the required workability. It is important to have the bonding among the used admixture and the cement and also with the water used for the mixing process.

Other two parameters to look carefully at are quality and the quantity of water used. To maintain the desired efficiency, the water must be free from other undesired salts, which may interact with the raw materials and produce other by-products. Other materials such as suspended particles can be avoided as they greatly affect the setting, hardening and bond characteristics. Presence of algae content in the water used for making concrete marked a significant reduction in concrete strength by reduction of bond formation, by combining with cement or by creating large amounts of air voids in concrete. Water must be confined to the stated BIS: 456-2000 requirements. Generally, water suitable for drinking, potable water is best suited for making concrete.

F. Superplasticizer

Superplasticizer are the chemical admixtures known as water reducers. They have the capacity to reduce the water usage in the concrete by 30%. These superplasticizers achieve reduction of water usage without altering their workability, as they are surfactant in nature and disperse the cementitious particles in the mix. For this study, a super plasticizer CONPLAST SP430 is used for obtaining the workable concrete at low W/B ratio. CONPLAST SP430 complies with BIS: 9103-1999 and BS:5075-part3 and ASTM C494. They work by repelling the cement grains as they are oppositely charged. This repelling process makes the concrete flow by increasing the mobility. Additionally, they reduce the cement content for the same workability, which is ideal for pumping the concrete. The properties of superplasticizer used are tabulated in Table 6.

Table 6. Properties of Superplasticizer

Properties	Result
Superplasticizer variant	Sulfonated naphthalene formaldehyde condensate
Specific gravity	Ranging from 1.25- 1.5
Chloride	Nil
Dosage recommended	0.5 to 1.8 litres per 100 Kg of cement
Additional air entrainment	1%
Compatibility	All type of cement except high alumina cement
Solid content	40%
Workability	Produce high workable flowing concrete mix without segregation and requires no compaction.
Cohesion	Minimising segregation and improving surface finish
Compressive strength	Early strength up to 40 to 50%

III. MIX PROPORTIONS

The mix design of concrete is an activity through which the proportions of the materials used for making concrete are established with an attempt to achieve the required strength and durability at its minimum, with their possible economy. Two kinds of costs are involved in making the concrete are the cost of materials and the labour.

Table 7. Mix proportion

Raw materials	Mix Proportion	Weight per m^3 of concrete [in kg/m^3]
Cement and flyash	1	385
Fine aggregate	1.89	728
Coarse aggregate	3.2	1232
Water	0.4	140

The cost for labour consists of formwork, batching, mixing, transporting, and curing of the concrete is literally the same for all concrete types. Therefore, the mix design aims at selecting the cement with minimum possible requirement with no negligence in their performance, strength and durability. The mix proportion used for the study was M30 concrete. The mix proportions for the experiments have been calculated as per IS 10262.The materials required for per cubic meter of concrete is tabulated in Table 7.

IV. Results and Discussion

A. *Compressive Strength*

The compressive strength for this study, the concrete cubes of size 150mm x 150mm x 150mm were casted to test their compressive strength after being cured for 7 days, 28 days and 90 days respectively. The concrete cubes were casted by the replacement of cement with fly ash at various percentage of replacement. The replacement is done for 0%, 40%, 45% and 50% , and for each replacement three cubes were casted. The water to cement ratio is maintained at 0.45 for this study, and were kept constant.

Figure 2. Compressive test for cube

The results of the test for compressive strength of concrete cubes after being cured for 7,28 and 90 days are tabulated in Table 8.

Table 8. Results for the strength of compression

S.No	Percentage of fly ash replacement	Compressive strength at the end of 7 days [in MPa]	Compressive strength at the end of 28 days[in Mpa]	Compressive strength at the end of 90 days [in Mpa]
01.	0%	25.50	37.42	40.60
02.	40%	17.20	28.38	32.70
03.	45%	15.23	26.60	30.90
04.	50%	14.89	23.50	28.50

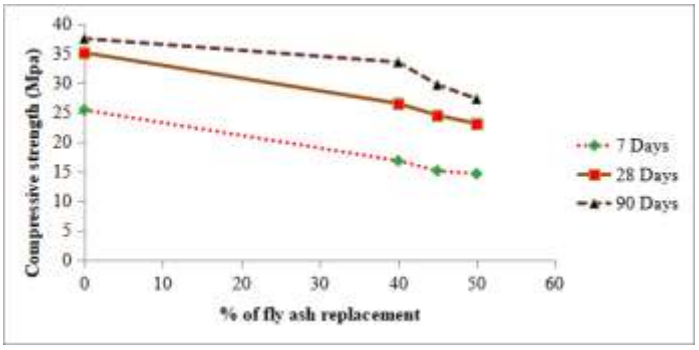

Figure 3 . Graph showing variation of compressive strength

The mix M1 with 0% fly ash acquired compressive strength of 25.5 MPa when they are cured for 7 days, whereas the mixes M2 ,M3 and M4 with 40%,45% and 50% fly ash replacement acquired compressive strength of 17.20 MPa,15.23 MPa and 14.89 MPa respectively for the same 7 days of curing. While being cured for 28 days, the 0% fly ash gained compressive strength of 37.42 MPa, whereas the 40%,45% and 50% fly ash replacement mixes gained compressive strength of 28.38 MPa,26.60 MPa and 23.50 MPa respectively, showed a reduction of 30%,38% and 42% in strength when compared to 0% fly ash containing concrete mix.

The test results at the end of 28 and 90 days of curing showed a significant and progressive improvement in their compressive nature, where the percentage of increase in the strength was between 20 to 25%.This increase of strength has two main reasons-due to the continued hydration process of the cement and, the other, due to the pozzolanic reaction of the fly ash, which is present in large amounts [40%-50% replacement].Although the replacement of fly ash in huge amounts decreased the strength of

the concrete then the conventional one, they can be still used for general concrete construction [for the concrete mix with 50% fly ash replacement] and the other [concrete mix with 40-45% replacement of fly ash] can be used as structural concrete.

B. Split Tensile Strength Test

This split tensile strength test is an indirect test to find out the tensile strength of the concrete mix. For the split tensile strength test, the concrete cylinders were casted with size of 150 mm x 300 mm and were tested using HELICO compression testing machine of 400 tonne capacity confining to IS: 5816 – 1970. The load was applied uniformly until the specimen split and the readings were recorded. The splitting tensile strength has been calculated using the following formula.

Split tensile strength $=2P/(\pi D L)N/mm^2$

Figure 4. Split tensile strength

The results of the test for compressive strength of concrete cubes after being cured for 7, 28 and 90 days are tabulated in Table 9.

Table 9. Split Tensile Strength results

S. No	Percentage of fly ash replacement	Split Tensile strength at the end of 7 days [in MPa]	Split Tensile strength at the end of 28 days [in MPa]	Split Tensile strength at the end of 90 days [in MPa]
01.	0%	2.80	3.36	4.67
02.	40%	1.91	2.80	3.28
03.	45%	1.57	2.00	2.90
04.	50%	1.10	1.75	2.50

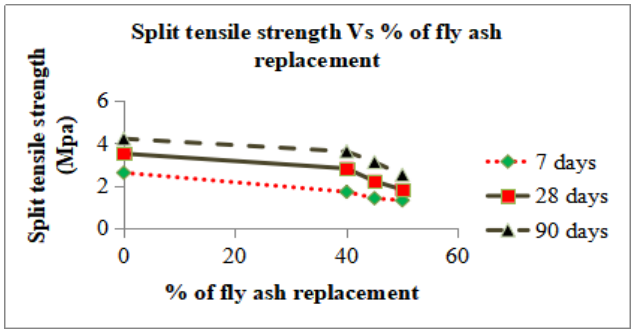

Figure 5. Graph showing variation of split tensile strength

The test results observed in split tensile strength were much similar to the test result variation obtained in the compression testing process. As happened with the compressive nature, the split tensile strength also decreased with the increase in the fly ash replacement, however, the split tensile strength significantly improved with the curing age. After the 7 days of curing process, the concrete mix M1 [0% fly ash] was found to be 2.80 MPa, whereas the mix M2 with 40% fly ash replacement ,mix M3 with 45% fly ash replacement and mix M4 with 50% fly ash gave the results of 1.91 MPa , 1.57 MPa and 1.10 MPa respectively, contributing to an overall decrease of 25% to 45% strength reduction than the conventional mix with the strength of the control mixture M1 (0% fly ash).However, splitting tensile strength was found to increase with age. After the 90 days of curing, the results were significantly improved, obtaining the strength of 4.67 MPa,3.28 MPa ,2.90 MPa and 2.50 MPa for the mixes M1,M2,M3 and M4 respectively, which was 5-35% higher than the results obtained after 28 days of curing. From the results obtained, it can be easily concluded that the increased percentage of strength at 7 and 90 days of curing was much more than the strength obtained at the end of 28 days, which can be due to pozzolanic action of the fly ash present in huge amounts.

C. Flexural Strength

The flexural strength for the concrete mix was calculated by casting the reinforced beam of size 1100mm x 100mm x 150 mm, after being cured for the span of 28 days. Once they are cured, the surface of the beam was thoroughly washed and cleaned for the clean visibility of the formed cracks. The test was carried out on the concrete mix containing no fly ash,40 % fly ash replacement,45 % fly ash replacement and 50% fly ash replacement.

Figure 6. Flexural Strength Test

For this study, the flexural strength was calculated at the end of 28 days of curing and the results were tabulated in Table 10.

Table 10. Tests of flexural strength test

S.No	Percentage of fly ash replacement	Load at initial crack in 28 days[in kN]	Ultimate Load in 28 days [in kN]	Nature of failure
01.	0%	18	67.5	Flexural failure
02.	40%	31	59	Flexural failure
03.	45%	17	57	Flexural failure
04.	50%	22	53.2	Flexural failure

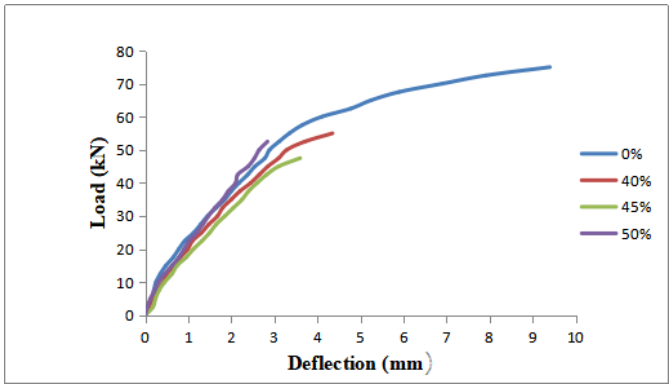

Figure 7. Graph showing variation of flexural strength

After analysing the test results, it was found that the flexural strength also increased with increased curing age, like the same happened with the compressive and split tensile test. The concrete mix M1 with 0% fly ash replacement obtained the flexural strength of 5.8 MPa after 28 days of curing, whereas the mix M2 with 40 % replacement and mix M3 with 45% replacement and mix M4 with 50% fly ash replacement obtained flexural strength of 3.75 MPa,3.0 MPa and 2.5MPa respectively. The results clearly indicate the strength development depending upon the fly ash content.

V. Conclusion

From the analysis of the test results, the results clearly indicated the strength reduction of the fly ash concrete at the age of 7 days and 28 days of curing, but the strength significantly improved beyond the 28 days of curing. The strength obtained beyond 28 days of curing for all the replacement proportions-40%,45% and 50% replacement of the fly ash is sufficient requirement for the construction of reinforced cement concrete. In addition to all these, the replacement of fly ash in huge volumes produced an slump loss of at a reduction of 50% average, when compared to the conventional concrete slump loss rate. For these type of high volume replacement of fly ash combinations, the correlations found represents a tool for the selection of initial proportions of target properties which includes the strength of compressive nature, its tensile split and flexural strength also.

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Bio Metric Based Security using Cloud Centric File System

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ABSTRACT-The most practical paradigm for people and businesses to access low-cost, scalable, all-encompassing, and resource pooling, application, and data repository services is emerging as cloud computing. Cloud computing is becoming more and more popular, and both businesses and people are quickly converting to using it. Whereas, a sizable beneficial to crucial private data and business data—including government documents, corporation financial information, and personal health records—is transported over the Internet and kept on cloud servers. Sensitive data outsourcing, however, faces serious privacy, security, and Restriction of access issues. These are typical worries of businesses and people who use cloud services. Data owners lose some control over their data when they move sensitive data to the cloud. In light of this, this project introduces Client Centric FS, a user-side fingerprint-based secured file system. Additionally, a biometric-based cryptographic protocol called BIOCRYP was introduced, which makes use of symmetric encryption techniques to enhance the performance and security of outsourced personal and shared information.

Keywords: Cloud, Security, Bio-Metric, File System, CCFS, BIOCRYP

I. INTRODUCTION

One of the most precious resources a corporation can possess is data. The cloud is one of the greatest places to save these assets.[1] The on-demand, pay-as-you-go delivery of IT resources through the Internet is known as cloud computing. Technology services, such as processing power, repository, and databases, can be acquired on an as-needed basis from a cloud provider[2] like Amazon Web Services rather than purchasing, operating, and maintaining physical data centres and servers (AWS).

Data management is a hot topic right now because of the rise in data volumes.[3] There is a greater emphasis on making sure everything is safe and secure and that there is no chance of data hacking or breaches as businesses .[3] start to shift to the cloud. Users benefit from flexibility and data agility since the cloud allows them to work without making costly expenditures in hardware and software. Security, however.[4], becomes a top worry for Cloud owners because the Cloud is frequently shared by numerous users. There are various particular security concerns and difficulties with cloud computing. Data is kept.[5] in the cloud with a third-party supplier and accessed online. This implies that access to and management of that data are constrained.

II. EXISTING SYSTEM

Cloud service providers view risks and challenges related to cloud security as a shared responsibility. The customer is responsible for the security of the data they store in the cloud, while the cloud service provider is responsible for the security of the cloud itself. Every cloud computing user is always in charge of safeguarding.[6] their data from security risks and managing access to it, whether the service is Platform as a Service (PaaS),infrastructure-as-a-service (IaaS) like Amazon Web Services (AWS) or software-as-a-service (SaaS) like Microsoft Office 365.

- Attribute Based Encryption (ABE)
- Cipher text Policy Attribute based Encryption

A. Disadvantages of Existing System

- CP-ABE has restrictions when it comes to controlling user attributes and establishing policies.
- The requirement that each authority's attribute set be distinct arose from the complexity of the multi-authority architecture.
- Inherent key escrow: The Private Key Generator is aware of the Private Key (PKG)
- The IBE system might rely on cryptographic methods that are vulnerable to code-breaking attacks.

III. PROPOSED SYSTEM

The suggested system offers Client Centric FS, a user-side biometric-based secured file system. It was suggested to utilise a hybrid crypto system that merge biometric encryption methods and fingerprint-based user authentication to improve the efficiency and security of shared and

outsourced personal information. The contents of externalised file in the CCFS are encrypted using biometric technology. The proposed ClientCentricFS has two objectives. To begin with, create a cryptographic layer that effectively and securely encrypts any files delivered to cloud repository. Next, make use of the advised CCFS to enable protect data sharing of cloud repository at the level of specific files.

A. Modules:

- Cloud Server Web App
- Cloud Client web App
- Fingerprint Module Integration
- DCNN Fingerprint Recognition
- Fingerprint Symmetric Cryptography
- Data Owner
- Data User

B. Advantages of Proposed System

- Reduces the need for key repository space while strengthening security.
- Files with Secure Biometric Lock System
- The key is created from the user's fingerprint, so there's no need to remember it.
- This method can also be used with other biometric features like the iris, face, voice, etc.

IV. SYSTEM ARCHITECTURE

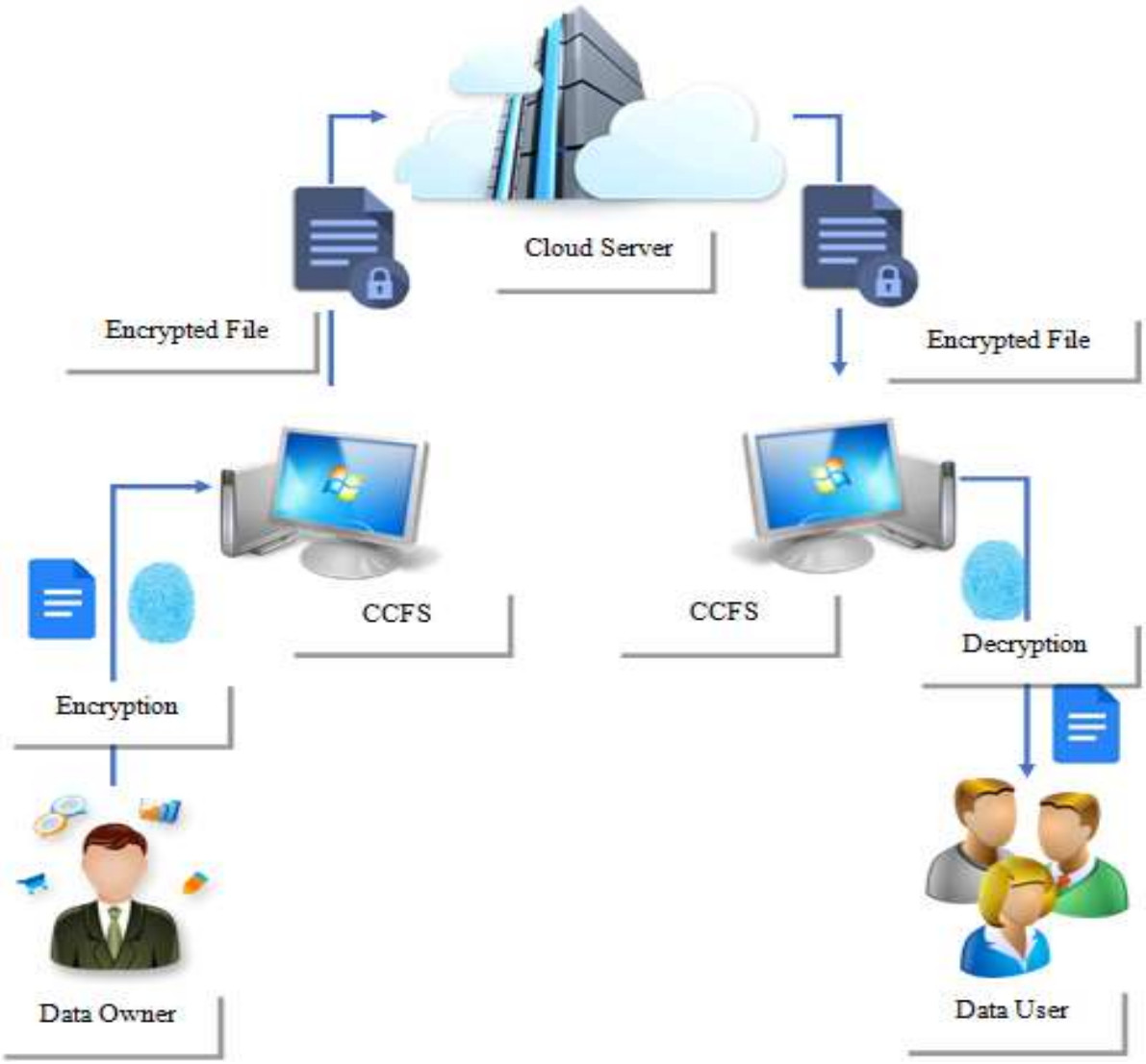

Figure 1. System Architecture Model

V. CONCLUSION

Client Centric FS is introduced in this project. To secure, the files are sent to cloud repository systems, CCFS, a user-side fingerprint-based encryption technology, is used. It has the ability to mounting a secure file system over a cloud-synchronized sector in order to carry out per-file transparent encryption using the BIOCRYP Key. CCFS proposes a Biometric Symmetric encryption strategy that combines a fingerprint and a BIOCRYP Key, which is used to encrypt data for private and shared files that are deployed, rather than adding dependencies to the asymmetric encryption cyphers. CCFS can assure the integrity of the deployed data files in order to defend the file against threats of destruction and alteration. According to a security analysis, the proposed CCFS is very secure and can successfully thwart attacks like brute-force, eavesdropping, man-in-the-middle, offline dictionary, and collusion on outsourced files.

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Review Paper on Safety Induction, Quality Control, Productivity Calculation for Residential Building

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Abstract: The Aim of project is to find the Productivity for finishing works in the Construction Industry and suggest some ideas to overcome the delaying factors. In this project, we include safety induction, planning, and finishing activities work procedure, quality control, productivity and rate analysis. Every organization requires more productivity which increase their profit, quality and to reduce cost and time. Therefore, we have collected productivity data for certain finishing activities (Block Works, Cement Plastering,) from the industry for 30 working days. We could also able to learn the importance of Safety both inside and outside the site through the video screened and the Safety Practices by the Industry. From the Quality Control we have learnt the test to be carried out for different materials and works.

Keywords: Finishing activities, Productivity, Quality control, Safety measures.

I.INTRODUCTION

Labour productivity has a major impact on cost, time and quality of a construction project. In this respect, evaluation and identification of factors that affect the labour productivity become a crucial issue for industrial practitioners [Agwu, M. O., 2014]. Therefore, the factors affecting the productivity are grouped into different categories and they were analyzed.

The measurement of labour productivity in construction is very important. Productivity improvement and Construction performance are the key focus in construction industry. In construction projects, there are three basis planning elements such as time, cost and quality. The Collection of data is done by work study method, for labour productivity highly important factor is skilled labour. From the analysis of collected data it is observed that quantity of labour productivity is useful in saving the cost of project as well as time of the project without hampering the quality of work [Attar, A. A. et al., 2012]. (1) Explains labour productivity has a significant impact on time, cost and quality of a construction project. In this respect, identification and evaluation of factors that affect the labour productivity become a crucial issue for industrial practitioners. Therefore, the factors affecting the productivity are grouped into different categories and they were analyzed [Choi, J. et al., 2006]. (2) Explains the importance of measurement of labour productivity in construction. Construction performance and productivity improvement are the key focus area in construction industry for any nation. In construction projects, there are three basis planning elements such as time, cost and quality. The data collection is done by work study method shows skilled labour as highly important factor affecting labour productivity [Huang, A. L., 2009]. From the analysis of data collected it is observed that measurement of labour productivity is helpful in saving the time of the project as well as cost of project without hampering the quality of work [Lindsay, C., 2004]. (3) Determines productivity of building craftsmen in wall plastering activity and explores the possibility of establishing productivity norm for accurate estimation of manpower requirements. The variability of construction labour productivity for wall plastering activity in the state is indicated by sample standard deviation and variance values. (4) Concluded that the productivity is one of the many factors that directly affect a firm's profitability is worker productivity [Odesola, I. A., 2015]. The purpose of this research is to measure and study variability of construction labor productivity in building construction project and to demonstrate the conceptual benchmarking principles for construction labor productivity, by the use of indices and measures of benchmarking in labor productivity [Odesola, I. A., 2015]. (5) Explains the labour productivity of floor tiling works in selected construction sites. In this paper the study variables were computed using conceptual model of labour productivity measurements. It also explains the accomplishment that represents the finished work. It was found out that the values of daily labour productivity to the baseline productivity better the labour performance this was evident with some of the projects that performed this was evident with some of the projects that performed well which had low project waste index values

[Odesola, I. A., 2016]. (6) Explains the work process and statistical analysis of data obtained during the work study. It is concluded that variability in construction labour productivity of blockwork activity during the period of the study is assignable to weather conditions and delay in supply of materials. Therefore ample considerations should be given to the effect of adverse weather condition during labour cost estimation by taking into cognizance the period of execution of the project [Odesola, I. A., 2019]. Similarly, adequate planning of construction resources will help in enhancing labour productivity on building projects.

II.PLANNING

Objectives of Planning

Planning is an important stage for the construction to complete the work within in a given timeline and cost. At first stage margin amount should be fixed for the minimizing the loss in the project.

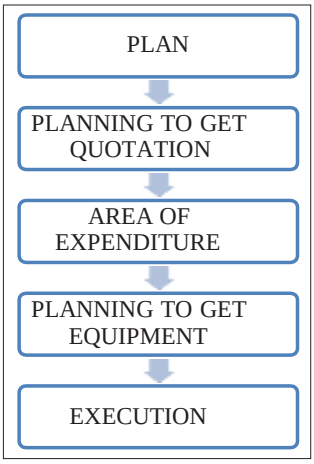

Figure 1. Planning model

Expenditure is of two types. The direct expenditure amount will be claim from the owner for the executed work. However, in case of indirect expenditure they cannot claim from the owner because they spent the amount for temporary structures, drinking water facility, labour bank charges, safety equipment, provident fund etc.

III.SAFETY INDUCTION

A. Objectives of Safety Induction

- Promote the health safety and welfare of people at work
- Protect people against risk
- Identify, asses, eliminate and control hazardous
- To make the job safe

B. Safety Measures

Construction is a great challenging job, which includes various measures to overcome. The first and foremost important thing is safety. They had a policy called EHS (Environment Health and Safety) and HIRA (Hazard Identification and Risk Analysis) for the workers safety. Workers selection process includes

- Collecting the details about the workmen
- Visualisation by site engineer
- Medical check up
- Safety induction class through video
- Provision of orange helmet for the new workmen

After the refresh training and analysis of workmen completed, yellow helmet will be provided

- Safety equipment
- Safety helmet for the protection of head
- Face shield for the protection of eyes during welding
- Goggles used while concreting
- Nose mask while doing cleaning activities
- Shoes

Different types of hand gloves such as

- Cotton gloves used while shifting of materials
- Leather gloves while wielding
- PVC and rubber gloves while using chemicals and concreting
- Ear plug, ear muff for ear protection from the entry of
- dust and high sound
- Safety belt has to be used while working above 3 m height. It should be tied above the head
- Safety net should be provided above 6 floors
- Scaffolding has a tag system
- Red colour (not allowed to use the scaffolding)
- Green colour (allowed to use carefully)

While using crane and other machineries to lift materials, two florescent signal man should be at the site for proper signalling

- Safety measures to start the work
- Installation of wire nets with rope
- Following standard operating procedure including warnings in floor openings, lift shaft, floor edges, temporary hand rails etc.
- Wearing safety belts
- Height pass will be given for the workers who works
- on the elevation part of the building
- Electrical safety measures
- Residual current circuit breaker is installed in electrical equipment to prevent workmen from the electrocuted
- Red helmets are provided with workmen who are working with electrical works
- Fire safety measures

Fire accident may be possible to occur at the site, in such cases certain precautions to undertake such as fire extinguisher. If the fire extinguisher cylinder is maroon it is acetylene and if it is a red it is a LPG.

Fire can be classified based on the material undergoes fire
Class A - fire from clothes, wood
Class B - fire from wax, fuel
Class C - fire from gases
Class D - fire from metals
DCP cylinder can be used for class A, B, C, foam type extinguisher for class C, CO2 cylinder for class B, C.

IV. QUALITY CONTROL

Before starting the construction work, the quality department should give the method of statement for each work. In the quality control laboratory, construction materials are check for its quality. I got some ideas about the test listed below. For cement, they check the fineness test, physical inspection for any lumps present in it. Compressive strength is check by preparing mortar cube and check it for 3, 7, 28 days, initial and final setting time test to fulfil the IS requirements. For fine aggregate and coarse aggregate, sieve test, bulk density test, abrasion test, impact test are carried out for analysing the zone. Specific gravity and so on. For cement blocks compressive strength should be check as per IS 2185 Part-1. Concrete cubes are prepared as per the design mix procedure and check the compression test as per IS 456 requirements. When the work is at the initial stage, the quality control should be there for inspection and give approval for the further work. For gypsum and cement plastering work material, button mark, mesh fixing, mix ratio should be check. For water proofing works leakage test is carried out by checking the waterproof coating, rounding of corners and final water tightness test. For doorframe moisture content, dimension, clamps, plumb level and painting should be check. For tile, water absorption and compressive strength should be check.
Concrete Works

In all the concrete works such as beams, columns, shear wall, foundations are completed. Structural concrete works are done using RMC (Ready Mix Concrete) and SCC (Self Compacting Concrete). RMC mix done using both 12.5 mm and 20 mm aggregates. SCC mix done using 12.5 mm aggregate. During SCC, concrete shutters can be removed after 24 hours of pouring the concrete. It does not require any vibrators for compaction. Based on the loading and structural analysis different concrete grades are used for every floors such as M40, M30 etc. M20 grade concrete is used for vacuum dewatered flooring in basement. M15 grade screed concrete is used in master bedroom.

V. PRODUCTIVITY CALCULATION AND RATE ANALYSIS

Productivity is the measure of the efficiency of a person, machine, factory, system, etc., in converting inputs into useful outputs. Productivity is computed by dividing average output per period by the total cost incurred or resources consumed in the period. Productivity is a critical determinant of cost efficiency.

A.Objectives

- Productivity shows direction for all the work.
- Productivity comprises all the control.
- Productivity is the best tool for comparing management
- effectiveness across the enterprise.
- Setting effective productivity with a team is the starting
- point for success.
- Productivity objectives set or formulated with the people who are going to do the work.
- To study and discuss various factors affecting labour
- productivity in construction industry.
- To statistically analyse the factors affecting labour
- productivity.
- To make recommendations to improve labour productivity in labour construction.

B. Productivity Calculation for Block Work

Before starting the block work the surface should be cleaned properly. Hatching made on the concrete surface about 4 mm for effective bonding. The Survey reference line will be mark by using the plan given. Mortar of 1:3 mix is prepared manually. Then the layout block work is done. Gap of 12 mm should be maintain between every block. After completing the layout, quality control will verify the work. Once they get an approval from the QC, they proceed for further block work. Successive layers to be construct with staggering of vertical joints. The sill level and concrete is provided above 1 m from the floor finish level for about 75 mm thick. In the lintel level, 150 mm thick mullion concrete is to be provided for door frames and joints.

Table I: Productivity for Block Work

Sr. No.	Description	UDM	Quantity	Productivity
1	Block work	Cu.m	6.00	3.00
2	Block work	Cu.m	8.00	8.00
3	Block work	Cu.m	12.50	6.25
4	Block work	Cu.m	7.50	3.75
Total quantity			34.00	
Productivity per man day			5.25 Cu.m	

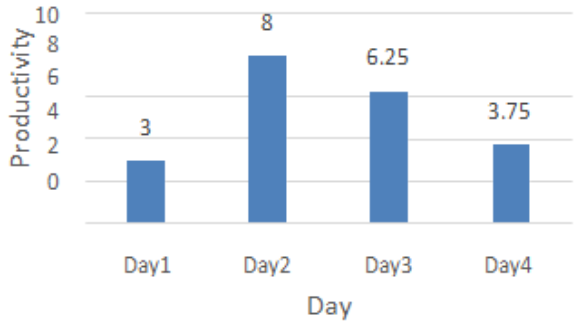

Figure. 2: Productivity for Block Work

C. Productivity Calculation for Cement Plastering

Before initiating cement plastering MEP (Mechanical, Electrical and Plumbing) clearance should made. In the process of pre check, hacking should done on the concrete surface and the surface should be dampen before 10 hours of plastering work start. After completion of pre check, right angles should be check and the button mark should kept for about 10 mm thickness. In the joint areas and conduit line galvanized iron mesh of 300 mm width (150 mm from the joint on both sides) need to place for the prevention of cracking. The cement mortar of 1:4 mix is prepared and used for plastering. The plastered surface should be smooth and even. After completing plastering, the plastered date should mentioned. Productivity for cement plastering shown in Table II. Curing should done for 7 days. Fig. 2 shows the Productivity of Cement Plastering.

Table II: Productivity for Cement Plastering

Sr. No.	Description	UDM	Quantity	Productivity
1	Cement Plastering	Sq.m	9.08	9.08
2	Cement Plastering	Sq.m	10.50	10.50
3	Cement Plastering	Sq.m	10.90	10.90
Total quantity			30.48	
Productivity per man day			10.16 Sq.m	

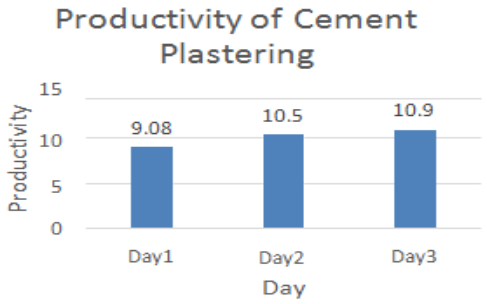

Figure. 3: Productivity for Cement Plastering

D. Productivity Calculation for Gypsum Plastering

Before initiating cement plastering MEP (Mechanical, Electrical and Plumbing) clearance should made. Gypsum plastering is done only for the internal walls. SAM GYPLAST is used to get a smooth finishing surface on the walls. The right angles should be check and the dhada is placed which is a button mark for gypsum plastering. The concrete surface should coated with bond max chemical before 24 hours of plastering work starts for the effective bonding. Fibre mesh of 300 mm width (150 mm from the joint on both sides) need to place for the prevention of cracking. The gypsum mix of 1:1 (one part of cement and one part of water) is prepared for plastering. Productivity for Cement Plastering shown in Table 3. Gypsum plastering have a thickness of 10 mm to 15 mm. Fig. 3 Shows the Productivity of Gypsum plastering for days. This plastering is done only in non-wetted areas and it does not require curing.

Table 3: Productivity for Gypsum Plastering

Sr. No.	**Description**	**UDM**	**Quantity**	**Productivity**
1	Gypsum Plastering	Sq.m	40.00	10.00
2	Gypsum Plastering	Sq.m	29.77	7.44
3	Gypsum Plastering	Sq.m	20.64	10.32
Total quantity			90.41	
Productivity per man day			27.76 Sq.m	

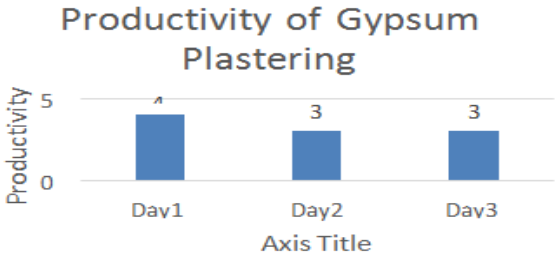

Figure. 4: Productivity for Gypsum Plastering

E. Productivity Calculation for Flooring

Before starting floor tiling all the wall dado should be completed and the surface should be cleaned. Mark the 1 m level from floor finishing level. Prepare cement mortar of 1:4 of PPC and lay it for the required level. Then cement slurry having consistency of3.30 kg/sq.m is coated over the bed of cement mortar for proper bonding and lay the tiles. Grove of 6 to 8 mm to be provided. Fix the PVC spacer for maintain the proper alignment. Clean the joints with brush to remove mortar and dust. The flooring surface should be checked for every 2 m. Grouting is done for the joints. Productivity Calculation for flooring as shown in Table 4. Cure it for 7 days and hollowness should be after two days. Fig. 4 shows the Productivity for flooring. Bubble sheet should be laid on the floor tile to prevent it from cracks.

Table 4: Productivity for Flooring

Sr. No.	Description	UDM	Quantity	Productivity
1	Flooring	Sq.m	3.63	3.63
2	Flooring	Sq.m	3.63	2.27
3	Flooring	Sq.m	3.63	3.63
Total quantity			11.8	
Productivity per man day			2.95 Sq.m	

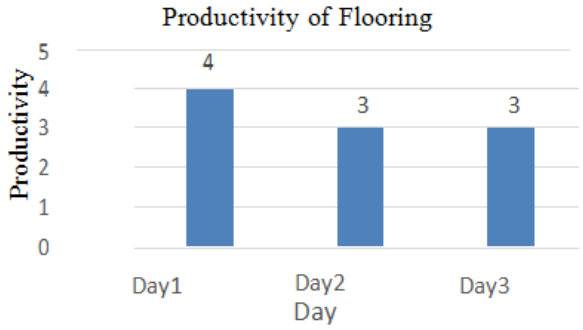

Figure 5: Productivity for Flooring

F. Productivity Calculation for Frame Work

Before initiating framework, check the frame without any cracks or defects. If any defects occur, it should be rectified properly. Then check the moisture content of the frame and inspect the frame head and leg joint connection by wooden raw plug. Door frame is fixed by using mild steel clamp, wooden screw and coach screw for main door, 4 clamps are used and other doors 3 clamps are used. After fixing the door frame, check the plumb level. Productivity Calculation of framework as shown in Table

Primer coating is done and allow it for 24 hours to dry. Fig. 5 shows the productivity for framework on days. Then two coats of painting is done and clean the sprinkling of wallpaint.

Table 5: Productivity for Frame Work

Sr. No.	Description	UDM	Quantity	Productivity
1	Frame work	Sq.m	4.00	4.00
2	Frame work	Sq.m	3.00	3.00
3	Frame work	Sq.m	3.00	3.00
4	Frame work	Sq.m	3.00	3.00
Total quantity			13.0	
Productivity per man day			13.0 Sq.m	

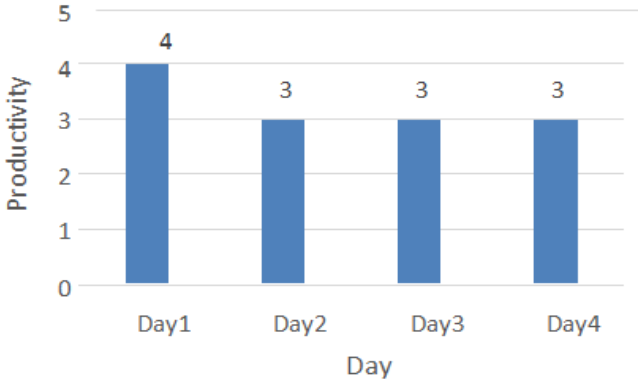

Figure. 5: Productivity for Frame Work

VI. RESULTS AND DISCUSSION

The average construction labour productivity in the Tamil Nadu zone based on work nature as given in Table VI. Table VI: Average Productivity

Sr. No.	Description	Productivity for One Person
1	Block work	5.25 Cu.m
2	Cement plastering	10.16 Sq.m
3	Gypsum plastering	9.03 Sq.m
4	Toilet flooring	2.95 Sq.m
5	Frame work	3 No's

The variability of construction labour productivity for some activities in Tamil Nadu indicated by sample standard deviation and variance values

VII. CONCLUSION

The delaying factor can be identified by due to Skill set of labour, Labour personal problem, Misunderstanding among labours, Overtime, Material transportation, Lack of housekeeping, Drinking water problem, Climatic condition, Time constrain in hoist, Communication.

Remedial measures to increase the productivity are the Stream line production, Invest in capital equipment, Invest in employee training, Providing hoist material and labour transportation, Provide drinking water facility in alternative floors, Safety training, Scheduling of material and labour transportation in hoist.

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Efficient ANN Topologies for Economic Load Dispatch – An Experiment

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Abstract --A proven truth is that most complex non-linear problems can be effectively solved by using Artificial Neural Networks. And hence this paper addresses the economic load dispatch in the power distribution sector of electrical engineering. There are 'N' number of quantities that affect the load dispatch and thus its optimization demands laborious training to achieve good results. This paper studies the prediction accuracy of three different ANN topologies on a 3-source 5-bus system. Topology used includes Long Short-Term Memory (LSTM), Gated Recurrent Unit (GRU) and Deep Feed Forward (DFF) networks and their corresponding results were portrayed.

Keywords --Long Short-Term Memory (LSTM), Gated Recurrent Unit (GRU), Deep Feed Forward (DFF), Recurrent Neural Network (RNN), Economic Load Dispatch (ELD), Artificial Neural Network, Power System.

I. INTRODUCTION

Artificial Intelligence imparts human like behavior and Artificial Neural Network (ANN) are designed to function like human nervous system. Artificial Neural Networks have proven to be efficient in studying complex non-linear problems and solving real-world problems which were difficult to solve optimally using conventional approaches based on mathematical theories.

ANN is formed from artificial neurons which hold the values of the data provided and then multiplied with some randomly initialized values which are known as weights. Each neuron from the input layer is multiplied with the randomly initialized vector of weightsw(i,j), where i denotes the neuron multiplied with the weight and j denoted the neuron which is finally produced as the byproduct of multiplication and then the activation function is applied to the multiplied result and the obtained result is the neuron of the first hidden layer. The first hidden layer neurons get through the same procedure to develop the neurons of the second hidden layer and finally, the last hidden layers make the neurons of the output layer which holds the predicted value of the model. The predicted value is then compared with the actual value and the loss function is decided for the proposed problem which gets reduced afterevery training iteration till it reaches a certain accepted value and then the testing is done.

Economic Load Dispatch ELD, is a complex non-linear problem of optimal distribution of generated power from the given generators in accordance with their maximum and minimum power limits and the balance of the power equation. The solution of the ELD problem is affected by numerous parameters involved such as the generation constraints, the reactance and the resistance of lines involved, and the losses that occurred in the operation of a grid system. Problems come in a variety of datasets, some are easy to capture in certain equations, some are sequential where there is a hidden sequence that needs to be predicted for future use. Numerous topologies are proposed in ANN for solving a variety of problems encountered[1] . Some of the most effective proposed network topologies for numeric data are LSTM (Long Short-Term Memory)[2], GRU (Gated Recurrent Unit)[3] and DFF (Deep Feed Forward).

DFF is a complex implementation of simple Feed Forward in which hidden layers are added for better fitting on the training data for the power system. Hidden layers are added for the improvement in the predictions.

GRU is the advanced implementation of standard Recurrent Neural Network, RNN [4] where two gates are applied for fixing the problem of vanishing gradients. Update gate is used to retrieve old sequence information and reset gate is applied to discard irrelevant information takes more time for training as it is a more complex model as compared to the standard RNN which is not equipped with intelligent gates to control the flow of information.

LSTM[2, 4] is another advancement done in standard RNN with the applications of 3 gates which gives the LSTM cell tight control over the flow of information. The three gates are named the forget gate, input gate, and output gate. The forget gate is to decide which information is relevant to keep from the prior steps and the input gate is to decide which information is relevant to add to the memory from the current step and the last output gate is to decide what will be the next hidden state. Together all three make a strong network for capturing hidden sequences with even better accuracy than the GRU. However, GRU being less complex takes less time than the LSTM and hence used in relatively small datasets where fast predictions are preferred over accurate ones.

In this paper, a 3-generator, 5- bus power system is considered along with its generating capacity constraints. Three different topologies of neural networks (DFF, LSTM, and GRU) are implemented on the power system for the optimum solution of the economic load dispatch problem. Their results are compared on the mean squared error loss function and number of epochs to converge the training loss for each model. The training time taken for each epoch is about 4 times in LSTM and GRU in comparison with DFF. Results are plotted for all three topologies to validate the bestsuited topology on the tabular dataset of the proposed ELD problem. Learning curves are plotted for the comparison of the learning of DFF, GRU, and

LSTM on G1, G2, and G3 by studying the overlapping of predicted values and the actual values graphs of all three generators named G1, G2, and G3.

II. PROBLEM DEFINITION

Economic Load Dispatch is the optimal distribution of the generation power to the generating units present in the power system while satisfying the load power demands[5] .

A. Datasetfor the Neural Network

The proposed problem is based on the dataset of 5 buses and 3 generator systems in which loads on 5 buses are fed as an input and optimal generation power for all three generators as an output. The dataset consists of 4204 data points which are split in the ratio of 80-20,80 percent data is for training and the rest 20 percent is for testing. The dataset contains varying instances of load distribution on all the buses. These variations will help to build a more robust and precise ANN model for the economic load dispatch problem on the described power system.

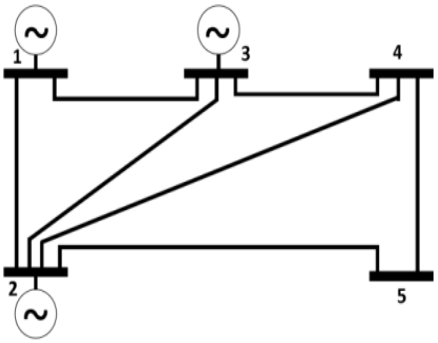

Figure 1. 3-Generator 5-Bus System under consideration

Table 1. Bus and Line data assumed for the problem under study

Bus Code	Assumed Voltage Magnitude (p.u.).	Assumed Angle Degree	Line Code	Line Impedances		Line Charging Y/2 (p.u.)
				R(p.u)	X(p.u.)	
1	1.06	0.0	1-2	0.02	0.06	0.030
2	1.045	0.0	1-3	0.08	0.24	0.025
3	1.03	0.0	2-3	0.06	0.18	0.020
4	1.00	0.0	2-4	0.06	0.18	0.020
5	1.00	0.0	2-5	0.04	0.12	0.015
-	-	-	3-4	0.01	0.03	0.010
-	-	-	4-5	0.08	0.24	0.025

B. *Balancing of Power*

The total power generated must be equal to the submission of total power demanded and the overall transmission losses involved which can be described in the equation:

$$P_G = P_D + P_L \quad (1)$$

$$P_L \leq P_G \leq P_D \quad (2)$$

P_G: Generation Power ;P_D: Total Demand Power ; P_L: Transmission Losses

Transmission line losses are given by,

$$P_L = \sum_{i=1}^{ng} \sum_{j=1}^{ng} P_i B_{ij} P_j + \sum_{i=1}^{ng} B_{oi} P_i + B_{00} \quad (3)$$

C. *GENERATOR LIMITS*

All the three generators named G1, G2, and G3 have their limits on which they can operate without the occurrence of any fault in the system. Limits are provided as: G1:10-85 MW G2:10-80 MW G3:10-70 MW.

III. ANN TOPOLOGIES IMPLEMENTED

ANN comes in a number of topologies to deal with a variety of problems available. Some neurons are simply feed-forward, some are having the feedback structure to adhere to the sequence generated. Three topologies are summarized below for better understanding:

A. *Deep Feed Forward (DFF):*

Deep Feed-Forward is the cumulative developed form of multiple hidden layers in a simple feed-forward neural network. They were developed in the early '90s. They are having more than one hidden layer which makes them different from the simple feed-forward networks which further makes them a better fit in learning core patterns in data for acceptable accuracy. Insights of applied DFF are elaborated below:

B. *DFF Model*

In this paper, one model is applied to each generator. So, 3 models of DFF are trained on the developed dataset. A summary of each model applied is provided below:

No of units in input layer: 5 neuron cells each containing the given load on the assigned bus .

No of hidden layers added: 6

No of neurons on each hidden layer: 50

Loss function: Mean Squared Error

Epochs: 500

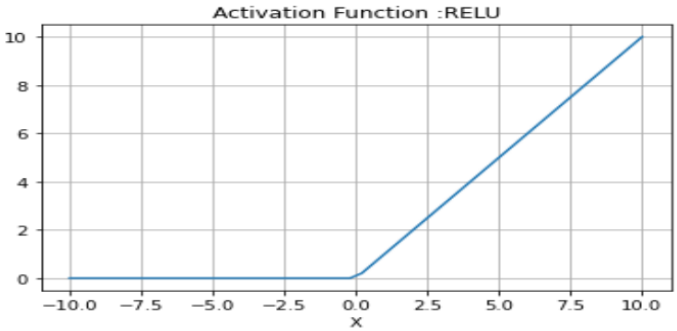

Figure 2. ReLU Activation Function.

Activation function used: ReLU [10] ReLU can be described as the Rectified Linear Activation Function[11] which is the piecewise linear function which outputs input directly if the input given is positive, otherwise, it gives 0 as the output and thus solved the problem of vanishing gradient which occurs in the case of other exponential activation functions The mathematical equation of ReLU :

$$Y = \max(0, x) \quad (4)$$

Optimizer applied: Adam [12] Adam optimizer can be described as the replacement algorithm for the optimization in place of stochastic gradient descent for the training of deep learning models.

C. Long Short-Term Memory (LSTM)

LSTM is the advanced form of standard recurrent networks which can learn the order dependencies and the sequence present in the problem for providing better predictions than the standard model. It uses 3 gates for controlling the flow of information named as forget gate, input gate, and output gate. It is more complex, thus takes more time to train in comparison with the standard model but provides much better predictions.

a) LSTM MODEL APPLIED

In this paper, one model is applied on each generator. So, 3 models of LSTM are trained on the developed dataset. A summary of each model applied is provided below:

No of units in input layer: 5 neuron cells each containing the given load on the assigned bus

No of hidden layers added: 6

No of neurons on each hidden layer: 40

Loss function: Mean Squared Error

Epochs: 500

Activation function used: Tanh and Sigmoid

Tanh activation function [10] is used in the regulation of the values passed in the LSTM network. This function ensures that the values only remain between 1 and -1 or particularly it normalizes the values passed inside the network in the range of [-1,1].

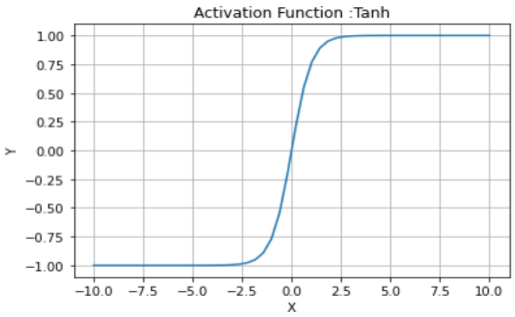

Figure 3.a. Tan activation function

Sigmoid [10] is the same as the tan in core functionality as it also ensures that the value remains in a particular range which is [0,1].These activation functions are useful in the case of dominant values which are so large that make other values insignificant and lead to overfitting.Optimizer applied: Adam LSTM gates: Input gate, Output gate and Forget gate Forget gate [13] (f_t) is the deciding gate whether the information has to be passed on or leave behind.The information coming from the hidden state and the current state is first passed through the sigmoid activation (σ_g) and then if the output is nearer to 0, information is irrelevant and if nearer to 1, information is relevant enough to pass on.

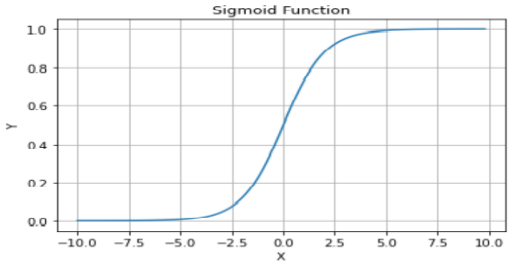

Figure 3.b. Sigmoid activation function

$$f_t = \sigma_g(W_f[h_{t-1}, x_t] + b_f \quad (5)$$

Input gate [13] (i_t) is useful for updating the cell state. The previous hidden state and the current input state are passed through the sigmoid function which decides which values are important to pass on further, then the previous hidden state and the current state are also passed through the tanh function which squishes the values in the range [-1,1] for regulation purposes. Finally, tanh and the sigmoid output get multiplied and the sigmoid output decides the relevant information from the available tanh output.

$$i_t = \sigma_g(W_i[h_{t-1}, x_t] + b_i \quad (6)$$

Cell state is the state of the passed information which gets updated after each training session. For the update process, the previous cell state gets point-wise multiplied to the forget vector from which some values may be dropped in case of multiplication with the values which are nearer to 0 and then the point-wise addition of output from the input gate and the output of the point-wise multiplication gives the new relevant cell state. Output gate[13] (σ_t) is the deciding entity for the next hidden state. The previous hidden state and the current state are first passed through the sigmoid function and the new derived cell state is passed through the tanh function. Finally, the multiplication of the sigmoid output and the tanh output makes the content of the new hidden state which is used for predictions.

$$o_t = \sigma_g(W_o[h_{t-1}, x_t] + b_o \quad (7)$$

$$c_t = tanh_c(W_c X_t + U_c h_{t-1} + b_c \quad (8)$$

$$c_t = f_t \odot c_{t-1} + i_t \odot c_t \quad (9)$$

$$h_t = O_t \odot \sigma_g(c_t) \quad (10)$$

D. Gated Recurrent Unit (GRU)

GRU was a simplified modification introduced in 2014 to the LSTM. GRU is able to solve the vanishing gradient problem arising in RNN using only two gates- update and reset gate[14] .These gates are responsible for passing the previous information to the current state using sigmoid and tanh activation functions[15] .

a) Gru Model Applied

In this paper, one model is applied on each generator. So, 3 models of GRU are trained on the developed dataset A summary of each model applied is provided below:

No of units in input layer: 5 neuron cells each containing the given load on the assigned bus
No of hidden layers added: 6
No of neurons on each hidden layer: 50
Activation function used: Tanh and Sigmoid
Optimizer applied: Adam
Loss function: Mean Squared Error
Epochs: 500
GRU gates: Update gate and Reset gate

Update gate[16] (z_t) is responsible to keep only the relevant part of the previous information for the problem. It uses the sigmoid function to calculate the relevancy of previous information [13] .

$$z_t = \sigma(W^{(z)}x_t + U^{(z)}h_{t-1}) \quad (11)$$

Reset gate[16] (rt) forgets the irrelevant part of the previous information. The sigmoid function helps in measuring the relevancy of the information on a scale of 0 to 1.

$$r_t = \sigma(W^{(r)}x_t + U^{(r)}h_{t-1}) \quad (12)$$

The current memory (h_t) state is calculated using the tanh activation function on the results from reset and update gates. Finally, the results from the update and reset gates are multipliedwith the previous and current memory state to calculate the current unit and pass it on for future predictions.

$$h'_t = \tanh(Wx_t + r_t \odot Uh_{t-1}) \quad (13)$$

$$h_t = \tanh(z_t \odot h_{t-1} + (1 - z_t) \odot h'_t) \quad (14)$$

IV. SIMULATION RESULTS

All the three topologies were applied to the proposed dataset and then training was started with a high loss which decreases with each iteration. The learning curve and comparison curve between prediction and actual values were studied for all three generating units for each ANN architecture. Finally, comparison curves were plotted for the final comparison of all three topologies. We used the Keras library to build and run all the sequential ANN models [17].

A. Performance Comparison

Training curves of all architectures are studied for all three generators named G1, G2, G3. All three architectures have converged to acceptable accuracy in a lesser number of iterations. DFF has performed slightly better than GRU and LSTM on all three generators irrespective of the fact that the other two architectures are modern and complex.

Figure 4. MSE loss on test dataset for the 3 models

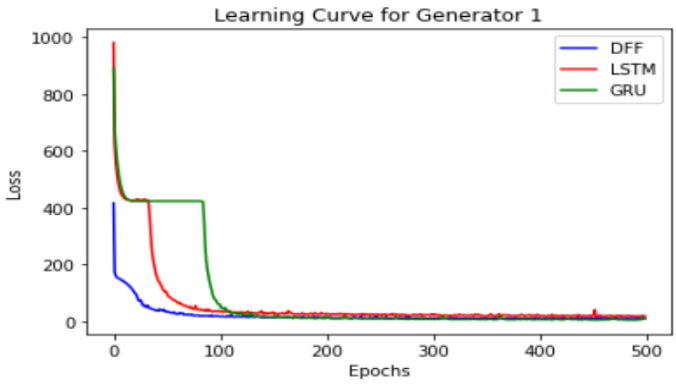

Figure 5. Loss Vs Epoch for Generator1

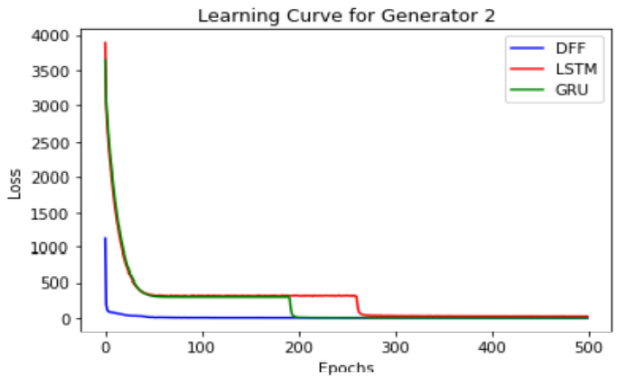

Figure 6. Loss Vs Epoch for Generator2

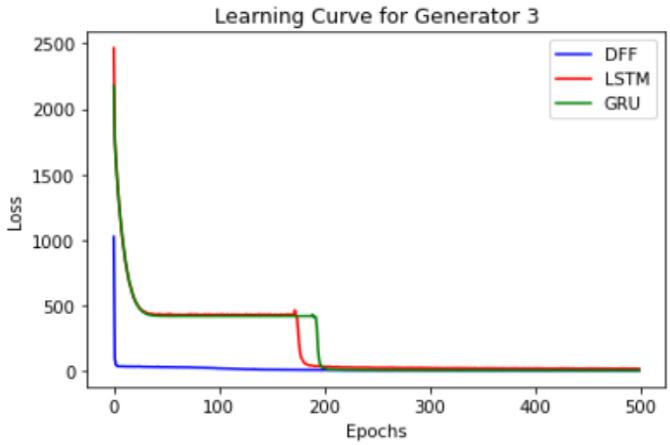

Figure 7. Loss Vs Epoch for Generator3

Table 2. Performance comparison of the experiment

ANN Model	MSE loss values on Test Data.		
	Generator 1	Generator 2	Generator 3
DFF	13.6678	2.8227	3.8296
LSTM	15.2760	3.1170	5.1399
GRU	16.6401	2.8131	3.4041

V. CONCLUSION

This paper presents Deep Feed Forward as the best-suited topology for a non-linear problem of Economic Load Dispatch in comparison to the other two proposed topologies named as Gated Recruitment Unit and Long Short-Term Memory. In DFF, due to less complexity in the structure, both time and learning are optimized to acceptable accuracy. GRU and LSTM have performed well in learning but the time taken is approximately 4 times as compared to DFF and testing loss is slightly greater than the DFF. The performance of GRU and LSTM is somewhat comparable or equal in learning and testing. These results have demonstrated the feasibility of DFF over LSTM and GRU in the case of the non-sequential problem of Economic Load Dispatch.

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Investigation on Food Detection and Nutrients Science using Modern Artificial Intelligence and Machine Learning for Health Care Management

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ABSTRACT - The goal of Artificial Intelligence (AI) is to imitate intellectual processes, knowledge-based management and learning abilities. AI has several uses in the medical research, clinical settings and health care oriented systems. The field of diseases prediction, biomedical, health care application and food sciences has seen an extension of AI-based applications coupled with Machine Learning (ML) in recent decades. An AI with ML have a lot of impending in the areas of risk assessment, medical diagnostics, identification of critical diseases, food safety, healthcare, support for treatment and analyzing the root cause for the disease. The paper's goal is to look at the utilization of AI in the domain of nutritional based science research and the health care system. It illustrates how computer-based decision-making processes works and might assist to improve health and medical treatment. A cutting-edge system built on machine learning that accurately classifies food photos and calculates food qualities automatically. Although machine learning and advanced statistics form the basis of AI, the subject of neural networks is currently undergoing revolutionary developments. In order to improve categorization accuracy, experiments were conducted using a range of food categories, with each category containing many numbers of images.

Keywords: Health Care, Food Safety, Nutrients Science, AI, ML, CNN

I INTRODUCTION

To address this growing concern in food safety and health management, researchers are exploring various approaches to monitor food calorie intake. One such approach is to use technology, such as computer vision algorithms and deep learning models, to classify food images and estimate their calorie content. In this research, experimentation is made with different food categories, each having huge number of images, to train our model. The goal was to develop an accurate and efficient system for food calorie estimation that could be used by individuals to monitor their daily food intake and maintain a healthy diet. The results of this study showed promising outcomes, demonstrating the potential of this technology to support individuals in managing their food calorie intake and promoting healthy eating habits. Nevertheless, more research is needed to refine and improve the accuracy and generalizability of these models across different food types and cultural backgrounds.

The link between obesity and various serious and chronic health conditions has been established, leading the American Medical Association to recognize obesity as a disorder requiring medical attention in 2013. To effectively manage weight and maintain a healthy diet, it is crucial to monitor daily food intake. The traditional method of recording and analyzing food intake over the past 24 hours can be effective, but often leads to patients forgetting or avoiding the use of these programs due to discomfort. Different data's were analyzed for the literature review suggesting various ideas related to health and food management. This paper focuses on AI with nutritional based epidemiology, biomedical oriented nutrients research, and clinical nutrients research. The ML based algorithms were extensively employed in research on the micro-biodata and the influence of nutrients.

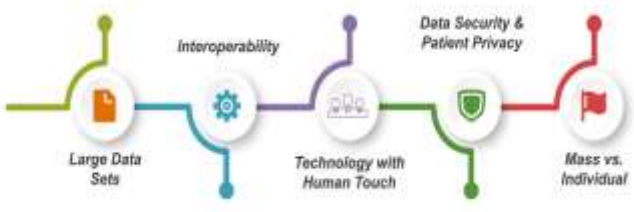

Figure 1: AI in Health Management System

In recent years, interdisciplinary scientific study, political based discussion, and social activism revolved the growing interest using of AI in medicine and healthcare. The figure 1 represents the flow graph for health management system. To maximize the usage of biomedical AI, this information aims towards the benefits of AI in the healthcare and medical based industry, which helps to identify the major risks that are associated with its application. It helps the developers and the physicians' involvement in putting AI-based mediated healthcare that are guaranteed to the security and reverent treatment of patients receiving it.

II SYSTEM DESIGN AND IMPLEMENTATION

The aim is to shed light on the various elements, processes and tools used in the implementation of the system and how they contributed to its desired outcomes and functions. The methodology that is used in this study is a multidisciplinary approach that is based on a comprehensive review and analysis of literature from diverse sources, including biomedical based research, computer science, biomedical ethics, social sciences, law, industry and government oriented reporting. It examines various technical challenges and solutions, clinical research, findings, government recommendations, and best practices that are used of AI in medicine and healthcare. The paper begins by highlighting the potential of AI in addressing pressing problems in medicine, such as an ageing population, increasing chronic diseases, shortage of medical professionals, incompetence of health based systems, health disparities and the lack of sustainability.

This report delves deeper into the specific contributions made and yet to be made by AI in various medical specialties including the cardiology, radiology, digital based pathology, medical risk, emergency based medicine, surgery, prediction of disease, home care application, and mental health in the context of clinical practice. The report highlights the potential benefits of AI for biomedical research, such as clinical trials, drug development, and personalized treatment. Additionally, the report discusses the potential impact of AI on global health and public health. However, the report also acknowledges the potential dangers of AI in medicine and highlights the need for responsible development and distribution of AI systems.

The illustration provided in the report depicts the application of AI in healthcare: In the healthcare domain, these human factors include healthcare professionals, clinicians, and the patients. Even when the robust and accurate, AI technologies are reliant on how humans consume them in the practice and data they provide are employed. Inappropriate use of AI tools can clue to imprecise medical valuation and decision-making, which ultimately detriment the patient.

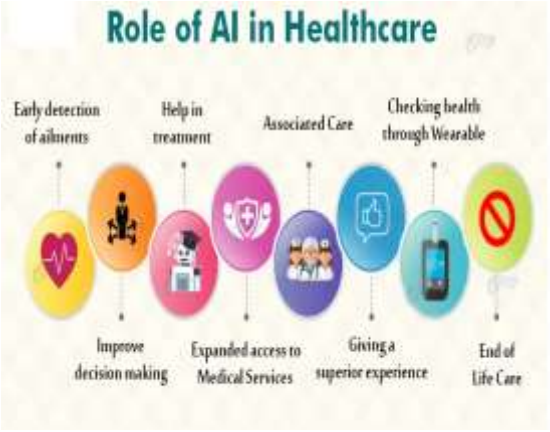

Figure 2: Role of AI in Healthcare

Lack of training in medical AI between the lack of considerate, healthcare oriented professionals, and the illiteracy between the patients, and the growth of eagerly available in mobile and online AI results without enough explanation and information are all potential factors that contribute to the misuse of AI. The absence of clearness in the creation, assessment, and the utilization of AI based tools is a major concern aimed at the technology. Transparency is crucial at two levels: traceability of AI development and usage ability of actual AI decisions.

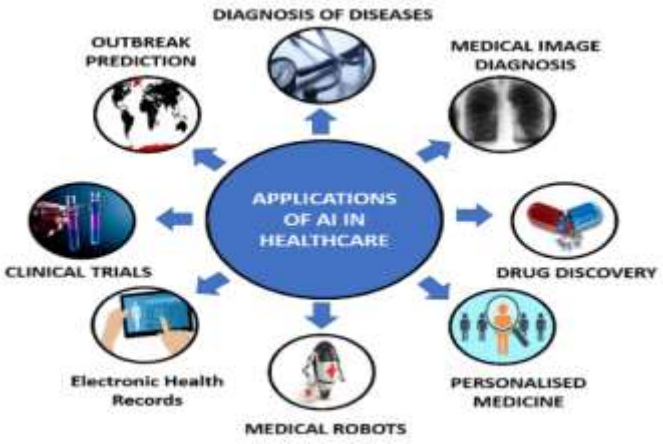

Figure 3. Application of AI in Healthcare

Figure 2 and 3 highlights the role of AI with its application in healthcare. The absence of transparency can lead to a lack of understanding and trust in AI predictions and decisions, difficulty in individually evaluating and reproducing of AI algorithms, problems in recognizing the bases of AI based errors and determining responsibility and limited adoption of AI based tools in the clinical exercise and real-world based settings. These risks and their impact on AI implementation are described in detail in the report.

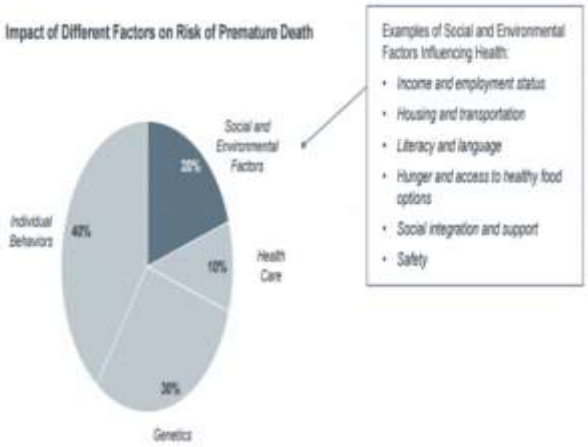

Figure 4: Risk of Premature Death

As a result, it's important to establish clear definitions of accountability and responsibility in the medical AI process. This includes specifying who is responsible for the development, deployment, and use of the AI model and who is responsible for monitoring its performance and ensuring that it is aligned with ethical and safety standards. In order to promote transparency and accountability, it is crucial to establish clear guidelines and regulations for the use of medical AI. This will not only ensure that healthcare professionals are held responsible for their actions, but it will also provide a clear framework for the use and development of AI models. The lack of clear guidelines and regulations can lead to confusion and the potential for harm, which must be avoided at all costs. By establishing clear guidelines and regulations, the medical AI industry can build trust with the public and healthcare professionals, which is essential for the continued growth and development of this field. Different algorithms and approaches to AI in health and health care system are shown below.

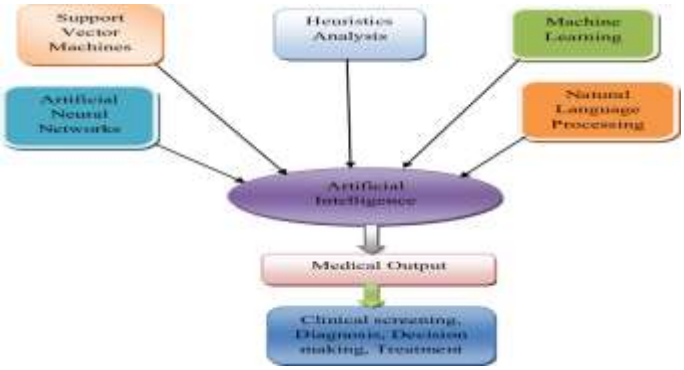

Figure 5: System Flow Diagram

A new structured method of risk management with assessment approach is necessary for the implementation of AI in healthcare and medicine, addressing the technological, clinical, and ethical challenges that arise from its use. Figure 5 explains the system flow of AI in health care. The potential harm and likelihood of harm can be used to categorize and regulate AI concerns through a risk assessment framework. In 2021, the European Commission published a proposal for an AI regulation aimed at harmonizing AI laws across Europe. AI technologies that conflict with EU values are considered illegal and fall into the highest category. Medical AI technologies fall under the intermediate category, considered high-risk AI, and are only approved if they comply with strict guidelines for effective risk based management, like providing human based oversight and conducting the post-market based monitoring.

The proposed AI regulation by the European Commission is a broad approach to regulate AI across all sectors, including healthcare. However, this approach fails to take into account the specific risks and unique characteristics associated with AI in the medical industry. The current regulations, MDR and IVDR, were established when AI was still in its early stages and do not address issues such as identifying algorithmic biases. While the European Commission's proposal attempts to harmonize AI regulation across Europe, it also retains some of the limitations of MDR and IVDR, such as the lack of mechanisms to address the continually evolving nature of medical AI technologies.

The potential for AI in healthcare and medicine is vast, but so are the potential dangers. To mitigate these risks, a structured approach to risk assessment and management is crucial. Some countries had developed the ALTAI assessment checklist, which covers seven elements of reliable AI, including technical healthiness and safety, the human agency and inaccuracy, the privacy and the data governance, and more. However, this approach is not specific to AI in healthcare. A network of research projects and international experts have come together to create consensus recommendations for reliable AI in medicine, known as FUTURE-AI, which includes six categories and a self-assessment checklist to assist with creating trustworthy and ethical AI solutions for the medical industry. It is crucial to detect and manage the potential dangers posed by medical AI through comprehensive evaluations. Despite the importance of evaluating clinical safety, effectiveness, fairness, transparency, and privacy, most research in this field has primarily focused on model accuracy and tool robustness in laboratory settings. To ensure reliable and ethical AI solutions in healthcare, a more comprehensive and multi-faceted evaluation approach is needed. To meet the unique risks and needs of healthcare, it is recommended to enhance AI regulatory frameworks and codes of conduct through domain-specific risk assessment, as different medical specialties may have varying clinical and ethical concerns.

The future of medical AI technology must undergo standardized and comprehensive risk assessment that takes into consideration not just model robustness and accuracy but also clinical acceptance, fairness, safety, transparency, and

traceability. The current regulatory framework must be strengthened to identify and address the multifaceted risks and limitations of AI in healthcare. Multi-stakeholder engagement is crucial for the success of medical AI systems in the real world. AI developers should collaborate with clinicians, patients, social scientists, healthcare managers, and regulators to ensure that the AI tools are designed and implemented in a way that meets the diverse needs and circumstances of the real world. A new approach is needed to promote inclusive, multi-stakeholder participation in medical AI development. Medical AI solutions should be created based on a collaborative and inclusive approach that involves end-users, AI developers, and relevant specialists like biomedical ethicists. This will allow for the creation of AI algorithms that better represent the needs and cultures of healthcare workers and identify potential hazards early on. Additionally, traceability and transparency can be improved by establishing methods such as AI passports that provide standardized information about the AI technology and its lifecycle. The AI passport should include information on models, data, evaluation, usage, and maintenance to provide consistent traceability across nations and healthcare organizations.

AI based systems or autonomous based systems are extensively used in nearly all aspect of technology. This allows for the efficient optimization of issues, computerization of the food industry, and transformation of food industry products. The industry may evaluate and ensure that the best circumstances, like crop monitoring, seed selection, watering, and the temperature monitoring, that can be improved by employing a computerized system, which will result in the perfection of the food sector goods. These are not the only applications of AI. Robotics and intelligent drones are only two examples of intelligent devices that can significantly and critically contribute to reducing the cost of packaging. Food security management and food quality management are the two major categories into which the significant responsibilities of AI in the food industries may be divided.

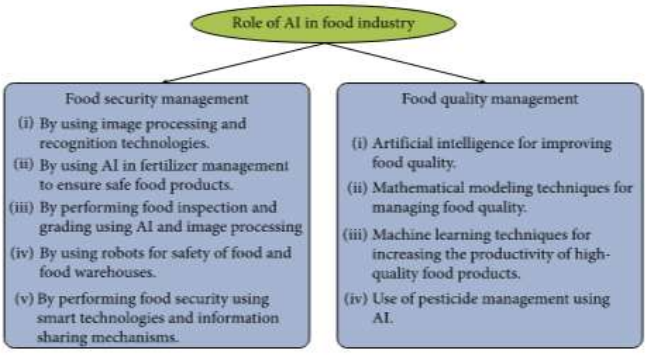

Figure 6: AI in Food Industry

Figure 6 narrates the role and functionalities of AI in food industry. Finally, to improve accountability in medical AI and food AI, the roles and responsibilities of the AI developers, healthcare providers, patients, and regulatory bodies must be clearly defined and effectively monitored.

Figure 7: AI in Food Processing Industry

This can be achieved by incorporating methods of continuous performance assessment, such as monitoring data, performance, and audits. Additionally, creating incentives for all stakeholders to act in a responsible and ethical manner will also contribute to the establishment of a fair and reliable medical AI ecosystem. In order to enhance the validity and efficacy of medical AI technologies, it is important to promote further research on the robustness of its clinical, ethical, and technical aspects. It should focus on areas such as explainability, interpretability, bias mitigation, privacy, and security in AI. Additionally, the development of methods for adaptation to ensure generalizability of AI tools across different populations, therapeutic settings, and geographical locations must also be explored. Furthermore, incorporating uncertainty estimation into medical AI solutions will provide valuable indicators of confidence for clinicians in AI predictions.

III PRE-TRAINED MODEL SELECTION

In this proposed methodology, process is divided it into three separate sections to ensure clear and organized implementation. The first section concentrates on utilizing transfer learning-based Convolutional Neural Network (CNN) models, the second section deals with retrieving text from various sources, and the final section focuses on training the text data.

A. Pre-Trained Convolutional Neural Network Model

In the realm of machine learning, pre-trained network models are employed to overcome the problem of the system becoming trapped in a local solution during the training phase. These models are capable of performing machine learning quickly in response to various inputs. In this method, transfer learning-based CNN model is used to extract attributes from food items in our produced dataset. This approach allows for faster and more accurate recognition and extraction of food attributes.

B. Dataset Preparing and Per-processing Phase

It employs a transfer learning-based Convolutional Neural Network (CNN) to classify food images into their respective categories and extract relevant attributes. Our dataset consists of thousands of food images and approximately 1.8 GB of text data collected from Common Crawl and Scrapy sources. To increase the efficiency of the training data, data augmentation techniques is applied, such as using a spatial transform network to transform the images. The goal of this approach is to enhance the model's ability to classify and extract attributes from food images accurately.

C. Architectural Overview

The system was designed with server-side architecture with the goal of improving the accuracy of pre-trained models. This allows developers and architects to utilize the system by creating their own web-based and Android-based applications on the client side. The three modules in Figure 8 are responsible for processing food names to generate relevant information for training a classification model using CNN. The first module, Text Data Retrieval, retrieves text data from websites by extracting URLs and using Google search, based on the categorized food name provided by a pre-trained model.

The retrieved data is then processed by removing HTML tags and stop words using Python tools and further preprocessed through lemmatization and stemming. The processed text data is used as input for the next module, Text Data Training, which trains the data using the word2vec method. The final module trains the classification model using CNN, which can be used to categorize food items accurately. Figure 8 gives the description of proposed system.

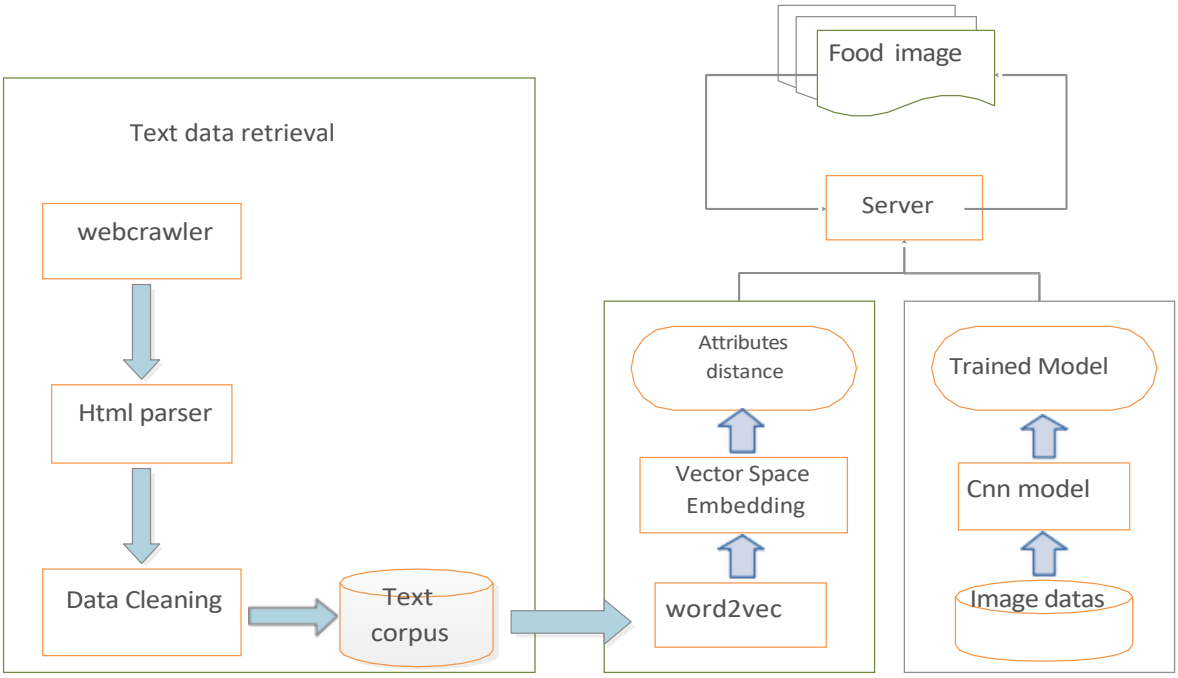

Figure 8: Block Diagram of Proposed System

D. Textual Data Model Training

The vector representation of words is calculated using the Word2Vec machine learning technique, which is a more advanced algorithm than clustering and is used to replace it as a two-layer neural network. The training of text data utilizes three methods, including Word2Vec, Continuous Bag of Words, and Skip Gram, to produce effective results. These methods have been implemented to enhance the accuracy and performance of the text data training process. The attributes and ingredients are initially classified and divided into groups based on their relevance, to facilitate the extraction process. The distance between the attributes and ingredients and their respective classes is determined by fixing the food class and iterating all of the attributes and ingredients against it. The trained Word2Vec model is used to extract traits and components from the text data. The corpus of text data is then trained using Word2Vec to obtain vector space embedding for semantic similarity. These models can predict the features and attributes of an image based on the input provided. The classification and division of attributes and ingredients play a crucial role in determining the distance between them and their associated classes.

The proposed system starts with the creation of picture and textual data, which leads to the final stage of categorization and identification of ingredients and attributes. The gathered food photos are preprocessed using data augmentation to increase the diversity of the data. The pre-trained CNN model is then trained and fine-tuned to

improve its accuracy. The categorization phase begins with user input and uses the output from the previous stage as input for the attribute estimation model. The attribute estimation model is created by first preprocessing the raw text data and using the Word2Vec program to generate vector embeddings based on the distances between the words. These embeddings serve as the basis for the attribute estimation model to predict relevant ingredients or attributes.

IV RESULTS AND EVALUATION

Before our system can classify images in the dataset, training is necessary. The training process takes place on a Linux-based operating system, with Python 2.7 and 3.6, and the Anaconda Python distribution being installed. The Anaconda environment is set up by using specific commands, followed by the installation of essential packages like Theano, Pygpu, and Keras within the environment. The model is implemented using Python and the Keras package with Tensor Flow. Experiments with several CNN models were conducted to extract features from around 50,000 photos, with the Inception model having the best accuracy of 91.73%. The final two convolutional blocks were trained by deleting the final fully connected layer from the Inception model and adding previously trained weights to the new model. To combat over fitting, techniques such as data augmentation, batch normalization, dataset enhancement, and regularization were used, along with multi-crop evaluation during prediction.

Table 1: Comparison of models in terms of Single and Multiple Crops

Model		Top-1	Top-2	Top-3	Top-5
Inceptionv3	Single corpus	79.8%	87.9%	91.6%	95%
	Multiple corpus	89.12%	-	-	98.31%
Inceptionv4	Single corpus	83.8%	89.8%	92.4%	94.7%
	Multiple corpus	91.73%	-	-	98.56%
V4-101	single corpus	78.3%	85.4%	88.2%	91.2%
	Multiple corpus	-	-	-	-

After conducting thorough research and testing, the Inception-v3 and Inception-v4 Convolutional Neural Network (CNN) models were selected for the proposed problem domain as they consistently showed better performance compared to other models. These models were fine-tuned using both custom created datasets and Food-101 datasets to further improve their accuracy and compare their performance. The fine-tuning process involves adjusting the parameters of a pre-trained model to better fit the specific problem domain, in this case, food classification. The results of this process showed that the Inception-v3 and Inception-v4 models have a high level of accuracy and are suitable for use in our proposed system.

Figure 9 a. Top-1 Most accurate of inception-v4 model

Figure 9 b. Top-1Least accurate class

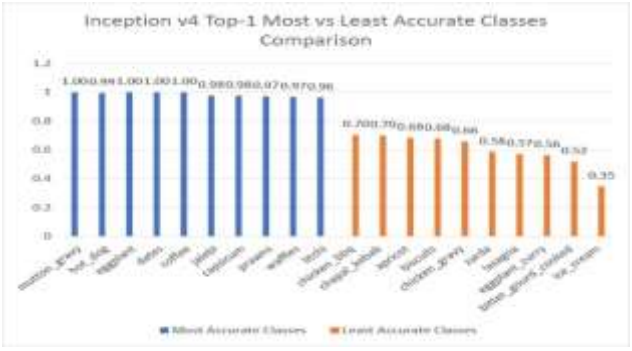

Figure 10: Comparison of top-1 Most Vs Least accurate classes

Figure 11.a Top-1 Accuracy comparison

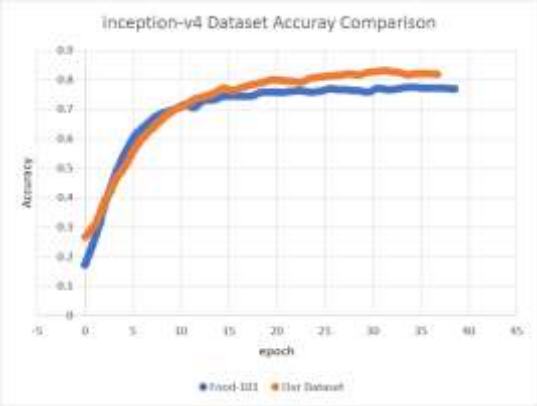

Figure 11.b Inception-v4 model based performance

V. FUTURE WORK

This section explains the drawbacks current and improvements as future work.

A. Recognition and Detection of various food

With existing techniques, it is challenging to identify and analyse mixed physical representations. They do not include cooked, liquid, or composite foods like sandwiches and salads. In a subsequent study, the issue of processing a mixed food image and a physical image that resembles cooking by combining image segmentation technique solves the issue of the image having oblique edges or each other causing the recognition detection to fail.

B. Enhancement of Systems and Datasets

The outcomes of the detection are significantly influenced by data sets and features. Existing data sets are insufficient and only include a small number of characteristics, such as diverse backgrounds, camera angles, lighting conditions, etc. Better review methodologies [13] should be utilized in future studies to examine different kinds of data sets. The system and application are also architecturally improved, and to process the image, a database for calculating values, food labels, and other parameters is integrated with a quicker lookup method.

C. Calories Awareness and Nutrition aware

Understanding calorie calculations and their significance is crucial. The literature [13] addresses the field's issues in light of a brief fast food questionnaire, while the literature [14] employs gaming techniques to gather more food and calorie information. By adding additional calories to evaluate nutritional attributes and combining with deep learning techniques, the basic understanding of calorie computations among users can be improved.

VI CONCLUSION

At this time, obesity is a major issue for people. People are curious about measuring their weight and maintaining a healthy diet. This methodology presents a fresh way to give us knowledge about the kind of food we eat and its properties. Using a range of AI and ML methodologies, food analysis, awareness, risk, health, and safety-based variables are investigated. The algorithm will tell us of the features of the dish once it has correctly classified the user-provided food photograph. A dataset that includes a typical Food-101 meal and food from the subcontinent has been used by our system. In order to recognize food items, modification is done with the Inception V-3 and V-4 models. The proposed method determines the attributes of the food using the attribute estimation model. The results are enhanced via data augmentation, multi-cropping, and other related techniques. The categorization and attribute extraction accuracy of our recommended method is very high at 89%. Further potential improvements to the system's accuracy and usability can be enhanced in future.

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Green Material Optimum-Selection Driven by Digital Twins for Sustainable Manufacturing

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Abstract- In product design material selection and qualities are crucial. Environmental considerations should be incorporated in addition to technical and financial considerations in order to produce more sustainable products. The assessment indicators of the materials are supplied to meet the standards. This technique establishes an ideal evolution model first, which is a developing, high-fidelity digital twin of the actual object. The gathered digital and physical data are then combined. The performance of choosing green materials is analysed and simulated using the mode and fused data.

I.INTRODUCTION

Nowadays, material selection is crucial to consider the materials used in a manufacturing process. It has a significant impact on the product life cycle. Designers should take into account a wide range of criteria when choosing materials. Prior to now, the selection process was either cost- or product- or design-oriented. However, environmental worries have become worse recently. Thus, it turns into a decision issue with numerous criteria. Cost, mechanical qualities, process performance, among other factors, are taken into account when deciding which materials to utilise for a sustainable product design. Technical, economic, and environmental considerations are all part of the requirements for material selection. Sustainable manufacturing, which aims to cut costs, ensure product performance, and lessen environmental effect throughout the product's life cycle, heavily relies on the choice of green materials [1]. Although there are often trade-offs between physical property, cost, and the environment, the design aims and criteria in the material selection process are frequently in conflict. Additionally, each material performs differently in terms of its material properties [2].Green material optimal selection (GMOS) has historically been an optimization challenge that is reliant on the individual professional knowledge and experience of the designer. Furthermore, virtual layer algorithms and models served as the driving force for current GMOS research [3]. Numerous scholars used advanced computer software tools, optimization algorithms, and mathematical techniques to study this issue. Artificial neural networks and a genetic algorithm approach to GMOS optimization were proposed by Zhou et al. [4] in terms of optimization algorithms. Beiter et al. [5] created an expert system in complex computer software tools to do reasoning for the selection of plastics materials. Burkhardt et al. [6] investigated corrosion simulation and field analysis for the material selection of decoupling elements in simulation.

II DIGITAL TWIN-BASED EVOLUTION MODEL

Candidate materials are used in a variety of simulations, projections, and decision-making processes to simulate the whole life cycle of a sustainable manufacturing process, including design, production, transportation and logistics, recycling and remanufacturing, servicing, and so forth. The predicted characteristics derived from each simulation or careful examination in virtual space is compared to the anticipated qualities in actual space. If the comparison result is not achieved, the aforementioned simulation, prediction, and decision-making will proceed under different experimental conditions. The whole thing is an evolutionary process. Up until the predicted attributes are reached, the candidate material will be selected and manufactured. The ultimate objective of GMOS is to physically portray a product's true attributes. The mode of the GMOS based on DT is shown in Figure 2. Each possible material must have its properties anticipated via simulation in order to preserve consistency. The ultimate goal is to get the assessment results based on the predicted characteristics data and evaluation model.

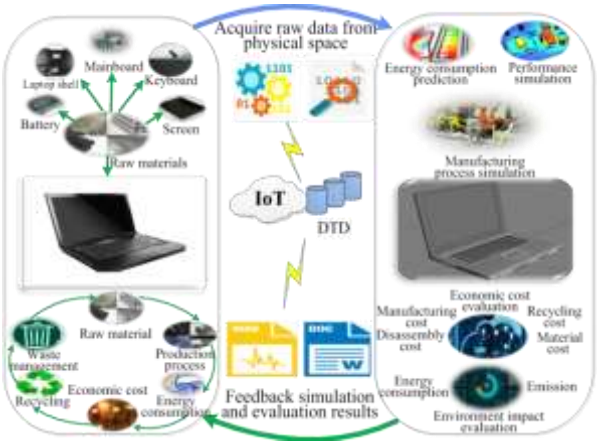

Figure.1.Digital twin driven green material optimal selection [7]

A. Digital Twin 5-D Model

The 5-D model proposed by Tao et al. [7] has currently gained widespread acceptance, and it can be represented as follows. M_{DT}=(PE,VE, DD, Ss,CN), where PE stands for physical entity, VE stands for virtual entity, DD stands for Digital Twin Data, Ss stands for Service for PE and VE, CN stands for connection among PE,VE,DD and Ss

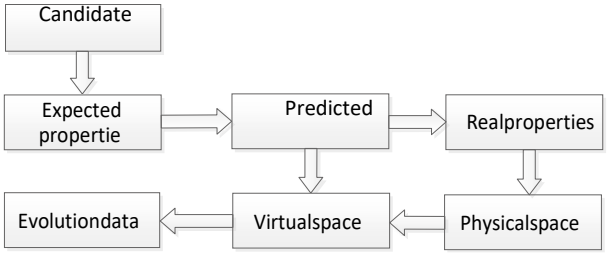

Figure.2. The mode of GMOS based on DT

III 5D-EDTM driven GMOS method

Over 277 million laptop were created in 2017, claims the report. Additionally, a laptop's shell is a crucial component that affects the device's functionality, price, and environmental impact. GMOS for laptop shell is a subject worth researching as a result. The method outlined above will be utilised to optimise the material choice for the laptop casing. 5D-EDTM.Three sets of indicators, namely physical properties, economic properties, and environmental qualities, are used to categorise the design requirements in step 1. Candidate materials are then screened in accordance with the design criteria [14]. These potential materials include engineered plastics, carbon fibre, magal, and titanium alloy (EP). In Step 2, X = {Magal, titanium alloy, carbon, engineering plastics} and define {x_1=magal, x_2=titanium, x_3=carbon, x_4=engineering plastics}, then load X to 5D-EDTM the GMOS is executed until i=4. As shown in Fig.3 .For the purposes of virtual space, physical space, and service modules, GMOS has evolved through four incarnations. Through data fusion and connection, the evolutionary optimization model is updated after each iteration. GMOS for the 5D-EDTM-based laptop shell is depicted in Fig.3.Data from the physical and virtual worlds are combined in step 3.

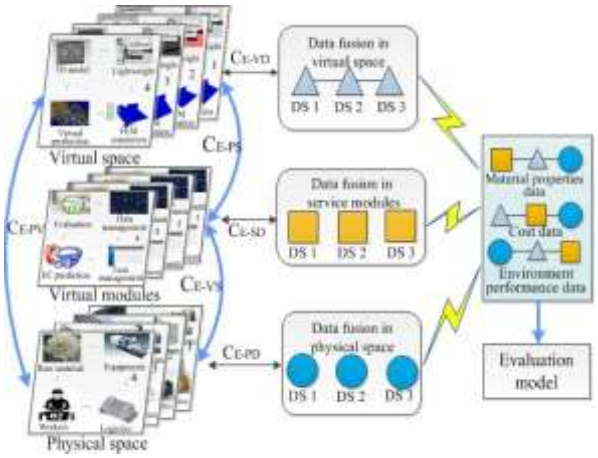

Figure.3. Green material optimal selection for laptop shell base on 5D-EDTM

These data include predictions, material property data, simulation data, and more. These combined data will be utilised as assessment criteria and indicators to assess the effectiveness of the item. $Evaluation\ Grade = \sum_{i=1}^{i=n} \frac{I_1+I_2+I_3}{n} + \cdots (0 < I < 1)$. I_i is evaluation for related indicators from evaluation models [15].

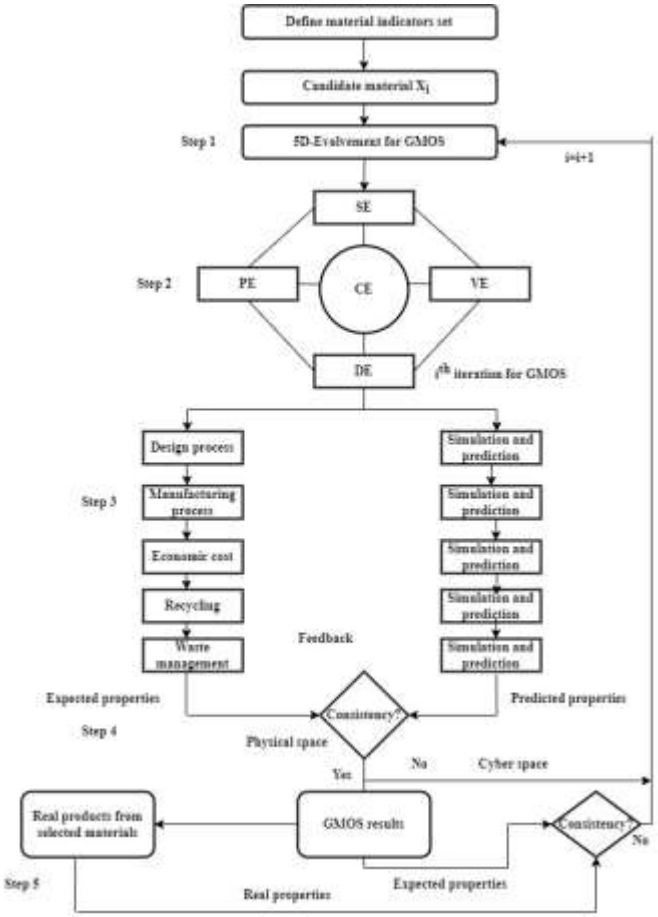

Figure.4. The process of 5D-EDTM driven GMOS Method

Table 1. The Result of Material Iterative Optimization

Iteration	Material	Design Objects	Parameters	Evaluation Score
1	Magna	Effectiveness	Strength, Toughness, Density Stress, Compressive stress, Heat Resistance, Cost of Processing, Material, After Sale, Recycle Waste, Energy Consumption	M1
		Worth		M2
		Atmosphere		M3
2	Ti Alloy	Effectiveness		T1
		Worth		T2
		Atmosphere		T3
3	Carbon	Effectiveness		C1
		Worth		C2
		Atmosphere		C3
4	Engg Plastics	Effectiveness		E1
		Worth		E2
		Atmosphere		E3

IV CONCLUSION AND FUTURE WORK

The GMOS is the primary process in product design, and its effects can be quite important because they have an impact on not only the cost, EC, manufacturing method, and recycling of the product, but also its function and quality. This research offers insight into DT driven GMOS and a direction for future work in order to accomplish the accuracy and efficiency of GMOS. The primary contributions are summarised as follows: (1) GMOS was the first system for which the 5D-EDTM idea was developed. (2) The DT-driven GMOS approach was presented and investigated. (3) The evolution of the 5D-EDTM is demonstrated using a laptop shell casing. The research still needs a lot more effort and is now in the early exploring stage. Future research will concentrate on the following topics: (1) analysing data fusion in 5D-EDTM, (2) exploring feature synchronisation in 5D-EDTM, (3) evaluating the rules and system of DT driven GMOS, and (4) using DT driven GMOS in sustainable manufacturing.

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A Study on Effective Gender Assortment towards the Worker's Endorsement in the Engineering College, Salem District, Tamil Nadu

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Abstract -- The delivering of the employee assortment is the fact that every single individual is distinguishing, and on the topic of their inimitability could be like their race difference, gender difference, age difference, class difference and physical ability difference, along with sexual grouping and religious inclination. Gender assortment in more important in the field of professional teaching and this paper is highlighting the aspects of gender assortment consequences on the workers endorsement in the Engineering College located in Tamil Nadu and focus on one district Salem. In Salem District at the time of research there are 24 Engineering colleges with statically data of 2336 workers are in teaching and the sample taken for survey is 331 workers from all the categories. The survey collected by using Structured Questionnaire which is focus on gender assortment oriented. The descriptive research design is used for this research. To measure the hypothesis, the researcher used the following tools like Correlation Analysis, independent T Test sampling. The output of this research paper shows that there is a important affinity between gender assortment and worker enactment in engineering college. The research work proves there is no important affinity lies in the gender assortment and workers endorsement.

Key Words: Gender Assortment, Endorsement, Effective

I. INTRODUCTION

Workers are assorted by various dimensions they are by age, gender, education qualification, religions, experience and income also one of the factors. The effective gender assortment depends on the workers endorsement while in the field of education assortment by gender varies by handling the students and the way of approach as big deal the way of teaching also differs. In the greater education even, government have taken more steps to eliminate the assortment among the workers, by enormous training and development programme. To investigate the affinity between the gender Assortment and workers Endorsement in engineering colleges at Salem District. possibility of the study

REVIEW OF LITERATURE

Gender Assortment, Sean Dwyer ET al (2003) examining the factor causing of gender assortment in management on firm's Endorsement. The study suggested that the gender assortment will be effect on the management levels which is tempered by the firm's strategic orientation path, the organizational culture which resides, in the multivariate interaction among these variables.

Ali Ahmadi ET al (2018) examined the affinity between the two aspects of the Duality Role of Chief Executive Officer (CEO) and the CEO tenure, on the board structures and gender Assortment have two activity on Endorsement in listed companies in CAC 40.

Almudena Barrientos Báez ET al (2018) explored the status of gender Assortment in corporate governance and its implications to corporate Endorsement and emotional intelligence.

Daniel Fox ET AL (2019) examined that there are gender disparity in the salaries of K-12 educators with others. This study reveals that an important part of the gender gap relay on the male educators with earning additional income outside of their primary teaching salary. Trong Tuan Luu ET AL (2019) investigated how to do the assortment-oriented HR practices, that address about the gender assortment and on their value of employee Assortment contribution towards employee work engagement.

II. RESEARCH METHODOLOGY

The researcher used the research design of cross sectional research. The sample population is 2236 among which 331 sample size is chosen for the study. The research tools used for measuring the affinity between the the gender assortment and worker endorsement are descriptive methods of mean and

Standard Deviation to rank the factors and Independent T Test sample and Correlation analysis.

H1: There is a significant affinity between the gender Assortment and workers Endorsement in engineering colleges at Salem District.

H2: Gender have not equal means on effective workforce Assortment in the engineering colleges at Salem district.

Table 1: Gender of the Respondents

Gender	**Frequency (f)**	**Percentage (%)**
Male	168	50.8
Female	163	49.2
Total	331	100.0

III. DATA INTERPRETATION

A. Central Tendencies of Measurement of Variables

The measurement of central tendencies was used to measure and fix the level of agreement of the respondents on each item of the variables, like gender Assortment, age Assortment, educational background Assortment, organizational tenure Assortment, work experience Assortment, religion Assortment and in their institution.

Table 2: Central tendencies measurement of construct of gender on Endorsement

Mean		**Std. Deviation**	
A1	The workers are not been discriminated by the employer while hiring and recruiting based on gender basis.	3.2840	1.19253
A2	There is a proper mix of males and females in the organization	3.0121	1.17028
A3	There are females in top management	2.8671	1.09842
A4	There is no gender bias during the Endorsement appraisal process. Increments and promotions are purely given on the merit basis.	2.9607	1.10986
A5	Male & female workers are treated in a fair & equal manner.	3.2659	0.98258
A6	I feel comfortable working with the opposite gender	3.6224	1.08124
A7	Working with opposite gender helps me increase my Endorsement	3.3172	1.02940
A8	Women's were involved in the organization's decision making as much as men.	3.2326	1.04314
A9	The organization's T&D program is developed to meet the criteria/requirement of the male and female.	3.1843	1.20070

Based on the findings in Table 2 above, the respondents agreed about the "The workers are not been discriminated by the employer while hiring and recruiting on gender basis" (Mean = 3.2840; STANDARD DEVIATION = 1.19253). Furthermore, the respondents agreed that "There is a proper mix of males and females in the organization" (Mean = 3.0121; STANDARD DEVIATION = 1.17028), "Male & female workers are treated in a fair & equal manner" (Mean = 3.2659; STANDARD DEVIATION = 0.98258), "I feel comfortable working with the opposite gender" (Mean = 3.6224; STANDARD DEVIATION = 1.08124), "Working with opposite gender helps me increase my Endorsement" (Mean = 3.3172; STANDARD DEVIATION = 1.02940), "Women are being involved in the organization's decision making as much as men" (Mean = 3.2326; STANDARD DEVIATION = 1.04314), and "The organization's T&D program is developed to meet the criteria/requirement of the male and female" (Mean = 3.1843; STANDARD DEVIATION = 1.20070).

On a different note, the respondents gave a neutral response on that "There are females in top management" (Mean = 2.8671; STANDARD DEVIATION = 1.09842). Furthermore, the respondents gave a neutral response on that "There is no gender bias during the Endorsement appraisal process. Increments and promotions are purely given on the merit basis" (Mean = 2.9607; STANDARD DEVIATION = 1.10986).

IV. CORRELATION ANALYSIS

The statement of possibility is given below:
H0: There is no significant affinity between the gender Assortment and workers Endorsement in engineering colleges at Salem District.
H1: There is a significant affinity between the gender Assortment and workers Endorsement in engineering colleges at Salem District.

Table 3: Correlation of gender Assortment and workers Endorsement

Gender Assortment		**Workers Endorsement**	
Gender Assortment	Pearson Correlation	1	0.038
Sig. (2-tailed)		0.490	
Employee Endorsement	Pearson Correlation	0.038	1
Sig. (2-tailed)		0.490	

From the above table 3, it can be seen that the correlation coefficient (r) equals 0.038, indicating a positive correlation at the same time no significant affinity between the gender Assortment and workers Endorsement. Since p-value (0.490) > 0.05, we accept the null possibility. It was concluded that there

is no important affinity between the gender Assortment and workers Endorsement

V INDEPENDENT SAMPLE T TEST

Gender wise opinion of workers regarding the workforce Assortment in the engineering colleges.

H0: Gender have equal means on effective workforce Assortment in the engineering colleges at Salem district.
H1: Gender have not equal means on effective workforce Assortment in the engineering colleges at Salem district.

Table 4: Group Statistics for gender wise opinion of workers regarding the workforce Assortment in the engineering colleges

Workforce Assortment	Gender	N	Mean	Std. Deviation	Std. Error Mean
Gender Assortment	Male	168	3.1905	0.85438	0.06592
	Female	163	3.2515	0.83403	0.06533
Age Assortment	Male	168	3.7262	0.68081	0.05253
	Female	163	3.7301	0.67642	0.05298
Educational Background Assortment	Male	168	3.4583	0.69948	0.05397
	Female	163	3.3988	0.72470	0.05676
Organizational Tenure Assortment	Male	168	3.8690	0.67955	0.05243
	Female	163	3.7975	0.62023	0.04858
Work Experience Assortment	Male	168	3.9583	0.69519	0.05363
	Female	163	3.9877	0.67575	0.05293
Religion Assortment	Male	168	3.5893	0.91121	0.07030
	Female	163	3.6258	0.81715	0.06400

The table 4 shows that the sample sizes used for our t test are 168 (Male) and 163 (Female).

i. Male have an average 'Gender Assortment' score of 3.1905 whereas the female scores 3.2515.
ii. Male have an average 'Age Assortment' score of 3.7262 whereas the female scores 3.7301.
iii. Male have an average 'Educational Background Assortment' score of 3.4583 whereas the female scores 3.3988.
iv. Male have an average 'Organizational Tenure Assortment' score of 3.8690 whereas the female scores 3.7975.
v. Male have an average 'Work Experience Assortment' score of 3.9583 whereas the female scores 3.9877.
vi. Male have an average 'Religion Assortment' score of 3.5893 whereas the female scores 3.6258.

Table 5: Independent-Samples T Test for gender wise opinion of workers regarding the workforce Assortment in the engineering colleges

Workforce Assortment		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
Gender Assortment	Equal variances assumed	0.010	0.920	-0.658	329	0.511	-0.06106	0.09284	-0.24369	0.12157
	Equal variances not assumed			-0.658	328.987	0.511	-0.06106	0.09280	-0.24362	0.12151
Age Assortment	Equal variances assumed	0.009	0.922	-0.052	329	0.959	-0.00387	0.07461	-0.15065	0.14291
	Equal variances			-0.052	328.813	0.959	-0.00387	0.07461	-0.15064	0.14289

	not assumed									
Educational Background Assortment	Equal variances assumed	0.133	0.716	0.761	329	0.447	0.05956	0.07828	-0.09443	0.213555
	Equal variances not assumed			0.760	327.587	0.448	0.05956	0.07832	-0.09452	0.213564
Organizational Tenure Assortment	Equal variances assumed	0.736	0.392	0.999	329	0.319	0.07150	0.07157	-0.06930	0.212330
	Equal variances not assumed			1.000	327.784	0.318	0.07150	0.07148	-0.06911	0.212211
Work Experience Assortment	Equal variances assumed	0.614	0.434	-0.390	329	0.697	-0.02940	0.07539	-0.17770	0.118990
	Equal variances not assumed			-0.390	328.999	0.697	-0.02940	0.07535	-0.17763	0.118984
Religion	Equal	3.3	0.0	-0.	329	0.70	-0.03	0.09523	-0.2	0.150
Assortment	variances assumed	38	69	383		2	648		2382	85
	Equal variances not assumed			-0.384	326.991	0.701	-0.03648	0.09507	-0.22351	0.150 55

Table 5 explores that Independent-Samples T Test used for gender wise opinion of workers regarding the workforce Assortment in the engineering colleges.

i. Gender have equal means on 'Gender Assortment', because the mean 'Gender Assortment' scores did not differ, t (329) = -0.658, p = 0.511. The population means are equal that is the p-value (0.511) which is greater than the significance level of 0.05. Hence, the null possibility are recognized, there is relationship between the gender and gender assortment and the alternative possibility rejected.

ii. Gender have equal means on 'Age Assortment', because the mean 'Age Assortment' scores did not differ, t (329) = -0.052, p = 0.959. The population means are equal that is the p-value (0.959) which is greater than the significance level of 0.05. Thus, the null possibility are recognized that there is relationship between the gender and age assortment and the alternative possibility rejected.

iii. Gender have equal means on 'Educational Background Assortment', because the mean 'Educational Background Assortment' scores did not differ, t (329) = 0.761, p = 0.447. The population means are equal that is the p-value (0.447) which is greater than the significance level of 0.05. Therefore, the null possibility are recognized, that there is relationship between the gender and the educational background assortment and the alternative possibility rejected.

iv. Gender have equal means on 'Organizational Tenure Assortment', because the mean on 'Organizational Tenure Assortment' scores did not differ, t (329) = 0.999, p = 0.319. The population means are equal that is the p-value (0.319) which is greater than the significance level of 0.05. So, the null possibility are recognized, that there is a relationship between the gender and the organization tenure assortment and the alternative possibility rejected.

v. Gender have equal means on 'Work Experience Assortment', because the mean 'Work Experience Assortment' scores did not differ, t (329) = -0.390, p = 0.697. The population means are equal that is the p-value (0.697) which is greater than the significance level of 0.05. Accordingly, the null possibility are recognized, there is a

relationship between the gender with work experience assortment and the alternative possibility rejected.

vi. Gender have equal means on 'Religion Assortment', because the mean 'Religion Assortment' scores did not differ, t (329) = -0.383, p = 0.702. The population means are equal that is the p-value (0.702) which is greater than the significance level of 0.05. Consequently, the null possibility are recognized, there is a relationship between the the gender have relationship with religious assortment and the alternative possibility rejected.

Therefore, it is concluded that gender have equal means on effective workforce Assortment (Gender Assortment, Age Assortment, Educational Background Assortment, Organizational Tenure Assortment, Work Experience Assortment, and Religion Assortment) in the engineering colleges at Salem district since their p-values (0.511, 0.959, 0.447, 0.319, 0.697, and 0.702 irrespective) which are greater than the level of significance level of 0.05. Therefore, the null possibility are recognized, there are relationship between the the gender, age, educational background, organization tenure assortment, work experience and religious assortment and the workers enactment

Therefore, the null possibility are recognized and the alternative possibility rejected.

In state to comparing the samples means of marital status wise opinion of workers regarding the workforce Assortment in the engineering colleges at Salem district. The Independent-Samples T Test was conducted and results were given below.

VI FINDINGS AND SUGESSTION

To investigate the affinity between the gender Assortment and workers-endorsement in engineering colleges at Salem District.

i) With regard to 1stpossibility (H_1), the result reveals that there is a positive correlation at the same time no significant affinity between the gender Assortment and workers Endorsement.

ii) Regarding 2NDpossibility (H_7), the result indicates that gender have equal means on effective workforce Assortment (Gender Assortment, Age Assortment, Educational Background Assortment, Organizational Tenure Assortment, Work Experience Assortment, and Religion Assortment) in the engineering colleges at Salem district.

VII SUGGESTION

All genders ought to be treated in a reasonable and equivalent way. There ought to be no sexual orientation predisposition at the season of Endorsement evaluation or promotions. Management of engineering colleges should keep on promoting equivalent career growth opportunities for all sex. To energize gender Assortment, managements should make adaptable working strategies that can assist female workers with managing their work and their own life (work-life balance) without conflicts. The management ought to likewise endeavor to screen their measurement by checking occasionally the rate of male and female in the organization, the rate of promotion for male and female and even the normal salary of the two sexes at each dimension in the organization. By doing this, they can make sure to see whether their strategies are supporting Assortment as far as contracting both male and female, advancement and maintenance.

VIII CONCLUSION

The study on effective gender assortment towards the worker endorsement in engineering colleges, article is an eye opening for the gender assortment reflection in the endorsement of their work, the assortment based on the gender is the part of their endorsement, this can be rectify by the rational treatment of the male and female in the endorsement appraisal. This has to be started from the salary, responsibility distribution by promotions and the training which make them to balance their work and the own life without conflict. Compare to the male, female can be given leaves and extra privileges not the monetary benefits.

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Reliability Determination of a Complex Engineering Item Under the Distributional Setup

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Abstract: This paper proposes a technique for finding reliability of a complex system in terms of design parameters where exact analytical determination of reliability is difficult to manage. Here we have established reliability approximation of tensile stress of an element under the Weibull setup. Numerical studies of this approach have also been cited. Numerical studies indicate that the proposed technique gives very good approximation of reliability of complex systems under stress-strength set-up. This technique is conceptually simple, handles analytic intractability and reduces computational time. This technique can be employed in manufacturing industries for production of high-reliable items.

Keywords: Stress strength model, Reliability bounds, Approximation, Extent of error, Engineering Item.

I INTRODUCTION

To find the system reliability, the application of stress strength model, is gaining momentum in the hands of reliability engineers during the early stages of product design. Under this model reliability is defined as the probability of the event that random stress (S) is less than the random strength (Y). If we know the stress and strength distribution then reliability can be computed in term of the parameters of those distributions. If we know the stress and strength distributions, ordinary transformation techniques due to Parzen [1] can be applied for the computation of system reliability. When stress and strength variables are made of multiple stochastic factors then problem arises in computation of reliability. The inference theory approach for reliability prediction due to kapur and Lamberson [2] fails because for a complex system stress or strength distributions are mostly unknown.

Taylor-series method, Monte-Carlo method, Quadrature method, Discretization Method and Discrete concentration method are existing approaches for estimating reliability of complex engineering items. To approximate the stress or strength distribution, Taguchi [3] proposed a factorial experiment approach which discretizes a continuous variable by a 3-point discrete distribution. D`Errico and Zaino [4] modified Taguchi`s concept for discretizing stress and strength variables based on moment equalization. English et al [5] applied this moment equalization rule in the stress-strength setup. Roy and Ghosh [6] proposed to discretize a continuous random variable by equating the raw moments of the original distribution and they discretized distribution. Discretization of Exponential distribution was carried out by them. Barbiero [7] proposed a discretizing method for reliability estimation in complex stress-strength model. Roy and Dasgupta [8] depicted discretizing procedure using discrete concentration of Roy [9] and they gave a new approximating technique by using survival function. This method is mentioned as method of discrete concentration. Roy and Dasgupta [10] suggested a discretization approach by using a survival function of a continuous random variable. approach for the Weibull distribution also. Ghosh et al [12] depicted the usefulness of discretization of a random variable using the reversed hazard rate function.

Nayak and Roy [13] described bound based reliability approximation under the Weibull, Rayleigh and Exponential setups for simplified form of I-beam.. Nayak and Roy [14] also studied a new approach for approximating reliability of a complex system under the Weibull setup. Here they approximated reliability of I-beam. Nayak [15] described reliability approximation of hollow rectangular tube under the Weibull and Rayleigh setups. Nayak et al [16] computed reliability of solid shaft under the Gamma set up. Nayak and Roy [17] also depicted bound based reliability approximation of an engineering item, resistor under the stress-strength model. Nayak and Seal [18] has determined reliability values of Ball bearing under the Weibull frame work.

Here we have proposed reliability approximation of tensile stress under the Weibull set up. Extent of error is also established for this important engineering item.

II RELIABILITY APPROXIMATION APPROACH

Finding of exact reliability of a complex system is mostly analytic hard. We have already mentioned that some techniques are available in the literature for approximating the reliability for intractable cases. But some drawbacks are observed in their work. All the approaches, mentioned above suffer from locking effects in the sense that the approximated reliability values remain constant towards changes in the value of the strength parameter. The author's have concentrated on simulation study. But further manipulation in terms of design parameter can`t be under taken under their approaches. There are cases where discrete

approximations are extremely weak. For instance, under the Exponential setup where lack of memory property holds, the discretization approach doesn`t offer close approximate value.

So to bridge this gap of this field, we propose an efficient approach to approximate reliability of complex engineering items accounting for competitor pricing reaction. The current proposed work aims at offering a different approach for reliability approximation so that one not only gets a clear idea about the extent of error but also can manipulate reliability in terms of design parameters. Our approach can be applied in manufacturing industries for producing high reliability items. Actually this approach will help to improve the manufacturing industries. Our proposed procedure can be implemented to other methods available in the literature for the evaluation of reliability in stress strength model, where stress and strength are two functions of different stress and strength r.v. components. Our proposed approach is as follows Here we have proposed average of the two bounds as the reliability approximation and half of the absolute deviation between the two bounds as the extent of error. It is a crucial alternative in approximating system reliabilities of complex system where analytic methods fail to offer a closed-form solution. Our proposed reliability approximation is a function of the design parameters and the corresponding error-bound can be easily calculated. Let U and L are the upper and lower reliability bounds respectively. The corresponding reliability approximation, R_{approx}, and extent of error are given as follows:

$$R_{approx} = \frac{U+L}{2}$$

The extent of error is given by

$$\text{Error} = |R - R_{approx}| = |R - \frac{(U+L)}{2}|$$

Since $R \leq U$

$$R - \frac{(U+L)}{2} \leq U - \frac{(U+L)}{2} = \frac{(U-L)}{2}$$

Similarly, $R - \frac{(U+L)}{2} \geq L - \frac{(U+L)}{2} = \frac{(L-U)}{2}$

Therefore, $|R - \frac{(U+L)}{2}| \leq \frac{(U-L)}{2}$

Thus, Error $\leq \frac{(U-L)}{2}$

On the basis of distributional assumption, we will determine upper and lower bounds of reliability of tensile stress. So, Extent of error will be obtained in terms of distributional parameters.

III. RELIABILITY BOUNDS UNDER THE WEIBULL SETUP

Weibull set up would be more appropriate description of any engineering item as it provides an excellent way to focus on both burn-in and burnout phenomena and can model increasing failure rate (IFR) and decreasing failure rate (DFR) class of distribution for different choices of shape parameter. This distribution is the most widely used stochastic description of the life distribution of a component [19], for stress and strength variables. As a result, a study on bound based reliability approximation based on Weibull setup will have a wider appeal.

The tensile Stress of the element is given by

$S = \frac{P}{\pi r^2}$, [2]

Where, P is the load acting on the element and r is the radious of the circular cross section. Now we are interested to find reliability of tensile stress of an item. When Y is the Strength and S is the stress then under the stress-strength model, reliability, R, is given by

$$R = P(Y > S)$$
$$= P(Y > \frac{P}{\pi r^2})$$
$$= P(r > (\frac{P}{\pi Y})^{\frac{1}{2}}) = E_P E_R[P\{(\frac{P}{\pi Y})^{\frac{1}{2}} | P = p \text{ and } R = r\}]$$

Therefore, $R = \int_0^\infty \int_0^\infty e^{-\Upsilon(\frac{P}{\pi Y})^{\frac{\beta}{2}}} dF_Y dF_P$ (1)

Here we have a assumed that stress component P follows W(ρ, ψ) and stress component r follows W(Υ, β). We have also assumed that strength Y follows W(**θ**, μ). We have also assumed that strength and stress components are independent. Under this distributional background, we are interested to find reliability bounds.

Note that $E(P^r) = \frac{\Gamma(1+\frac{r}{\psi})}{\rho^{\frac{r}{\psi}}}$ and $E(P^{-r}) = \frac{\Gamma(1-\frac{r}{\psi})}{\rho^{\frac{-r}{\psi}}}$ with the survival function $S_P(p) = e^{-\rho P^\psi}$

Result 1: Reliability upper bound, S (Υ, β, ψ, ρ, μ, **θ**), when Tensile stress and strength of an element follow Weibull distribution is given by

$$S(\Upsilon, \beta, \psi, \rho, \mu, \boldsymbol{\theta}) = 1 - \frac{\Upsilon}{\pi^{\frac{\beta}{2}}} \frac{\Gamma(1+\frac{\beta}{2\psi})}{\rho^{\frac{\beta}{2\psi}}} \frac{\Gamma(1-\frac{\beta}{2\mu})}{\theta^{\frac{-\beta}{2\mu}}} + \frac{\Upsilon^2}{2\pi^\beta} \frac{\Gamma(1+\frac{\beta}{\psi})}{\rho^{\frac{\beta}{\psi}}} \frac{\Gamma(1-\frac{\beta}{\mu})}{\theta^{\frac{-\beta}{\mu}}}$$

for $\mu > \beta$.

Proof: Note that $e^{-l} \leq 1 - l + \frac{l^2}{2}$ for $l > 0$.

Now from (i) with the choice of $l = \Upsilon(\frac{P}{\pi Y})^{\frac{\beta}{2}}$, we get

$$R \leq \int_0^\infty \int_0^\infty [1 - \Upsilon(\frac{P}{\pi Y})^{\frac{\beta}{2}} + \frac{\Upsilon^2}{2}(\frac{P}{\pi Y})^\beta] \, dF_Y dF_P$$
$$= 1 - \frac{\Upsilon}{\pi^{\frac{\beta}{2}}} E(P^{\frac{\beta}{2}}) \, E(Y^{\frac{-\beta}{2}}) + \frac{\Upsilon^2}{2\pi^\beta} E(P^\beta) \, E(Y^{-\beta})$$
$$= 1 - \frac{\Upsilon}{\pi^{\frac{\beta}{2}}} \frac{\Gamma(1+\frac{\beta}{2\psi})}{\rho^{\frac{\beta}{2\psi}}} \frac{\Gamma(1-\frac{\beta}{2\mu})}{\theta^{\frac{-\beta}{2\mu}}} + \frac{\Upsilon^2}{2\pi^\beta} \frac{\Gamma(1+\frac{\beta}{\psi})}{\rho^{\frac{\beta}{\psi}}} \frac{\Gamma(1-\frac{\beta}{\mu})}{\theta^{\frac{-\beta}{\mu}}} \text{ for } \mu > \beta \quad (2)$$

Therefore, Reliability upper bound, S (Υ, β, ψ, ρ, μ, **θ**), when Tensile stress and strength of an element follow Weibull distribution is given by

$$S(\Upsilon, \beta, \psi, \rho, \mu, \boldsymbol{\theta}) = 1 - \frac{\Upsilon}{\pi^{\frac{\beta}{2}}} \frac{\Gamma(1+\frac{\beta}{2\psi})}{\rho^{\frac{\beta}{2\psi}}} \frac{\Gamma(1-\frac{\beta}{2\mu})}{\theta^{\frac{-\beta}{2\mu}}} + \frac{\Upsilon^2}{2\pi^\beta} \frac{\Gamma(1+\frac{\beta}{\psi})}{\rho^{\frac{\beta}{\psi}}} \frac{\Gamma(1-\frac{\beta}{\mu})}{\theta^{\frac{-\beta}{\mu}}}$$

, for $\mu > \beta$.

Result 2: Reliability lower bound, I (Υ, β, ψ, ρ, μ, **θ**), when Tensile stress and strength of an element follow Weibull distribution is given by

$$I(\Upsilon, \beta, \psi, \rho, \mu, \boldsymbol{\theta}) = 1 - \frac{\Upsilon}{\pi^{\frac{\beta}{2}}} \frac{\Gamma(1+\frac{\beta}{2\psi})}{\rho^{\frac{\beta}{2\psi}}} \frac{\Gamma(1-\frac{\beta}{2\mu})}{\theta^{\frac{-\beta}{2\mu}}}, \text{ for } \mu > \beta.$$

Proof: Note that $e^{-l} \geq 1 - l$ for $l > 0$.

Now from (i) with the choice of $l = \Upsilon(\frac{P}{\pi Y})^{\frac{\beta}{2}}$, we get

$$R \geq \int_0^\infty \int_0^\infty [1 - \Upsilon(\frac{P}{\pi Y})^{\frac{\beta}{2}}] \, dF_Y dF_P$$

$$= 1 - \frac{\Upsilon}{\pi^{\frac{\beta}{2}}} E(P^{\frac{\beta}{2}})\, E(Y^{\frac{-\beta}{2}})$$

$$= 1 - \frac{\Upsilon}{\pi^{\frac{\beta}{2}}} \frac{\Gamma(1+\frac{\beta}{2\psi})}{\rho^{\frac{\beta}{2\psi}}} \frac{\Gamma(1-\frac{\beta}{2\mu})}{\theta^{\frac{-\beta}{2\mu}}} \text{ for } \mu > \beta \qquad (3)$$

Therefore, Reliability lower bound, I (ϒ, β, ψ, ρ, μ, **θ**), when Tensile stress and strength of an element follow Weibull distribution is given by

$$I(\Upsilon, \beta, \psi, \rho, \mu, \boldsymbol{\theta}) = 1 - \frac{\Upsilon}{\pi^{\frac{\beta}{2}}} \frac{\Gamma(1+\frac{\beta}{2\psi})}{\rho^{\frac{\beta}{2\psi}}} \frac{\Gamma(1-\frac{\beta}{2\mu})}{\theta^{\frac{-\beta}{2\mu}}}$$

IV RELIABILITY ESTIMATION AND EXTENT OF ERROR UNDER THE WEIBULL SET UP:

When the determination of actual reliability becomes intractable we make use of approximation approach. Here we have considered mean of two bounds as the reliability approximation and half of the absolute difference between the two bounds as the extent of error. Therefore, on the basis of result1 and result2, reliability approximation of tensile stress is given by

$$R(\Upsilon, \beta, \psi, \rho, \mu, \boldsymbol{\theta}) \le \frac{S(\Upsilon,\beta,\psi,\rho,\mu,\theta)+I(\Upsilon,\beta,\psi,\rho,\mu,\theta)}{2} = 1 - \frac{\Upsilon}{\pi^{\frac{\beta}{2}}} \frac{\Gamma(1+\frac{\beta}{2\psi})}{\rho^{\frac{\beta}{2\psi}}} \frac{\Gamma(1-\frac{\beta}{2\mu})}{\theta^{\frac{-\beta}{2\mu}}} + \frac{\Upsilon^2}{4\pi^{\beta}} \frac{\Gamma(1+\frac{\beta}{\psi})}{\rho^{\frac{\beta}{\psi}}} \frac{\Gamma(1-\frac{\beta}{\mu})}{\theta^{\frac{-\beta}{\mu}}} \text{ for } \mu > \beta. \qquad (4)$$

This reliability approximation approach is simple to use and having intuitive appeal, is expected to be preferred by the design engineers. Again using result1 and result2, extent of error in terms of design parameter of tensile stress is given by

$$E(\Upsilon, \beta, \psi, \rho, \mu, \theta) \le \frac{S(\Upsilon,\beta,\psi,\rho,\mu,\theta)+I(\Upsilon,\beta,\psi,\rho,\mu,\theta)}{2} = 1 - \frac{\Upsilon}{\pi^{\frac{\beta}{2}}} \frac{\Gamma(1+\frac{\beta}{2\psi})}{\rho^{\frac{\beta}{2\psi}}} \frac{\Gamma(1-\frac{\beta}{2\mu})}{\theta^{\frac{-\beta}{2\mu}}} \text{ for } \mu > \beta. \qquad (5)$$

V STUDY OF CLOSENESS BETWEEN THE TWO RELIABILITY BOUNDS

We have approximated the reliabilities of the element at different values of ϒ using our proposed reliability approximation technique. For a numerical evaluation of reliability bounds, reliability values and extent of error of tensile stress, we choose the parameters in such a way so that the extent of error becomes less. For this purpose we have taken β =10, ψ = 5, ρ = 6, μ = 18, **θ** = 7 and the parameter, ϒ, has been allowed to vary.

One may observe from the given table that the upper and lower reliability bounds are reasonably close, especially for high reliability values. Thus for the case of high reliability value, midpoint of these bounds can fairly approximate the actual value itself.

Table 1: Showing system reliability and extent of error for tensile stress under the proposed approach

Sl.No.	ϒ	Upper bound	Lower bound	Reliability approximation	Extent of error
1	780	0.809346	0.687832	0.748589	0.060757
2	760	0.811198	0.695836	0.753517	0.057681
3	740	0.813211	0.703841	0.758526	0.054685
4	720	0.815383	0.711845	0.763614	0.051769
5	710	0.816529	0.715847	0.766188	0.050341
6	700	0.817715	0.719849	0.768782	0.048933
7	690	0.818941	0.723851	0.771396	0.047545
8	680	0.820207	0.727854	0.774030	0.046177
9	670	0.821513	0.731856	0.776684	0.044829
10	660	0.822859	0.735858	0.779358	0.043500
11	520	0.845894	0.791888	0.818891	0.027003
12	500	0.849824	0.799892	0.824858	0.024966
13	475	0.854961	0.809898	0.832429	0.022532
14	450	0.860348	0.819903	0.840125	0.020222
15	425	0.865984	0.829908	0.847946	0.018038
16	400	0.871870	0.839914	0.855892	0.015978
17	375	0.878006	0.849919	0.863963	0.014043
18	350	0.884391	0.859925	0.872158	0.012233
19	325	0.891026	0.86993	0.880478	0.010548
20	300	0.897911	0.879935	0.888923	0.008988
21	275	0.905045	0.889941	0.897493	0.007552
22	250	0.912429	0.899946	0.906188	0.006241
23	225	0.920063	0.909952	0.915007	0.005056

24	200	0.927946	0.919957	0.923951	0.003995
25	175	0.936079	0.929962	0.933021	0.003058
26	150	0.944462	0.939968	0.942215	0.002247
27	125	0.953094	0.949973	0.951533	0.001560
28	100	0.961976	0.959978	0.960977	0.000999
29	80	0.969261	0.967983	0.968622	0.000639
30	70	0.972964	0.971985	0.972474	0.000489
31	60	0.976706	0.975987	0.976347	0.000360
32	50	0.980489	0.979989	0.980239	0.00025
33	40	0.984311	0.983991	0.984151	0.00016
34	30	0.988173	0.987994	0.988083	8.99E-05
35	20	0.992076	0.991996	0.992036	3.99E-05
36	15	0.994042	0.993997	0.994019	2.25E-05
37	10	0.996018	0.995998	0.996008	9.99E-06
38	5	0.998004	0.997999	0.998001	2.50E-06
39	4	0.998402	0.998399	0.998401	1.60E-06
40	3	0.998801	0.998799	0.998800	8.99E-07
41	2	0.999200	0.999200	0.999200	3.99E-07
42	1	0.999600	0.999600	0.999600	9.99E-08

VI IMPORTANCE OF THE PROPOSED TECHNIQUE

This reliability approximation technique can be employed in designing engineering items. This technique will reduce overuse of resource and replacement costs of the manufacturing industries for producing these items. Therefore, production of high reliable items can be made using this technique. Hence, we can say that use of this technique will result financial growth and good reputation of the manufacturing industries.

This technique is easy to understand and use and has greater applicability because reliability approximation and extent of error will be obtained in terms of distributional parameters so that one can increase or decrease reliability according to their requirements.

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Automatic Vehicle Based Human Detection and Tracking in Underwater

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Abstract: The human detection and tracking is a challenge for underwater. The focus of this research was automatic detection and tracking of realistic underwater. These systems are developed by using vision-based method. Hence, we present our solution of an automatic underwater operated Vehicle in which we will fit the camera to detect the human in optimal time. This essay suggests ways to save people who have drowned in the water because it can be challenging to find and save them if they fell into the lake instead of under the water. In this instance, a life-saving rescuer dove underwater to look for the person who had fallen into the water. This deceives him in two ways, either preventing him from saving a human life or putting him in danger. A new strategy for saving the drowning person under water has been proposed after taking into account all of these factors. The suggested technique makes use of a wireless robot that can be controlled via Li-Fi (Visible light communication) technology, a remotely operated vehicle (ROV), and a PIR (Pyroelectric Infrared Sensor) to detect people in the water. The proposed device, which combines a camera and a sensor, searches underwater for humans to be saved in order to quickly and easily identify them, locate them, and alert the rescue team to save them..

Keywords: Automatic vehicle, Human detection, Underwater tracking.

I. Introduction

Detecting and controlling automatic vehicles underwater for tasks such as exploration or maintenance can be a complex but vital endeavor. Here's an overview of how human detection and traction control might be implemented in underwater autonomous vehicles. Developing a system that can identify and monitor people in an underwater setting is crucial in order to lower the possibility of a drowning accidently resulting in death [1]. Thus, the purpose of this thesis is to state the possibility of recognizing human presence in an underwater environment and to investigate the usage of deep learning ideas for the purpose of detecting humans from underwater digital data. Autonomous Underwater Vehicles (AUVs) have garnered significant attention in recent times, owing to its potential applications in subsea inspection, maintenance, and repair operations, resource exploitation, species abundance investigation, and military science. Underwater unmanned vehicles are gaining attention again as a result of recent advancements in the field of artificial intelligence (AI). Target tracking is one of the most important topics of discussion in AUV nowadays. There are three fundamental methods [2].

II. Problem Statement

Nowadays, a large amount of human labor is required in the event that a fire occurs in a building, power plant, etc. Thus, there could be a chance that humans would suffer severe harm. So we are creating a remote control robot with the fire extinguisher and camera.

III. Proposed Work

Automatic vehicles for underwater use require a combination of advanced sensors, machine learning algorithms, precise traction control, and safety measures to detect and interact with humans effectively while carrying out their missions, be it in research, exploration, maintenance, or rescue operations. The primary objective of this thesis is to investigate if deep learning can be used to recognize and track humans in an underwater environment. using Wi-Fi camera and evaluate their performance

Based on the ATmega 328P, the Arduino UNO is an open-source microcontroller board. The board can be directly connected to the computer using a USB cable, which serves as both a serial port and a power source. The Arduino IDE (Integrated Development Environment), which offers a condensed version of C/C++ programming, is used to program Arduino Uno. It's an excellent option for beginners because it's simple for users to write and upload code to the board. A vast library of pre-written code and a supportive community further simplify the programming process.

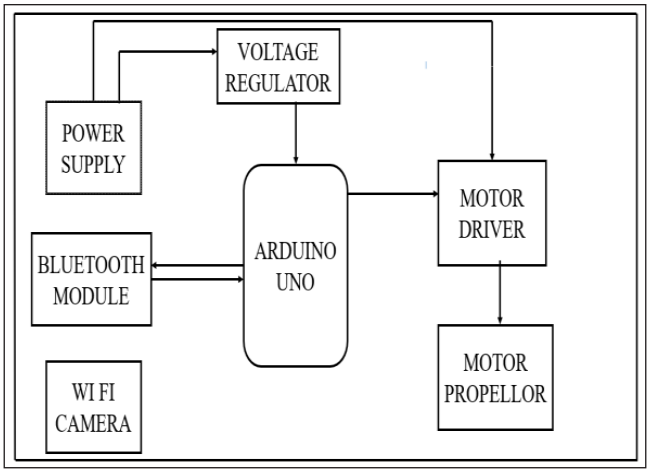

Fig. 1: Block Diagram of Proposed Work

A 12V DC gear motor is an electric motor that operates on 12 volts of direct current (DC) power and is equipped with a gearbox to reduce the speed of the motor's output shaft. These motors are widely used in various applications, including robotics, automotive, industrial automation, and more. Here's some content about 12V DC gear motors. When selecting a 12V DC gear motor for your application, it's essential to consider factors such as speed, torque, and power consumption. Additionally, the motor's construction and durability should match the demands of the environment it will operate in.

A relay switch is an electrically operated switch that uses an electromagnet to mechanically open or close a circuit. It consists of a control circuit and one or more contacts that open or close when a current is passed through the coil of the electromagnet. When the coil is energized, it creates a magnetic field that pulls or releases the contacts, causing them to switch between the open and closed positions. Relay switches are commonly used in applications where it is necessary to control a high-powered circuit using a low-powered signal, such as in automotive, industrial, and telecommunications systems. They are also used in automation and control systems, HVAC (Heating, Ventilation, and Air Conditioning) systems, and many other applications where switching of electrical circuits is required.

For the purpose of rotating a wheel or carrying out a certain task, even the most basic robot needs a motor. Motors demand more current than a microcontroller pin can normally produce, so you'll need a switch of some kind that can take in a tiny current, amplify it, and produce a larger current—which feeds the motor even more. A person referred to as a motor driver completes this full procedure. That process is made easy using the L293D Motor Driver IC, which has been used in a lot of applications with ease. The most popular driver for bidirectional motor driving applications is the L293D H-bridge driver. The DC motor may run in either direction thanks to this L293D IC. A 16-pin integrated circuit (L293D) is capable of controlling two DC motors at once.

IV. Result and Discussion

The power supply is given to the circuit by using 12V battery. The power is regulated by the voltage regulator and to the regulator. Bluetooth is used to control the kit. The wifi camera is used to monitor the live by mobile by using motor and propeller it can work and move under the water.

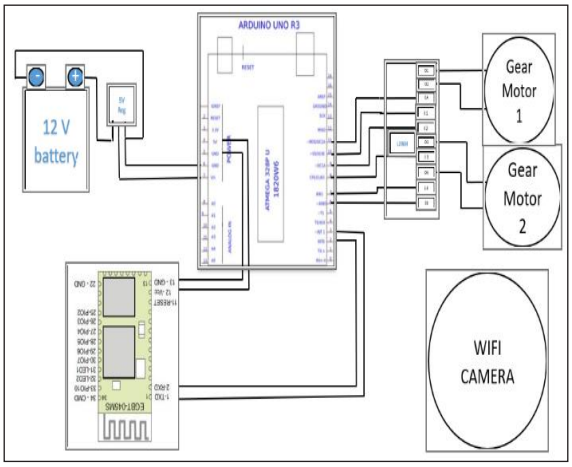

Fig. 2: Circuit Diagram

The Arduino uno is brain of our project, arduino has programmed already with software Arduino IDE. In that program we are able to control the robot and operate the switches when we need .we are fixing an identifier to identify the robot when the robot struct at the fog. Identifier means light, buzzer etc. The robot has a Bluetooth module HC-06 for wireless communication. An Android app installed on a mobile device is used to establish a Bluetooth connection with the robot. And using this bluetooth we are able to control the movement of the robot and pump.

The Android app provides a user interface that allows the operator to control the robot's movement and fire extinguishing mechanism such as pump. The app typically has buttons or controls for moving the robot forward, backward, left, and right and some buttons for pump, light control. The interface between the control circuits and the motors is provided by motor drivers. While the controller circuit operates on low current signals, the motor requires a large quantity of current. Consequently, the purpose of motor drivers is to convert a low-current control signal into a higher-current signal that is capable of powering a motor. Motor driver is need for controlling.

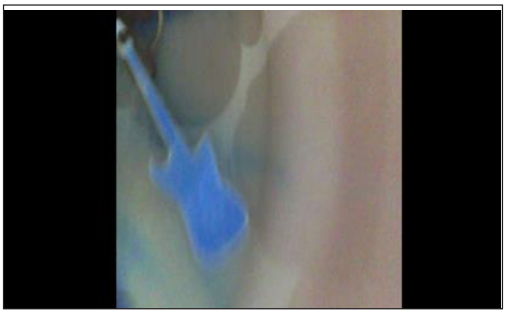

Fig. 3: Prototype Model Work

The Control pins IN1 and IN2 for motor 1 and control pins IN3 and IN4 for motor 2 regulate the direction of rotation. Prior to controlling speed, the rotational orientation of IN1 and IN2 must be verified. Enabled terminals will then receive PWM pulses. Here the motor1 means two motor have parallel connection and same for the motor2. Here I am using 12V dc motor, A 12V DC gear motor is an electric motor that operates on 12 volts of direct current (DC) power and is equipped with a gearbox to reduce the speed of the motor's output shaft. These motors are widely used in various applications, including robotics, automotive, industrial automation, and more.

Fig. 4: Object Find Under Water

V. Conclusion

In this research, AUV vehicle with Bluetooth and Wi-Fi camera a data showing people in different underwater settings with the goal of identifying and tracking people in an underwater environment. This could help lower the incidence of fatal drowning accidents. The 3200 frames of real-world events that the trained algorithms were tested on yielded findings that were gathered and examined utilizing accuracy. However, as the goal of this thesis is to address a practical issue, it can be said that an AUV vehicle is the best option for efficiently detecting and tracking people in an underwater environment.

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Virtual Book using Augmented Reality – An Experiment

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Abstract: This project introduces an augmented virtual world that enhances traditional book reading experiences with digital visual elements and auditory stimuli, revolutionizing how people comprehend and engage with information. In an era where researchers and students often grapple with the challenges of grasping complex theoretical concepts, the Virtual Book emerges as a dynamic solution, facilitating intuitive and comprehensive learning. Crafted through the integration of Python, Blender, and Unity software, this innovative tool empowers users to explore subjects visually, significantly reducing the cognitive stress associated with abstract theories.

Keywords: Augmented, Innovative tool empowers, Unity software, Virtual book unit, Visually.

I. Introduction

In today's rapidly evolving educational landscape, the integration of technology has become paramount for enhancing the learning experience. This paper introduces an innovative project, the Virtual Book, which leverages digital visual elements, sound, and other sensory stimuli to create an augmented reality that aids individuals in comprehending complex information from traditional books.

In the real world, researchers and students often face the challenge of comprehending theoretical concepts, leading to stress and inefficiencies in the learning process. The Virtual Book is designed to address this issue by providing a visually and auditorily enriched educational platform. This novel approach facilitates an immersive and intuitive learning experience, making complex concepts more accessible.

The Virtual Book is developed using a combination of Python programming language, Blender, and Unity software. This amalgamation of technologies allows for the creation of a dynamic and interactive learning environment, enhancing the engagement and comprehension of users. This paper outlines the conceptualization, development, and implementation of this educational tool, shedding light on its potential to revolutionize traditional learning methods.

A. Overview

Augmented Reality (AR) technology, a groundbreaking innovation, seamlessly integrates computer-generated graphics into the real world. Its transformative capabilities have the potential to revolutionize the learning landscape by providing an immersive, real-time educational experience. In doing so, AR technology not only enriches the learning journey but also creates a user-friendly environment, offering on-screen insights about the subjects and objects of study.

Fig. 1: AR Techology Learning Journey

B. Domain Introduction

A pivotal component of this work is the utilization of the Vuforia Engine, a versatile and widely adopted Software Development Kit. It empowers developers to incorporate advanced computer vision capabilities into Android, iOS, and UWP applications, creating AR experiences that seamlessly interact with objects and the environment. Vuforia Engine, renowned for its adaptability, is compatible with a wide range of devices, including smartphones, tablets, and eyewear, making it ago-to choice for AR development.

II. Related Works

Shin *et al.* (2008) [1] study various application areas for augmented reality technologies in industrial construction based on technology suitability. The research assesses different work tasks from the human factors perspective and presents a comprehensive map, which identifies eight work tasks including layout, excavation, positioning, inspection, coordination, supervision, commenting, and strategizing out of seventeen classified work tasks which could potentially benefit from AR systems.

Wang (2009) [2] gives a detailed review of AR in the AEC industry, and gives a review of several major research efforts prior to 2009, and categorizes various AR technologies with their advantages and disadvantages.

Wang *et al.* (2013) [3] reviews 120 articles published between 2005 and 2011 in various journal and conferences databases with a focus on augmented reality technologies in the built environment. The paper classifies all available toolkits for augmented reality prototyping in five categories: 2D marker AR-PC and web-cam based, 2D marker AR- mobile, 3D objects recognition-mobile, marker-less tools, GPS-compass based AR. In their research, AR literature is classified in three categories: (1) application area; (2) AR system layers: concept and theory (with four sub-layers including: algorithm and modeling, conceptual framework, evaluation framework, and technology adoption), implementation (with two sub-layers: software and hardware), evaluation (with two sub-layers: effectiveness and usability), and industry adoption; (3) other technical criteria. The paper explores state-of-the-art technologies in each category and proposes future research directions.

Chi *et al.* (2013) [4] discusses trends in AR applications for the AEC/FM with a specific focus on four AR technologies: localization, natural user interface, cloud computing, and mobile devices. The paper reviews 101 articles and outlines future trends and opportunities for applying AR in the AEC/FM industry in six directions: (a) field exploration based on hybrid localization, (b) in-field gesture or kinesthetic control of AR interface, (c) integration with location-specific information, (d) accessing field information using ubiquitous services, (e) portable AR devices in the field, (f) context-aware augmented reality in AEC/FM fields.

III. Problem Statement

In the realm of modern education, the utilization of digital resources is paramount, especially when dealing with intricate subjects such as biology. In particular, we consider the scenario of a 10th-grade student studying within the ICSE (Indian Certificate of Secondary Education) curriculum, who is diligently preparing for an upcoming biology examination focusing on the topic of "Life Processes." This comprehensive subject encompasses complex concepts, including the intricate workings of the human heart and the respiratory functions within the human body.

The challenge faced by students in comprehending these multifaceted concepts from conventional textbooks is well-documented. Often, the textual content within these books may be dense and not optimally suited to a student's learning pace, resulting in frustration and suboptimal learning outcomes. Consequently, students increasingly turn to the internet, particularly YouTube and web browsers, to access a wide array of instructional materials, including videos and web articles, to gain a deeper understanding of these complex biological processes.

However, this pursuit of knowledge via the internet is not without its drawbacks. The presence of intrusive advertisements and the proliferation of irrelevant search results can considerably impede the learning process. Navigating through these obstacles can be not only time-consuming but also detracts from the learning experience itself.

In light of these challenges, this work proposes the development of a Virtual Educational Platform, referred to as the "Virtual Book." This innovative platform seeks to address the aforementioned issues by providing students with a dedicated application designed to offer a structured and curated collection of verified video content, complemented by relevant images and audio components.

The Virtual Book aims to create a user-friendly, ad-free environment for students, offering a seamless and enriched learning experience. It will empower students to access preciselythe information they require, ensuring that the content is accurate, relevant, and highly educational. Accessible through mobile devices that meet specified system requirements, such as a camera, sufficient memory, and the requisite software for execution, the Virtual Book aspires to revolutionize biology education, making it a more interactive, engaging, and effective learning journey for the students.

IV. Methodology

Focusing on the advancements in software development and increasing the smart education we plan to use an agile methodology approach.

To the user, the proposed work appears as a collection of five APIs:

1. Setup and Licensing
   - Install Unity and ensure its properly configured.
   - Download and import the Vuforia Engine package into your Unity project.
   - Create a Vuforia developer account, obtain alicense key, and save it.
2. Prepare image Target
   - Upload your desired image to the Vuforia Developer Portal.
   - Create an Image Target database containing your uploaded image and download it.

3. Build Augmented Reality scene
   - In Unity, create a new scene dedicated to your AR application.
   - Add a Vuforia AR Camera to the scene, which serves as the AR viewfinder.
4. Configure and Map
   - Drag and drop your imported Image Target onto the AR Camera Game Object in the Scene.
   - Configure Image Target properties, including defining the video you want to map onto it.
   - Import or create the video content you intend to overlay on the Image Target.
   - Attach the video to a Game Object, like a Planeor Quad, within your Unity scene.
   - Adjust the size and position of the Game Object to align with the Image Target.
5. Scripting, Building and Testing
   - Set up your Android development environment if not already done.
   - Configure the Unity project settings for Android, including package name and minimum API level.
   - Build the project for Android.
   - Deploy the APK to an Android device or emulator.
   - Thoroughly test the application to ensure it accurately recognizes the Image Target and correctly maps the video onto it.

V. Result and Discussion

The implementation of the Virtual Book's interactive lecture video feature has yielded promising results in augmenting the learning experience for students. By integrating a mechanism that plays lecture videos when an image is placed or hovered over, we have provided students with a dynamic and engaging way to access educational content. This feature enables students to pause and play the video content by taking the application outof the focus of the image and resuming seamlessly when the application is placed back over the image.

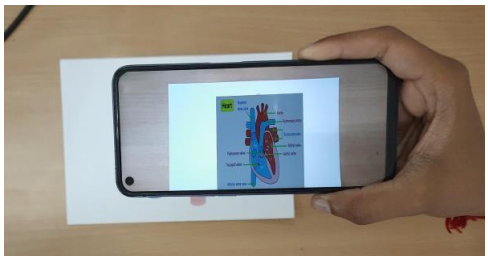

Fig. 2

Initial user testing and feedback collection have demonstrated a high degree of usability and effectiveness. The following results highlight the key findings:

A. Enhanced Engagement

Students reported a higher level of engagement with the study material due to the interactive nature of the lecture videos. The ability to control the video playback by simply moving the application in and out of the image's focus significantly improved their experience.

B. Improved Comprehension

The dynamic visual and audio elements in the lecture videos contributed to a deeper understanding of complex concepts. Students found it easier to absorb and retain information presented in this format.

C. Time Efficiency

The interactive feature of the application has enabled students to manage their study time more efficiently. They can quickly pause and resume their learning process, which is particularly valuable for students with busy schedules.

The implementation of interactive lecture videos in the Virtual Book addresses the unique challenges faced by students in comprehending intricate concepts. The discussion focuses on the significance of this innovation and its implications for the educational landscape.

D. Multisensory Learning

The integration of visual and auditory elements in lecture videos aligns with research on multisensory learning. It caters to diverse learning styles, making it an inclusive tool for a broad spectrum of students.

E. Enhanced Accessibility

The dynamic nature of the application ensures that students can access educational content in a flexible manner. This feature is particularly valuable for self-paced learning, catering to individual learning needs.

F. Positive User Feedback

The positive responses from students during initial testing indicate a high degree of user satisfaction. This technology's potential to enhance comprehension and engagement in learning is a significant step forward in educational technology.

VI. Conclusion and Future Work

Learning with Augmented Reality is a new technology that involves the overlay of computer graphics on the real world. This

has the ability to greatly enhance the entire learning experience and helps the users to experience the real time. Provide a user-friendly environment for user. To offer on-screen information about the things and the objects about the user wantsto learn for AR in the learning. In these strange times, immersive virtual book provides a welcome escape from the things at which the user not able to understand the concept or the working of the object.

In the industrial sector, the need for machine operation, maintenance, and understanding of working principles is paramount. Many seasoned and new employees often require refresher training to comprehend the intricate procedures and principles governing the operation of various machines and equipment. Traditionally, this training process involves mentorship and guidance from superiors, which can be resource-intensive and time-consuming.

To address this issue and usher in a new era of efficiency and productivity in industrial settings, an innovative approach is being introduced—the application of augmented reality. Augmented reality technology provides a platform to explain machine operations and principles, offering an interactive and immersive learning experience. This AR application employs graphical user interface components to guide users through step- by-step procedures, enabling them to operate machines with precision and confidence.

Moreover, this advancement in AR technology extends beyond training alone. It serves a dual purpose by incorporating machine health monitoring capabilities. This feature allows industries to assess and track the operational status of their machines, thereby facilitating timely maintenance, minimizing downtime, and optimizing overall efficiency.

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Effect of Pozzolanas on Fibre Reinforced Concrete

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Abstract: India generates more than 88 million tons of fly ash annually, predominantly of Class F type, with a meager utilization rate of approximately 10 to 15%. To enhance its utilization, an extensive investigation was conducted to explore its incorporation in concrete. This article presents the outcomes of an experimental study involving concrete with elevated proportions of Class F fly ash. Portland cement was substituted with three different percentages (40%, 45%, and 50%) of Class F fly ash. Tests were conducted to assess fresh concrete properties, including slump, air content, unit weight, and temperature. Compressive, splitting tensile, and flexural strengths were measured over a 28-day testing period. The results indicated that incorporating high volumes of Class F fly ash as a partial replacement for cement led to a reduction in the 28-day compressive and flexural strengths of the concrete. Nevertheless, based on the findings, it was concluded that Class F fly ash can be effectively utilized up to a 50% level of cement replacement in concrete, particularly for precast elements and reinforced cement concrete construction.

Keywords: Class F fly ash, Fly ash utilization, High volume fly ash concrete.

I. Introduction

Concrete, a widely used man-made construction material globally, is formulated by combining cementitious materials, water, aggregate, and occasionally admixtures in specific proportions. In its initial state, referred to as plastic concrete, it can be molded into various shapes and eventually solidifies into a rock-like mass known as concrete [1]. The solidification process results from a chemical reaction between water and cement, evolving over an extended period, contributing to increased strength over time.

The extensive utilization of concrete in the first half of the previous century, employing ordinary Portland cement (OPC) and plain round mild steel bars, fostered a complacent attitude. This neglect for durability, combined with the ease of obtaining constituent materials, resulted in a deterioration in the quality of concrete structures [2]. This decline accelerated after 1970, coinciding with the increased use of high-strength rebars with surface deformations (HSD), alterations in cement properties, and the inclusion of supplementary cementitious materials and admixtures without adequate consideration.

The detrimental impact on the health of newly constructed concrete structures stands as direct evidence of the service life performance challenges. The degradation of infrastructure globally, especially when exposed to real environments, presents an alarming and unacceptable trend.

Ordinary Portland Cement (OPC), a crucial component in concrete production, lacks a substitute in civil construction. However, cement production significantly contributes to carbon dioxide emissions, exacerbating environmental concerns. This mandates the exploration of alternative or supplementary materials to achieve global sustainable development and minimize environmental impact.

Various pozzolanic materials like fly ash, ground granulated blast furnace slag, rice husk ash, high reactive metakaolin, and silica fume offer potential as partial replacements for cement in concrete [3]. Ongoing studies, both in India and abroad, assess the impact of incorporating these materials, showing promising results [4, 5]. Concrete properties, including strength and durability, are influenced by ingredient properties, mix proportions, compaction methods, and controls during placement and curing.

In the pursuit of high-strength and durable concrete, the construction industry has witnessed the emergence of high-performance concrete (HPC) over the last 35 years. HPC aims to achieve compressive strengths ranging from M60 to M120 and even higher in laboratory conditions. Prestressed concrete technology has further propelled the development of high-strength concrete [6, 7]. However, concerns about the durability of structures using these materials necessitate careful consideration.

The term “High-Performance Concrete” encompasses concrete meeting specific performance and uniformity requirements beyond the capabilities of conventional constituents and practices. ACI defines critical characteristics for HPC applications, including ease of placement, compaction without segregation, early age strength, long-term mechanical

properties, permeability, density, heat of hydration, toughness, volume stability, and resilience in severe environments [8]. Achieving these characteristics often involves a combination of mineral and chemical admixtures.

Salient features of HPC include high compressive strength, low water-binder ratio, reduced cement grain flocculation, a wide range of grain sizes, densified cement paste, homogeneous mix with no bleeding, less capillary porosity, and discontinuous pores.

The demand for high-strength concrete arises from the need for earlier serviceability, reduced column sizes, and increased space in high-rise buildings, as well as for the superstructures of long-span bridges and durable bridge decks. Special methods such as seeding, revibration, high-speed slurry mixing, use of admixtures, crack inhibition, sulfur impregnation, and the use of cementitious aggregates are employed in producing high-strength concrete [9, 10].

As the construction industry leans towards precast elements and the demand for post-tensioning grows, achieving high-strength concrete becomes imperative. The construction focus on achieving cost savings further underscores the importance of high-strength concrete in the concreting process.

II. Materials Used

A. Cement

Cement is a substance characterized by its cohesive and adhesive qualities when mixed with water, and cements that exhibit these properties are known as hydraulic cements. These hydraulic cements mainly comprise silicates and aluminates of lime, derived from limestone and clay. One common type of hydraulic cement is Ordinary Portland Cement (OPC).

Ordinary Portland Cement (OPC) stands out as the fundamental Portland cement and is particularly well-suited for general concrete construction purposes. OPC is classified into three grades: 33 grade, 43 grade, and 53 grade, each denoting different compressive strengths. One notable advantage of OPC is its rapid rate of strength development, making it a preferred choice for various construction applications.

B. Rice Husk Ash

Rice husk ash is a by-product obtained by burning rice husk under controlled conditions, ensuring minimal environmental impact. When properly burned, it contains a high concentration of SiO_2 and can be utilized as a concrete admixture. Rice husk ash demonstrates pronounced pozzolanic properties, contributing significantly to the strength and impermeability of concrete.

The composition of rice husk ash primarily comprises amorphous or non-crystalline silica, with approximately 85-90% of cellular particles, 5% carbon, and 2% K_2O. The specific surface area of rice husk ash ranges between 40,000 to 100,000 m^2/kg. This unique combination of elements makes rice husk ash a valuable additive in concrete formulations, enhancing its performance and durability. Table I gives the description about chemical composition of RHA.

Table I: Chemical Properties of RHA

Chemical Compounds	Composition (in wt%)
SiO_2	85.88
Al_2O_3	0.47
Fe_2O_3	0.18
CaO	1.12
MgO	0.46
Na_2O	1.15
K_2O	4.10
SO_3	1.24

C. Silica Fume

Silica fume, also known as micro-silica or condensed silica fume, is an artificial pozzolanic admixture employed in construction. It is produced by reducing high purity quartz with coal in an electric arc furnace during the manufacturing of silicon or ferrosilicon alloy. The process involves subjecting quartz to high temperatures, causing reduction and the release of SiO vapors. These vapors undergo oxidation during exit and condense into a non-crystalline state with ultra-fine particle size in low-temperature zones. The resulting silica fume, in oxidized vapor form, is collected through filters, cooled, condensed, and further processed to eliminate impurities and control particle size.

Condensed silica fume is primarily composed of silicon dioxide (SiO_2), exceeding 90 percent in a non-crystalline form. Due to its airborne nature, similar to fly ash, it exhibits a spherical shape. With particle sizes less than 1 micron and an average diameter of about 0.1 micron, silica fume is exceptionally fine, around 100 times smaller than average cement particles. It boasts a specific surface area of about 20,000 m^2/kg, in contrast to 230 to 300 m^2/kg for typical cement. Table II gives the description about chemical composition of Silica fume.

Table II: Chemical Properties of Silica Fume

Chemical Compounds	Composition (in wt%)
SiO_2	93
Al_2O_3	0.4
Fe_2O_3	0.2
CaO	1.2
MgO	1.2
Na_2O	0.1
K_2O	1.1
SO_3	1.3

D. Super Plasticizing Admixture

A substance that imparts exceptionally high workability to concrete while significantly reducing water content (by at least 20%) for a given level of workability is known as a high-range water-reducing admixture (HRWRA) or Superplasticizer. Superplasticizers, capable of reducing water content by approximately 20 to 40 percent, have been developed. These additives can be introduced into concrete mixes with low to normal slump and water-cement ratio to produce flowing concrete with a high slump. The effectiveness of superplasticizers is temporary, lasting for 30 to 60 minutes, dependent on composition and dosage, and is followed by a rapid loss in workability.

The water-cement ratio plays a crucial role in concrete production, influencing capillary pore formation, permeability, and overall durability. Superplasticizers are essential for creating high-performance concrete (HPC) characterized by a low water-cement ratio and workability without the need for excessive cement content. Concrete with remarkably low w/c ratios, such as 0.25 or even 0.20, has been achieved, resulting in highly durable HPC. Workability can also be influenced by the maximum size of aggregate, with larger sizes enhancing workability, while smaller sizes increase compressive strength by providing a larger surface area for bonding with the mortar matrix.

In the study, high-range superplasticizer was uniformly employed in all concrete mixes to ensure optimal workability. The addition of superplasticizers aimed to reduce water requirements by 15 to 20% without compromising workability, resulting in high-strength and dense concrete. Admixture dosage was adjusted to maintain uniform workability without altering the unit water content, ensuring identical water-cement ratios for specific cementitious content. This approach facilitated a direct examination of the impact of pozzolanic material replacement on various concrete properties.

E. Aggregate

Aggregate characteristics play a significant role in influencing the performance of concrete, as they constitute approximately 80% of the total volume of the concrete. Aggregates are broadly classified into two categories:

(a) Fine Aggregate (b) Coarse Aggregate

Fine aggregates are materials that pass through an IS sieve with a gauge size of less than 4.75 mm, beyond which they are termed as coarse aggregates. Coarse aggregates constitute the primary matrix of the concrete, while fine aggregates fill the matrix between the coarse aggregates. The crucial role of fine aggregates is to enhance workability and ensure uniformity in the concrete mixture. Additionally, fine aggregates assist the cement paste in suspending the coarse aggregate particles.

As per the guidelines outlined in IS 383:1970, fine aggregates are classified into four different zones, namely Zone-I, Zone-II, Zone-III, and Zone-IV. Furthermore, for coarse aggregates, a maximum size of 20 mm is recommended for concrete work. However, in situations where no restrictions apply, sizes of 40 mm or larger may be permissible. In cases involving close reinforcement, a 10 mm size is also utilized.

F. Fiber

In recent times, numerous investigations have been carried out to explore methods for enhancing the flexural strength of reinforced concrete (RC) members using fiber-reinforced composite fabrics. The adoption of high-strength fiber-reinforced polymer (FRP) materials as structural reinforcements for concrete has gained widespread acceptance.

This composite material integrates short discrete fibers that are distributed randomly throughout the concrete mass. The performance efficiency of this composite material significantly surpasses that of plain concrete and many other construction materials with comparable costs. This advantage has led to a consistent increase in the utilization of fiber-reinforced concrete (FRC) over the past two decades. Its current applications encompass a broad range, including airport and highway pavements, earthquake-resistant and explosive-resistant structures, mines and tunnel linings, bridge deck overlays, hydraulic structures, and rock slope stabilization.

Comprehensive research in the field of FRC has demonstrated that incorporating various fiber types, such as steel, glass, synthetic, and carbon, into plain concrete enhances its strength, toughness, ductility, and resistance to post-cracking. Key benefits of fiber-reinforced concrete include resistance to micro-cracking, impact resistance, resistance to fatigue, reduced permeability, and improved strength in shear, tension, flexure, and compression.

The characteristics and performance of FRC undergo changes based on varying concrete binder formulations, as well as factors such as fiber material type, fiber geometry, fiber distribution, fiber orientation, and fiber concentration.

G. Recron 3s Polypropylene Fiber

Recron Fiberfill, India's exclusive hollow fiber designed for filling and insulation is crafted with DuPont's technology from the USA. Adhering to international quality standards, Recron Fiberfill ensures maximum comfort, durability, and versatility in applications such as sleep products, garments, and furniture, backed by Reliance Industries Limited (RIL). The launch of Recron 3s fibers by RIL aims to enhance plaster and concrete quality.

The application of Recron 3s fiber-reinforced concrete in construction proves beneficial. In low dosages, the thinner and

stronger elements effectively span the entire section, mitigating cracking [13]. Recron 3s prevents the development of shrinkage cracks during curing, contributing to the inherent strength of structures, plasters, or components.

Moreover, when concrete experiences loads nearing failure, cracks may propagate rapidly. The inclusion of Recron 3s in concrete and plaster effectively prevents and arrests cracking resulting from volume changes, such as expansion and contraction. A concrete structure devoid of micro cracks prevents water or moisture infiltration, safeguarding the primary reinforcement steel from corrosion and thereby enhancing the structure's longevity. Specification of Recron3 polypropylene fiber is tabulated in Table III.

Table III: Specification of Recron3 Polypropylene Fiber

Properties	Results
Appearance	Form: Short-Cut Staple Fiber
Denier	1.5d
Cut length	6 mm,12 mm,24 mm
Tensile strength	About 6000 kg/cm^3
Relative density	0.89 – 0.94 g/cm^3
Dispersion	Excellent
Acid resistance	Excellent
Alkali resistance	Good

Recron 3s exhibits a high modulus of elasticity compared to the concrete or mortar binder, contributing to increased flexural strength. These fibers are environmentally friendly, non-hazardous, and easily disperse and separate in the mix [14]. With a minimal dosage of 0.2-0.4% by concrete, Recron 3s proves sufficient to gain the mentioned advantages. This not only offsets its own cost but results in a net gain by reducing labor costs and improving material properties. In summary, the advantages of Recron 3s fiber include enhanced strength, durability, and environmental friendliness in various construction applications.

III. Testing of Raw Materials

For the experiment type of cement used was Ordinary Portland cement (53 grade). Table IV shows the properties of OPC.

Table IV: Shows the Properties of OPC

Specific Gravity	Initial Setting Time (mm)	Final Setting Time (mm)
3.1	90	190

In this study, sand of Zone-II, known from the sieve analysis using different sieve sizes (10 mm, 4.75 mm, 2.36 mm, 1.18 mm, 600 μ, 300 μ, 150 μ) adopting IS 383:1963. Table V shows the properties of fine aggregate.

Table V: Properties of Fine Aggregate

Specific Gravity	Water Absorption	Fineness Modulus
2.65	0.6%	2.47

The coarse aggregate used here with having maximum size is 20 mm. We used the IS 383:1970 to find out the proportion of mix of coarse aggregate, with 60% 10 mm size and 40% 20 mm. Table VI shows the properties of coarse aggregate.

Table VI: Properties of Coarse Aggregate

Specific Gravity	Water Absorption	Fineness Modulus
2.67	0.4%	4.01

In this project, Recron 3s fiber, a synthetic fiber, was incorporated into the concrete at different weight fractions (0.0%, 0.1%, 0.2%, 0.3%). Rice husk ash (RHA) used in this study exhibited a white color due to being burnt at a higher temperature, resulting in lower carbon percentages, which positively impact strength development. The specific gravity of RHA, determined using the Le-Chatelier apparatus, was found to be 2.20.

Silica fume, known for its enhanced pozzolanic activity, was introduced in various percentages (0%, 10%, 20%, 30%) as a replacement for cement in conjunction with fiber. The specific gravity of silica fume was determined to be 2.36 using the Le-Chatelier apparatus.

The determination of normal or standard consistency involves establishing the quantity of water required to create a standard cement paste capable of withstanding a specified pressure. It signifies the water threshold necessary for the cement paste to resist the penetration of a standard plunger (1 mm diameter) under a specific load, up to a distance of 5-7 mm from the base of Vicat's apparatus. The consistency of cement is influenced by its type and fineness, with higher fineness values requiring more water. The water quantity was calculated using the formula [(P/4) + 3]% of 800 gm, where P represents the pressure. Consistency tests were conducted with different percentages of Silica Fume (SF) and Rice Husk Ash (RHA), specifically SF at 0%, 10%, 20%, 30%, 40%, and RHA at 0%, 10%, 20%, 30%. Subsequently, mortars of standard size were cast with varying percentages of SF (0%, 10%, 20%, 30%, 40%) and RHA (0% and 20%) as replacements for cement. Portland slag cement and sand of Zone-II were employed in this experimental setup. Table VIII illustrates the effect of RHA on the normal consistency of OPC, and Fig. 1 depicts the variation in the consistency of cement with different percentages of RHA.

Table VII: Effect of RHA on Normal Consistency of OPC

% of Cement Replaced by RHA	Consistency (%)
0	31.0
10	45.0
20	48.0
30	52.0

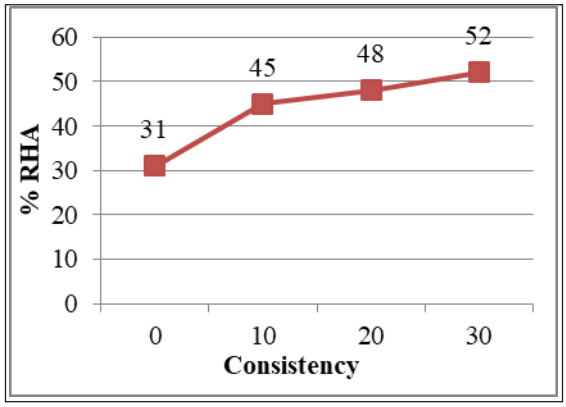

Fig. 1: Variation in Consistency of Cement with Different % of RHA

Compression tests were then carried out on the mortars using a Compression Testing Machine after curing for 7 days and 28days. The Compressive strength test results are tabulated in Table VIII and their variations are depicted in Fig. 2.

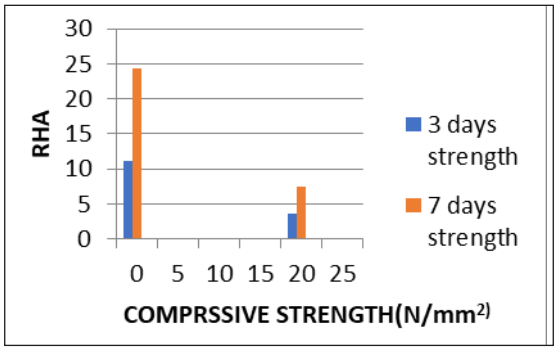

Fig. 2: Variation in Compressive Strength of Mortar with Use of RHA

Table VIII: Effect of RHA on Compressive Strength of OPC

% of Cement Replaced by RHA	3 Days Strength (MPa)	7 Days Strength (MPa)
0	11.176	24.31
20	3.65	7.45

Similarly, the effect of silica fume on normal consistency of OPC is carried out. Table IX shows the effect of Silica fume on normal consistency of OPC. Fig. 3 shows the variation in Consistency of Cement with different % of Silica fume.

Table IX: Effect of Silica Fume on Normal Consistency of OPC

% of Cement Replaced by Silica Fume	Normal Consistency (%)
0	31.0
10	38.0
20	41.5
30	45.0

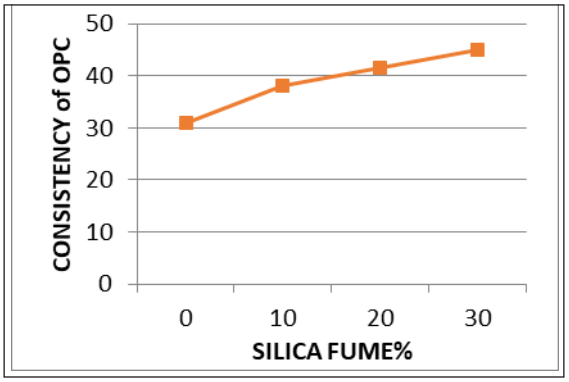

Fig. 3: Variation in Consistency of Cement with Different % of Silica Fume

The compressive strength of their mortar cubes after being cured for 7 days and 28 days is tested, and their results are tabulated in Table X. The Fig. 4 shows the variation of compressive strength with the effect of silica fume addition.

Table X: Effect of RHA on Compressive Strength of OPC

% of Cement Replaced by SF	3 Days Strength (MPa)	7 Days Strength (MPa)
0	11.176	24.31
10	9.66	15.63
20	10.55	17.65
30	8.10	9.15
40	6.74	7.46

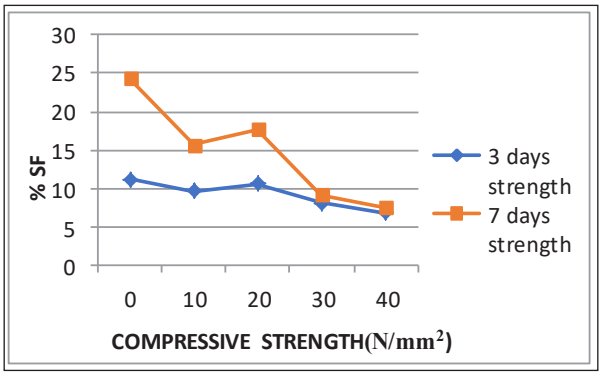

Fig. 4: Variation in Compressive Strength of Mortar with Use of SF

The analysis indicates a gradual rise in the consistency percentage as the proportion of Silica Fume (SF) replaces cement, although the change is not abrupt. In contrast, a noteworthy observation is the swift increase in consistency percentage with a higher percentage of Rice Husk Ash (RHA). Examining the variation in compressive strength among mortar mixes with different SF partial replacement proportions, the figure illustrates that the 3-day and 7-day compressive strength experiences an approximate 10% and 20% increment, respectively, moving from 9.66 MPa to 10.55 MPa and 15.63 MPa to 17.65 MPa as the SF percentage increases from 0 to 20%. However, further elevating the SF percentage results in a decline in compressive strength. Specifically, when the SF percentage reaches 40%, the strength decreases by around 60% and 70% in 3 days and 7 days, respectively, compared to the initial values. This leads to the conclusion that the utilization of SF, particularly in Ordinary Portland Cement, adversely affects the mortar's strength.

Furthermore, utilizing Rice Husk Ash (RHA) as a partial replacement for cement does not produce satisfactory strength. Despite the white type of RHA exhibiting better strength compared to low-burned RHA, the compressive strength of mortar mixes with varying SF proportions as a partial replacement for cement demonstrates superior strength compared to RHA as a partial replacement for cement. Consequently, concrete specimens were tested with different proportions of SF as a partial replacement for Ordinary Portland Cement and Recron 3s fiber in relation to the weight of concrete.

IV. Mix Proportioning of Recron-Fiber Reinforced Concrete

To develop Recron fiber reinforced concrete and to study the effect of silica fume keeping fiber percentage constant concrete specimen were casted. For this purpose it was used types of cement called ordinary Portland cement (53grade). Coarse aggregates with a maximum size of 20 mm and sand classified as Zone-II were utilized in the study. In the case of fiber-reinforced concrete, varying percentages (0%, 0.1%, 0.2%, 0.3%) of Recron fiber, relative to the weight of concrete, were incorporated. Subsequently, the percentages of silica fume were altered (0%, 10%, 20%, 30%), while keeping the fiber content constant, to investigate the impact of silica fume. A consistent slump range of 50-75mm was maintained to ensure proper workability for easy handling and placement in all instances. Sika admixture was employed to uphold this slump, maintaining water-cement ratios within the ranges of 0.35-0.41 and 0.41-0.45. Superplasticizer was applied in the ranges of 0.6%-1.4% and 1.4%-1.7% for ordinary fiber-reinforced concrete and fiber-reinforced polymer (FRP) with the addition of silica fume, respectively. The aggregate binder ratio was 3.08, and the coarse aggregate to fine aggregate ratio was 2.34.

In the case of Ordinary Portland Cement (OPC), a mix with a water-cement ratio of 0.38 and 0.8% admixture was obtained for normal concrete. Subsequently, mixes were created with varying percentages of silica fume (10%, 20%, and 30%), maintaining a constant 0.2% fiber content, and adjusting water-cement ratios (0.422, 0.44, and 0.46) and admixture (1.4%, 1.6%, and 1.7%).

All mixtures underwent mixing in a conventional rotary drum concrete mixer. The process involved loading the mixer with coarse aggregate and a portion of the mixing water, followed by the addition of sand, cement, and the remaining water, mixed for 3 minutes. In fibrous mixtures, the fibers were randomly distributed. The Sika admixture was added to the mixing water, and in the case of (cement + silica fume), it was added simultaneously with the cement. The resulting concrete was cast, vibrated using a vibrating machine, and molded into cubes, cylinders, and prisms of dimensions 150 mm cubes, cylinders with a height of 300 mm and diameter of 150 mm, and prisms with a length of 500 mm, height of 300 mm, and breadth of 100 mm each. All specimens were demolded after 24 hours and subsequently cured for 7 and 28 days. Compressive strength and flexural strength were assessed on cubes and prisms, respectively, following Indian standard codes (IS 456:2000, IS 5816:1999, IS 561:1959, IS 9399-1979, and IS 10262-1982). Fig. 5 and 6 depict the compressive strength and flexural strength tests on concrete cubes and prisms, respectively.

Fig. 5: Compressive Strength Test on Concrete Cube After 7 and 28 Days of Curing

Fig. 6: Flexural Strength Test on Concrete Prism After 7 and 28 Days of Curing

V. Results and Discussions

The consistency of cement is contingent upon its fineness. Due to its finer particles and increased surface area compared to cement, silica fume significantly augments consistency. It was noted that the normal consistency experiences a substantial 45% increase as the percentage of silica fume rises from 0% to 20% in comparison to plain cement.

The compressive strength of concrete cubes and the effect of silica fume at 0.2% fiber and OPC are tested after 7 days and 28 days of curing. Their results are tabulated in Table XI and their variation is depicted in Fig. 7.

Table XI: Effect of Silica Fume on Compressive Strength using OPC

Silica Fume (%)	7 Days Compressive Strength (N/mm^2)	28 Days Compressive Strength (N/mm^2)
0.0(0.2% Fibre)	29.00	35.33
10.0(0.2% Fibre)	29.50	36.00
20.0(0.2% Fibre)	32.00	38.28
30.0(0.2% Fibre)	34.50	42.32

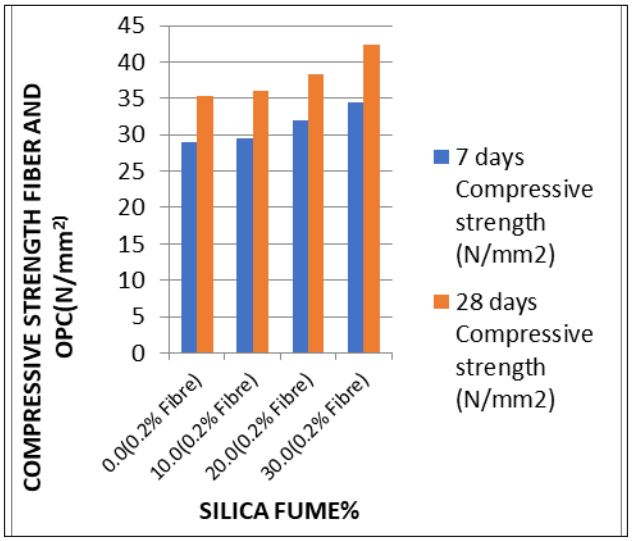

Fig. 7: Effect of Silica Fume on Compressive Strength at 0.2% Fiber and OPC

Concerning Ordinary Portland Cement (OPC), it was observed that incorporating Recron fiber in the range of 0.0% to 0.1% resulted in a slight enhancement in compressive strength. However, as the fiber percentage increased from 0.1% to 0.2%, there was further improvement in compressive strength. Subsequent increments in fiber content, however, led to a reduction in strength. The 28-day compressive strength of the concrete was highest with 0.2% fiber compared to other fiber compositions but lower than unreinforced concrete. Silica fume was introduced in conjunction with the fiber as a partial replacement for cement. Various percentages of silica fume (10%, 20%, and 30% replacement) were used alongside 0.2% Recron fiber. The highest strength was achieved with a 20% replacement of Ordinary Portland cement with silica fume compared to other replacement percentages.

In the context of Portland slag cement, the addition of Recron fiber from 0.0% to 0.1% resulted in a marginal increase in splitting tensile strength. However, with an increase in fiber percentage, particularly at 0.2%, the 28-day splitting tensile strength exhibited an improvement of about 5% compared to concrete without fiber. Further increments in fiber content led to a reduction in strength. When 20% silica fume was used as a replacement for cement alongside 0.2% fiber content, the strength increased by approximately 12% compared to normal concrete, surpassing other replacement percentages. The flexural strength of concrete prisms and the effect of silica fume at 0.2% fiber and OPC are tested after 7 days and 28 days of curing. Their results are tabulated in Table XII and their variation is depicted in Fig. 8.

Table XII: Effect of Silica Fume on Flexural Strength using OPC

Silica Fume (%)	7 Days Flexural Strength (N/mm^2)	28 Days Flexural Strength (N/mm^2)
0.0(0.2% Fibre)	9.50	11.125
10.0(0.2% Fibre)	7.875	9.00
20.0(0.2% Fibre)	6.75	8.25
30.0(0.2% Fibre)	6.04	6.875

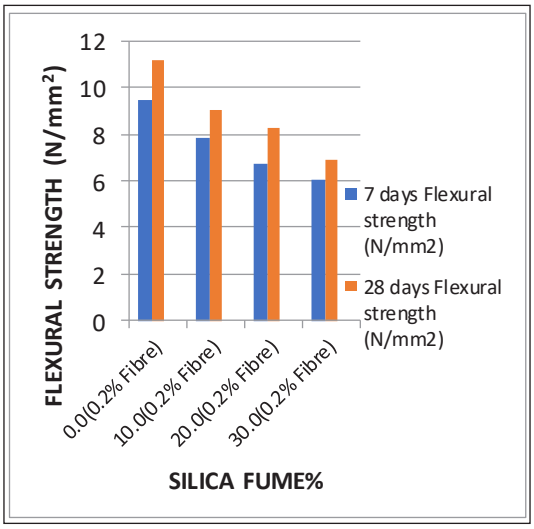

Fig. 8: Effect of Silica Fume on Flexural Strength at 0.2% Fiber and OPC

The flexural strength undergoes a decline when incorporating Recron fiber in proportions ranging from 0.0% to 0.1%. However, an escalation in fiber percentage from 0.1% to 0.2% results in a notable 5% improvement in flexural strength. Subsequent increments in fiber content, however, lead to a subsequent decrease in strength. In instances where silica fume replaces cement at a 0.2% fiber content, positive outcomes are

observed in flexural strength. At 20% silica fume replacement, there is a notably higher strength, approximately 10% more than normal concrete, marking it as the maximum strength among other percentages of silica fume replacement.

For Ordinary Portland cement, maintaining a 0.2% fiber content and varying silica fume percentages (10%, 20%, 30%), it was noted that the 28-day flexural strength decreases with an increase in silica fume percentage. The strength experiences a reduction of approximately 40% at 30% silica fume replacement compared to normal concrete.

VI. Conclusion

In this investigation, within the designated timeframe and laboratory setup, an effort has been made to shed light on the utilization of pozzolanic materials such as ground granulated blast furnace slag, rice husk ash, and silica fume in fiber-reinforced concrete, assessing their effectiveness. The findings can be summarized as follows:

- Replacement of cement with rice husk ash (RHA) leads to an increase in consistency. Properly burned RHA at controlled temperatures enhances the strength of mortar, while unsatisfactory results are obtained when using inadequately processed RHA.
- The use of superplasticizer allows for achieving a mix with a low water-to-cement ratio, facilitating the attainment of desired strength.
- Consistency increases with the progressive replacement of cement with varying percentages of silica fume.
- The optimal combination for achieving desired outcomes is identified as 0.2% Recron fiber and 20% silica fume.
- In the case of Ordinary Portland Cement (OPC), compressive strength increases with the percentage of silica fume ranging from 0% to 30%, accompanied by 0.2% Recron fiber, exhibiting approximately 20% higher strength than normal concrete with OPC.
- Splitting tensile strength experiences a 15% increase at 10% silica fume content, maintaining a constant 0.2% Recron fiber, followed by a decrease with higher silica fume percentages. Flexural strength exhibits a decreasing trend, with a significant 40% decrement as the silica fume percentage reaches 30%.
- Ordinary Portland Cement demonstrates superior compressive strength results compared to Portland slag cement in mixes with silica fume and 0.2% Recron fiber.

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Performance Assessment of Behaviour of Spiral Reinforced Concrete Columns

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Abstract: This paper presents an exploratory perception into the way of behaving of twisting built up substantial sections under pivotally concentric stacking. A sum of 6 sections were tried under transient stacking, 3 of which were twisting built up segments, while 3 were with typical ties. The sections were 700 mm high with a size of 230x230 mm. Concentrate on boundaries incorporates the variety of pitch of cross over support. A near report is finished for load conveying limit of winding crossed over and ordinary crossed over with comparative pitched segments. Furthermore, the complete cross over support length and ordinary cross over support length is looked at for comparative pitched segments. The cross over support length is found out by bar twisting timetable with a representation of charts.

Keywords: Load carrying capacity of columns, Spiral reinforced columns, Transverse reinforcement length.

I. Introduction

Concrete columns are fundamental structural elements widely employed in buildings and infrastructure. Ensuring their effective design, detailing, and maintenance is crucial for guaranteeing structural integrity and safety. This article aims to provide an in-depth exploration of the essential aspects associated with the design and upkeep of reinforced concrete columns, with a particular focus on the specialized considerations imperative for their successful implementation. The documentation presented herein encompasses a comprehensive guide covering various facets pertinent to reinforced concrete columns. This includes a detailed elucidation of the critical elements involved in their design and maintenance protocols. Moreover, it delves into the intricacies of column classification based on their slenderness ratio, shedding light on the distinct requirements and challenges associated with different categories. One of the pivotal aspects highlighted within this document is the comparative analysis between two significant reinforcement methodologies: normal ties and spirally reinforced square columns. Through a meticulous examination under short-term axially concentric loading, this analysis aims to unravel the performance disparities, advantages, and limitations of these reinforcement techniques. Such insights will aid in facilitating informed decision-making processes during the design and implementation phases of reinforced concrete columns.

As the structural integrity of columns directly influences the overall stability and safety of structures, understanding the nuances of their design and maintenance becomes paramount. This article serves as a comprehensive resource, catering to engineers, architects, and construction professionals seeking valuable insights and guidance in navigating the complexities associated with reinforced concrete columns. Slenderness Ratio, SR = k lu/r where, lu is unsupported column length; k is effective length factor reflecting end restraint and lateral bracing conditions of a column; and r is the radius of gyration reflecting the size of a column cross-section. Slenderness Ratio, SR = 700/230 = 3.04 < 12 [1]. The column in question is relatively short. The support provided by the winding (spiral) reinforcement should give way before reaching an extremely high level of stress to effectively bind the central concrete core [2]. Through this analysis, it has been observed that even under the highest levels of applied load, the stress induced in the winding support consistently remained well below its yield strength. Only the winding support in the uppermost part of the column yielded, which occurred significantly below the extreme load level. This indicates an insufficiency in the ability of the central concrete core to receive adequate restraint from the horizontal support specifically in the immediate post-top region, leading to an unexpected reduction in load-carrying capacity [3].

This finding highlight that the winding support experienced not only ductile loads from the central concrete but also from the clamping effect of longitudinal bars. Therefore, it becomes crucial to ensure that the longitudinal bars are adequately bundled to prevent excessive clamping when under load. It's important to note that secondary stresses associated with deformations in most columns used in practical applications are typically negligible or very small.

II. Literature Review

This test comprises of 68 concrete columns by fluctuating burden unconventionalities, substantial qualities and how much

support. It was tracked down that rising how much longitudinal reinforcement or potentially diminishing tie spacings will lessen a definitive limit with respect to consolidated bowing and pressure for every single substantial strength, as the support shaped a characteristic plane of partition between the center and cover concrete.They led examinations on eight spirally supported reinforced sections. The investigation discovered that malleability diminished with expanding concrete strength and the sections with higher measures of column kept up with top burden for longer yet showed less flexibility than the segments with less longitudinal support. Effect of varying reinforcement on high-strength concrete columns --They led examinations on eight spirally supported reinforced sections. The investigation discovered that malleability diminished with expanding concrete strength and the sections with higher measures of column kept up with top burden for longer yet showed less flexibility than the segments with less longitudinal support. Effect of cover spalling for high-strength and normal-strength concrete columns --Utilized limited component demonstrating to explore the impact of cover spalling for both high-strength (>60 MPa) and typical strength concentric segments subject to concentric pressure loads. It was viewed as through the model, and checked through trial testing, that as how much tie support expanded, a definitive section strength (or the heap at which early cover spalling occurred) diminished while the flexibility of the segment expanded [4].

They saw that the horizontal displacement or float of a supported cement section at disappointment was subject to and straightforwardly corresponding to the dispersing of support and the stress created inside the segment. Further, it was noticed that the parallel float experienced by the segments at pivotal disappointment was subject to and conversely corresponding to how much axial load applied on the sections. The presentation of sections under seismic stacking is additionally affected by the secondary moment because of concentrated on tentatively the way of behaving of columns under seismic stacking to comprehend the movement of harm and components causing breakdown in shear-basic supported substantial columns. In view of the experimental outcomes, the creators created scientific models to foresee the drift limit of columns. Concentrated on the effect of ideal longitudinal support on the arch malleability limit of segment areas. A methodology for deciding an adequate support through support estimating graph has been depicted. The creators presumed that curvature ductility capacity and flow flexibility limit improved for the instance of ideal longitudinal support comparative with the qualities registered for customarily reinforced columns [5].

Fostered a nonlinear form slope scan technique for tracking down the ideal support of a rectangular reinforced concrete cross section. The creators proposed the utilization of the model for areas exposed to uniaxial or biaxial bending. According to the writing assessed on conduct of segments under cyclic shear stacking, it was reasoned that satisfactory reinforcement support and fitting longitudinal support will give better flexibility, stiffness and strength to the column components of the structures [6].

III. Materials Used

A. Cement

Concrete is a material that has durable and cement properties in the presence of water. Such concretes are called water driven concretes. These comprise fundamentally of silicates and aluminates of lime acquired from limestone [7]. Table I shows the physical properties of cement.

Table I: Properties of Cement

Properties	Value
Specific gravity	3.25
Fineness	2%
Standard consistency	34%
Initial setting time	35 min
Final setting time	6 hours

B. Ordinary Portland Cement

Ordinary portland concrete (OPC) is the fundamental Portland concrete and is the most appropriate for use in everyday substantial development. It is of three sort, 33 grade, 43 grade, 53 grade. One of the significant advantage is the quicker pace of advancement of solidarity [8].

C. Aggregate

Aggregate properties greatly influence the behaviour of concrete, since they occupy about 80% of the total volume of concrete. The aggregate are classified as fine aggregate and coarse aggregate.

D. Fine Aggregate

Fine aggregate is material going through an IS sieve that is under 4.75 mm measure past. The primary framework of the substantial, while fine aggregate structure the filler network between the coarse aggregate. The main capability of the fine total is to give usefulness and consistency in the combination. The fine total additionally assists the concrete with gluing to hold the coarse total molecule in suspension [9].

E. Course Aggragate

According to IS 383:1970, the fine aggregate is classified into four different zones, that is Zone-I, Zone-II, Zone-III, and Zone-IV. Also in the case of coarse aggregate maximum of 20 mm coarse aggregate is suitable for concrete work. But where there is no restriction 40 mm or larger size may be permitted. In case of close reinforcement 10 mm size is also used [10].

IV. Experimental Inestigation and Discussion

A sum of six square columns were tried in this review; three of which were spiral transverse reinforced columns while three were ordinary transverse reinforced columns. They were 700 mm high with a size of 230x230 mm. In view of the slenderness proportion. They were delegated short columns. A similar report was made among columns according to Table II. Segments are axially loaded and compressive strength of those was tried. Table II shows the details of reinforcement in columns.

Table II: Details of Reinforcement in Columns

Ref. No.	Longitudinal Reinforcement		Transverse Reinforcement	
	No. of Bars	Diameter (mm)	Diameter (mm)	Pitch (mm)
C1	4	12	8	300
C2	4	12	8	200
C3	4	12	8	150
C4	4	12	8	300
C5	4	12	8	200
C6	4	12	8	150
C1,C2,C3	Normal Transverse Reinforcement			
C4,C5,C6	Spiral Transverse Reinforcement			

Table III: Comparative Studies Among Columns

Compared Columns	Purpose
C1,C4	Pitch of 300 mm
C2,C5	Pitch of 200 mm
C3,C6	Pitch of 150 mm
To Observe the Influence of Pitch of Transverse Reinforcement.	
To Investigate the Effect of Normal and Spiral Transverse Reinforcement.	

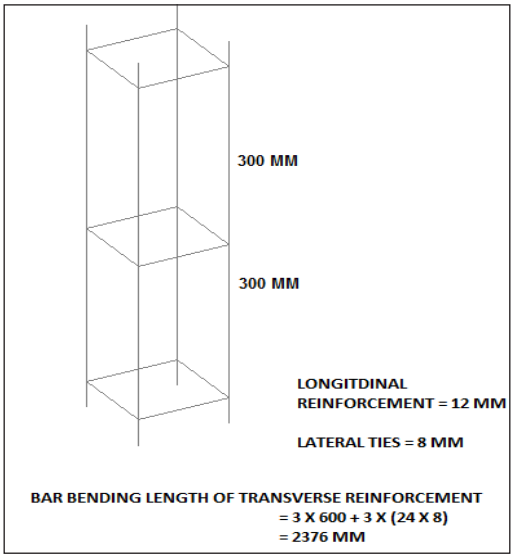

Fig. 1

Table III provides a comparative overview of different sets of columns labeled as C1 through C6, each serving a specific purpose in an experimental investigation focused on reinforced concrete columns. The columns are grouped in pairs (C1 with C4, C2 with C5, and C3 with C6), wherein each pair shares a similar purpose but differs in the configuration of their transverse reinforcement. Fig. 1 shows the reinforcement details of the column.

The purpose of the columns in each pair is as follows:

- C1, C4: Columns designed with a transverse reinforcement pitch of 300 mm.
- C2, C5: Columns designed with a transverse reinforcement pitch of 200 mm.
- C3, C6: Columns designed with a transverse reinforcement pitch of 150 mm.

The main objectives of this experimental setup are twofold:

Observing the Influence of Pitch of Transverse Reinforcement: The different columns in each pair are designed with varying pitches of transverse reinforcement. This aims to analyze and understand how altering the spacing (pitch) between the transverse reinforcements affects the behavior, load-carrying capacity, and structural performance of the columns.

Investigating the Effect of Normal and Spiral Transverse Reinforcement: Each pair of columns is constructed using different types of transverse reinforcements, specifically normal ties in one case and spiral reinforcement in the other. This comparison seeks to explore and assess the impact and effectiveness of these distinct reinforcement methods on the columns' behavior under loading conditions. It aims to determine the differences in structural response, ductility, strength, and overall performance between columns reinforced with normal ties and those with spiral reinforcement [11-12].

By conducting experiments on these different column configurations, the study aims to derive insights into the influence of reinforcement pitch and the comparative effectiveness of normal ties versus spiral reinforcement. These findings are essential in guiding engineers and designers in making informed decisions regarding the selection and design of transverse reinforcements in reinforced concrete columns for optimal structural performance and safety.

V. Conclusion

From this experimental observation, it was inferred that:

- The load conveying limit of spiral-supported concrete sections is bigger than typical built-up substantial segments by 5 to 7% with comparable pitch distance.
- The all-out length of transverse support utilized for spiral built-up substantial sections is relatively different from the typical supported substantial segments.

- Furthermore, subsequently, the spirally built-up sections are more conservative and the heap conveying limit is bigger than the ordinary supported segments.

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Potential Pathway of using Marble Powder as a Fine Aggregates in Manufacture of Self Compacting Concrete

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Abstract: This research delves into enhancing concrete strength through innovative approaches, particularly the substitution of traditional components with alternative materials like silica fumes, GGBS, fly ash, granite, and marble powder. The study specifically investigates the use of marble powder in self-compacting concrete, aiming to repurpose industry waste and minimize environmental impact. Focusing on M-40 concrete, the project replaces fine aggregate with varying proportions of marble powder (0%, 5%, 10%, 15%, 20%). The research explores the feasibility of this substitution by assessing the fresh and hardened properties, including self-compaction through tests like slump flow, V-funnel, and L-box. Additionally, beams are fabricated using TMT and HYBRID rods to evaluate structural behavior under diverse loading conditions. The experiment emphasizes the practical application of marble dust, considering its impact on flow properties and structural integrity. Multiple trial mixtures undergo testing, ensuring compliance with permissible limits for slump flow, V-funnel, and L-box. The structural behavior of beams, incorporating TMT and HYBRID bars, is thoroughly examined to ascertain the effectiveness of marble dust in enhancing concrete performance. In summary, this research offers valuable insights into the sustainable integration of marble powder in self-compacting concrete, addressing both environmental concerns and structural considerations.

Keywords: Alternative materials, Marble powder, Self-compacting concrete, Sustainable construction.

I. Introduction

The field of material science has witnessed rapid advancements, particularly in the last three decades, with global research dedicated to enhancing concrete performance in terms of strength and durability [1]. Concrete has evolved from a simple mix of cement, aggregate, and water into an engineered custom material, incorporating various constituents to meet specific construction industry needs. The increased use of concrete in specialized architectural configurations and structures with closely spaced reinforcing bars underscores the importance of ensuring proper filling ability, structural performance, and durability [2].

In the contemporary landscape of construction materials, the pursuit of sustainability has become a paramount objective. As the construction industry grapples with the challenge of minimizing its environmental footprint, innovative approaches that repurpose waste materials for concrete production are gaining significant attention. One such promising avenue is the utilization of marble waste powder as a replacement for fine aggregate in the manufacturing of Self-Compacting Concrete (SCC). This research not only addresses the critical issue of waste management in the marble industry but also seeks to unlock the potential of marble waste powder in creating a more sustainable and environmentally friendly concrete.

Marble waste powder, a by-product derived from the sawing and shaping processes within the marble industry, has long been regarded as a disposal challenge. However, recent advancements in concrete technology and a growing commitment to sustainable practices have prompted a reevaluation of such waste materials [3, 4]. This research is poised at the forefront of this reevaluation, exploring the transformative role that marble waste powder can play in the realm of concrete production.

The adoption of marble waste powder in SCC introduces a groundbreaking approach to sustainable construction practices. The primary advantage lies in the dual-purpose nature of this utilization - not only does it alleviate the environmental burden associated with marble waste disposal, but it also enhances the properties of concrete [5, 6]. By replacing traditional fine aggregate with marble waste powder, this research seeks to contribute to a circular economy model, where waste materials are repurposed in a manner that aligns with environmental stewardship.

The significance of this research extends beyond waste management; it delves into the core attributes of SCC, with a specific focus on fresh concrete properties. Workability, a pivotal aspect of SCC, is thoroughly examined through a battery of tests. These tests assess the concrete's flowability

and its resistance to segregation, crucial factors in determining the practical applicability of SCC in construction projects [7]. Understanding how the introduction of marble waste powder influences these fresh concrete properties is central to unlocking the full potential of this sustainable concrete variant.

Furthermore, the research undertakes a comprehensive analysis of the mechanical properties of SCC. This includes scrutinizing the compressive strength, flexural strength, and split tensile strength of the concrete. By evaluating these mechanical attributes, the research aims to ascertain how the incorporation of marble waste powder influences the structural performance and durability of SCC. The outcomes of these analyses are expected not only to provide valuable insights into the material's behavior but also to establish its credibility as a sustainable alternative in the construction sector.

In essence, this research stands as a beacon in the journey towards sustainable construction practices. By harnessing the latent potential of marble waste powder in SCC, it not only addresses a pressing waste management issue but also lays the groundwork for a more sustainable and environmentally conscious future in the construction sector. The investigation into fresh concrete properties and mechanical characteristics further underscores the commitment to ensuring that sustainability in construction is not just a concept but a tangible reality, paving the way for a more responsible and resilient built environment.

II. Materials Used

A. Cement

The cement used in the production of these hollow blocks is a locally available ordinary Portland cement (OPC). OPC are classified into three types, namely grades 33, 43, and 53, depending upon the strength they achieve at the end of 28 days. In this experimental analysis, grade 53 cement is used. The cement was tested to match the properties proposed by the Indian Standards, IS: 4031 (1988) and IS: 12269 (1987). Table I displays the results of the various property tests.

Table I: Physical Properties of Cement

Properties	Value
Specific gravity(g)	3.25
Fineness(f)	2%
Standard consistency(s)	34%
Initial setting time(I)	35 min
Final setting time(F)	6 hours

B. Marble Powder

Marble powder, a by-product of marble sawing and shaping, was utilized in the study. With a specific gravity of 2.55 kg/m^3 and a Blaine fineness value of 1.50 m^2/g, the marble powder exhibited a notably high specific surface area. This characteristic suggests that the inclusion of marble powder in mortars and concretes may enhance their cohesiveness. The physical and chemical properties of marble powder are tabulated in Table II and Table III respectively. Fig. 1 illustrates the marble powder used for this study.

Table II: Physical Properties of Marble Powder

Physical Properties	Values
Moisture	0.30%
Loose Bulk Density	44.83 lb/ft^3
Tapped Bulk Density	77.30 lb/ft^3

Table III: Chemical Properties of Marble Powder

Chemical Compounds	Composition (in wt%)
$Mg(OH)^2$	35.7%
SiO_2	0.17%
$CaCO_3$	63.4%
Al_2O_3	0.11%
Fe_2O_3	0.14%
Heavy Metals	>0.002%
LOI (1000°C)	36.5%

Fig. 1: Marble Powder

C. Aggregates

Aggregates, regarded as an inert material, plays a pivotal role in forming a robust mass through a mechanical bond with cement paste in concrete. Constituting 70 to 80% of the concrete volume, it represents a major and essential component. In the context of this study, the maximum size of coarse aggregate employed is 20 mm with a specific gravity of 2.68. Various types of sands commonly used in conventional concrete are equally suitable for Self-Compacting Concrete (SCC) [8]. This includes both crushed and rounded sands, whether they are siliceous or calcareous. In SCC, the fines content, referring

to particles less than 0.125 mm, is crucial, and it includes the powder component. It is essential to attain a minimum number of fines, originating from binders and sand, to prevent segregation in SCC mixes [9].

The use of aggregates not only ensures structural integrity but also contributes to economic efficiency, as they are more cost-effective than cement [10]. This strategic utilization helps minimize shrinkage, demonstrating the multifaceted importance of aggregates in concrete construction, aligning with IS standards for optimal performance.

III. Mix Design

This research explores the integration of marble powder waste into Self-Compacting Concrete (SCC) with a mix proportion of 1:2.2:3.4 (cement: sand: coarse aggregate) and a water-to-cement (w/c) ratio of 0.95. The study investigates the impact of replacing fine aggregate with varying percentages (0-20 wt%) of marble powder waste. The chosen mix proportion serves as a baseline for evaluating the concrete properties Table IV shows the various mix proportions for different percentages of replacement of marble powder.

Table IV: Mix Proportion for Various Percentage of Replacement of Tyre

Ingredients	Mix Proportion (%)				
Fine aggregate	55	50	45	40	35
Coarse aggregate	35	35	35	35	35
Cement	10	10	10	10	10
Marble powder	0	5	10	15	20

Primarily, the fine aggregate, coarse aggregate, marble powder, and cement are mixed together with the preferred water-cement ratio. The varying ratio of marble powder used in this mix design is shown in Table V.

Table V: Ratio for the Replacement of the Fine Aggregates

Percentage of Marble Powder Replaced on Fine Aggregate	Volume of Marble Powder (kg/m^3)	Volume of Fine Aggregate (kg/m^3)	Volume of Coarse Aggregate (kg/m^3)	Volume of Cement (kg/m^3)
0	-	0.450	2.140	1
5	0.02	0.430	2.140	1
10	0.04	0.410	2.140	1
15	0.06	0.390	2.140	1
20	0.08	0.350	2.140	1

IV. Results and Discussion

A. Workability Tests

The investigation involves varying marble dust content by substituting sand and adjusting super plasticizer dosage. The initial investigation maintains constant cement content of 508 kg/m^3, testing five mixes to achieve self-compacting concrete characteristics. The mix compositions, along with different plasticizer dosages used in the investigation, are provided in Table VI. Fig. 2 shows the slump flow test done on fresh concrete.

Table VI: Mix Compositions Along with Different Plasticizer Dosages

Description	0%	5%	10%	15%	20%	Suggested Value as Per Code
Slump flow (mm)	675	700	690	660	620	600-800
v-funnel (sec)	8	10	12	14	15	8-12
l-box (mm)	0.82	0.91	1	0.28	0.25	0.8-1
u-box (mm)	28	26	27	33	34	0-30
j-ring (mm)	9	9	10	11	10	0-10

Fig. 2: Slump Flow Test Done on Fresh Concrete

B. Hardened Concrete Tests

This compressive strength of the concrete is determined by using the compressive testing machine, which has a capacity of 2000 kN. The rate of loading used for a concrete specimen

is 315 kN/min (5 kN/sec) as per IS 516. The machine applies a constant rate of loads to until failure occurs. Scrutinize the loads and note the maximum load at failure. The compressive strength of bricks is equal to the maximum load (N) divided by the average area of the samples (mm^2). The concrete cubes of 150x150x150 are casted and they are tested for compressive strength that has undergone curing for 7 days, and 28 days to record the strength at different curing stages. Table VII and VIII show the compressive strength of the concrete cubes with a varied ratio of marble powder replacement at the end of 7 days, and 28 days, respectively. Fig. 3 shows the compressive strength test of concrete cube.

Table VII: Compressive Strength Test Results for Various Percentage of Replacement of Marble Powder After 7 Days

Specimen Index	Marble Powder	Compressive Strength in 7 Days (MPa)		
		Specimen 1	Specimen 2	Average
A0	0	37.5	37.5	37.5
B5	5	38	40	39
C10	10	35.25	36.75	36
D15	15	28	30	29
E20	20	23	25	24

Table VIII: Compressive Strength Test Results for Various Percentage of Replacement of Marble Powder After 28 Days

Specimen Index	Marble Powder	Compressive Strength in 28 Days (MPa)		
		Specimen 1	Specimen 2	Average
A0	0	55.3	55.4	55.35
B5	5	56.98	60.60	58.79
C10	10	54.45	55.78	55.10
D15	15	40.3	43.71	43.5
E20	20	37.80	39.70	38.76

Fig. 3: Concrete Cubes Undergoing Compressive Strength Test

The flexural strength test on hardened concrete is a crucial assessment of the material's ability to withstand bending forces. This test involves subjecting a prismatic or cylindrical concrete specimen to a bending moment until failure occurs. The specimen is typically supported at its ends and loaded at the center. The goal is to measure the maximum stress the concrete can endure before developing cracks or failing in flexure. As per the Indian Standard (IS 516:1959) for the Method of Tests for Strength of Concrete, the recommended size for a standard beam used in the flexural strength test is 150 mm x 150 mm x 700 mm. Table IX and X show the flexural strength of the concrete cubes with a varied ratio of marble powder replacement at the end of 7 days, and 28 days, respectively.

Table IX: Flexural Strength Test Results for Various Percentage of Replacement of Marble Powder After 7 Days

Specimen Index	Marble Powder	Flexural Strength in 7 Days (MPa)		
		Specimen 1	Specimen 2	Average
A0	0	3	3.4	3.2
B5	5	3.1	3.3	3.2
C10	10	2.2	2.6	2.4
D15	15	2	2	2
E20	20	2.4	2.10	2.24

Table X: Flexural Strength Test Results for Various Percentage of Replacement of Marble Powder After 28 Days

Specimen Index	Marble Powder	Flexural Strength in 28 Days (MPa)		
		Specimen 1	Specimen 2	Average
A0	0	5.40	5.39	5.3
B5	5	5.84	5.36	5.6
C10	10	4.69	3.90	4.3
D15	15	3.1	3.70	3.4
E20	20	3.10	3.50	3.3

The split tensile strength test is conducted to evaluate the tensile strength of concrete. According to Indian Standard IS 516:1959, the recommended size of cylindrical specimens for the split tensile strength test is 150 mm diameter and 300 mm height. In this test, a cylindrical concrete specimen is subjected to diametrical compression, creating a tensile stress across the diameter. The force required to split the specimen is then measured, and the split tensile strength is calculated. This property is important in assessing the ability of concrete to resist tensile forces. Table XI and XII show the flexural strength of the concrete cubes with a varied ratio of marble powder replacement at the end of 7 days, and 28 days, respectively. Table XIII and XIV gives a detailed comparison of compressive, flexural and split tensile strength at the end of 7 days and 28 days respectively.

Table XI: Split Tensile Strength Test Results for Various Percentage of Replacement of Marble Powder After 7 Days

Specimen Index	Marble powder	Split Tensile Strength in 7 Days (MPa)		
		Specimen 1	Specimen 2	Average
A0	0	3.92	3.88	3.78
B5	5	3.81	4.10	3.96
C10	10	3.15	3.65	3.4
D15	15	3.15	3.40	3.28
E20	20	3.15	3.52	3.33

Table XII: Split Tensile Strength Test Results for Various Percentage of Replacement of Marble Powder After 28 Days

Specimen Index	Marble Powder	Split Tensile Strength in 28 Days (MPa)		
		Specimen 1	Specimen 2	Average
A0	0	4.58	5.10	4.82
B5	5	4.61	3.91	4.9
C10	10	4.42	4.42	4.42
D15	15	3	3.26	4.9
E20	20	5	5.10	5.05

The table 12 and 13 presents the compressive strength, flexural strength, and split tensile strength of concrete samples with varying percentages of marble powder replacement at different curing periods, 7 days and 28 days respectively. After 7 days, the compressive strength slightly increased from 37.5 MPa (0% replacement) to 39 MPa (5% replacement), then decreased at higher replacement percentages. Flexural strength remained relatively constant, while split tensile strength showed some variations.

Table XIII: Comparison of Various Tests at Various Percentage of Replacement of Marble Powder After 7 Days

Specimen Index	Marble Powder	Compression Strength	Flexural Strength	Split Tensile Strength
A0	0	37.5	3.2	3.78
B5	5	39	3.2	3.4
C10	10	36	2.4	3.4
D15	15	29	2	3.28
E20	20	24	2.4	3.33

Table XIV: Comparison of Various Tests at Various Percentage of Replacement of Marble Powder After 28 Days

Specimen Index	Marble Powder	Compression Strength	Flexural Strength	Split Tensile Strength
A0	0	55.35	5.3	4.82
B5	5	46.5	4.3	3.83
C10	10	43.5	2.6	4.42
D15	15	38.75	2.7	3.13
E20	20	36.4	2.4	5.05

At 28 days, the compressive strength exhibited a substantial increase for the 0% replacement (55.35 MPa) compared to 7 days. However, as the replacement percentage increased, compressive strength decreased. Flexural strength followed a similar trend, with a notable reduction at higher replacement percentages. Split tensile strength displayed a varied pattern, with fluctuations in values at different replacement percentages.

Overall, the results indicate that incorporating marble powder up to a certain percentage can enhance early compressive strength. However, for later ages and as the replacement percentage increases, a decline in compressive, flexural, and split tensile strength is observed, suggesting a careful consideration of the optimum replacement level for achieving the desired concrete properties. Further analysis and optimization may be required to balance the trade-offs between marble powder utilization and maintaining key mechanical properties in the concrete. Fig. 4 and 5 shows the variation of tests at various percentage of replacement of marble powder after 7 days and 28 days.

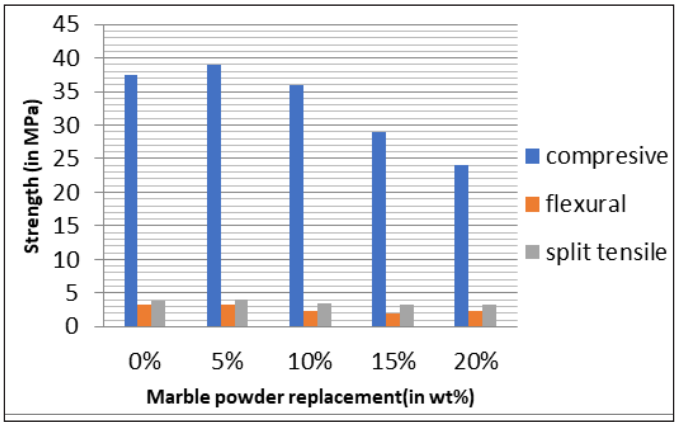

Fig. 4: Graph Showing the Variation of Compressive Strength After 7 Days of Curing

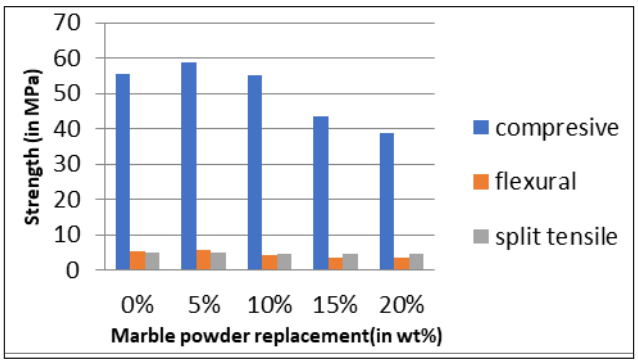

Fig. 5: Graph Showing the Variation of Strengths After 28 Days of Curing

V. Conclusion

The results emphasize the effective integration of marble powder in concrete, improving workability and showcasing varied mechanical properties. From achieving favorable fresh concrete characteristics to confirming structural efficacy in beams, the study contributes insights for sustainable construction. The following conclusions were drawn from the analysis of test results, shedding light on potential advancements across concrete grades and structural elements:

1. Workability Assessment (Fresh Concrete):
   - Slump values (500-800 mm) meet satisfaction criteria for replacements of 0%, 5%, 10%, 15%, and 20% of sand with marble powder.
   - V-funnel test (8-12 sec) yields satisfactory results for the same replacement percentages.
   - L-box test (0.8-1 mm), U-box test (0-30 mm), and J-ring tests (0-10 mm) also meet criteria with varied percentages of replacement.
2. Hardened Concrete Properties:
   - Compressive strength of hardened concrete is 55.35 MPa and 43.5 MPa for 5% replacement in self-compaction concrete, decreasing with higher marble powder percentages.
   - Flexural strength is 5.3 MPa for 5%, decreasing with increased marble powder content.
   - Split tensile strength is 4.9 MPa for 5%, reducing with higher marble powder percentages.
   - Optimal performance is noted at 5% replacement, guiding the selection for beam casting.
3. Future Scope: Suggested future work includes exploring various concrete grades and extending the application to other structural members like columns, prefabricated structures, pavers, flooring, and roof slabs.

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Developing Engineering Students' Writing Skills

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Abstract: This paper focuses on the writing abilities of engineering students across all branches, particularly during placements. English writing skills are practically required for the position. Today, it is a requirement for students to take a writing test before attending interviews. Language learning requires the development of LSRW abilities. The teacher must take the effort to inspire the kids in order to assist them with these writing techniques. The majority of the pupils are from rural areas and primarily have a regional educational background. Therefore, they need assistance at every turn. For them, writing becomes an impossible task. A crucial part of the teacher's job is to set off their necessity. This paper discusses a variety of writing perspectives, including free writing, writing mechanics, vocabulary, grammar, description of an image, paragraph, essay, and summary writing, as well as writing for reports, resumes, letters, and emails. Students might also benefit from exercises like pair or group work on all projects. The student's interest and mastery in the chosen subject are not the same. Every activity benefits from analysis and feedback, which is a bonus for the teacher and a benefit for the student. Students might realize their desire of landing a job before finishing their undergraduate degree if they are given rational training starting in their first year of engineering.

Keywords: Feedback, Learning, Interviews, Training, Vocabulary, Writing.

I. Introduction

The English language is more in demand these days all across the world. The English language setting has drastically transformed from the middle of the 19th century to the present. Students from lower socioeconomic groups also long for an English-medium education. Once fashionable, English-language communication is now essential. For engineering students in all fields, English is required as one of their subjects in the curriculum. The efforts of a teacher and a pupil are the same. The purpose of the research paper is to impart writing abilities to engineering students across all branches, particularly during placement interviews, where writing proficiency testing is required.

Engineers have different writing demands than other professionals, so the teacher must thoroughly assess each student's needs before modifying the curriculum and instructional strategies to meet those needs. The teacher must assess the pupils' proficiency in standard writing techniques, fluency, good knowledge of specialized language, and lexical accuracy before the lesson can begin. Students gain familiarity with typical writing projects and the production stage by using actual materials in class.

The students benefit from the advent of the English Language Laboratory since it provides a true platform for them to demonstrate their LSRW abilities. Each ability is crucial to learning a language. Among these four fundamental talents, speaking and writing are productive skills whereas listening and reading are receptive skills. Writing is a crucial ability that students should acquire throughout their academic career. Cook (1996) claimed, "People who start learning English as an adult never managed to learn it properly and other who learn it as a child is indistinguishable from the natives" Today, writing in English is essential for employment. Teacher must take the effort to inspire the kids in order to assist them with these writing skills. The majority of the pupils are from rural areas and primarily have a regional educational background. Therefore, they need assistance at every turn. For them, writing becomes an impossible task.

II. Writing for Specific Purposes

The recipient must comprehend the message for communication to be effective and to elicit the desired response or reaction. The written or spoken communication must be concise, accurate, complete, and relevant in order for this to be possible. The written message must be coherent, accurate, and cohesively written. To this purpose, the economy of the written language depends heavily on the usage of the appropriate linkers. Understanding, attitude, technique, tone, purpose (in business, the purpose is typically to remind, convince, inform, and request), and capability should be included as variables impacting communication. correctness, precise vocabulary and grammar structures, the avoidance of ambiguity, the use of specific terms, and correctness all contribute to a written text's cohesion and coherence.-coherence (both chronologically and spatially).

Writing serves a purpose that is directly related to their professional lives. For example, sales engineers must write and deal with orders, contracts, and brochures, production engineers must write charts, and research engineers must deal with research reports and scientific papers. Reference and documentation styles are a required stage for the latter type. Similar to how the organisation of spoken language varies depending on the sort of text produced.

III. Various Perceptions of Writing Skills

Prewriting is similar to free writing. This requires mental effort. The pupil is not given any topic. The teacher's guidance is crucial in inspiring students to write. Students may write about any subject they choose. There won't be any grammatical, spelling, or vocabulary fixes made. Producing content on the subject is essential on the student's end. Regularly starting the class with this practise will be very effective. Other students write about politics, other students write about the natural world, some students write about personal experiences, and so on. They have five minutes to write nonstop about the subject. The number of words will be considered. It doesn't matter what they write as long as they do it within the allotted time; what matters is how much work they put into it. Students must practise this free writing at home by adhering to the guidelines discussed in class. This ought to resemble a home journal entry.

Syntax, Spelling, Pronunciation and Punctuation are the fundamentals of writing. One effective method for students to produce material is through free writing. Then, students should focus on developing their writing abilities. Reading is important. They can get a decent concept of sentence form if they are encouraged to read novels, periodicals, articles in the newspaper, etc. Along with voice and punctuation, spelling ability initially grabs the reader or examiner's attention. They must be aware that the words they write can conjure up specific images in the examiner's head. No language seems decent without word order or syntax. Those who are good speakers also make good writers. In addition to writing practise, speaking practise is more crucial. Each student must comprehend how all LSRW skills are related to one another. The skill that pupils wish to develop won't materialise if they don't possess even one of these abilities.

Students find vocabulary and grammar exercises to be difficult. Teachers emphasise grammatical principles because they are crucial for conveying information clearly. Sentence, clause, and phrase are some of grammar's most important concepts. Vocabulary development for students will improve their writing abilities. The frequency of the words must be understood by the students. In their writing, students frequently employ uncommon words. To produce high-quality writing, certain terms should be swapped out by high frequency words. Nathaniel Hawthorn said: "Words, so innocent and powerless as they are, standing in a dictionary; how potent for good and evil they become in the hands of one who knows how to choose and combine them." Student can express their power of thought through powerful words.

Students are instructed to describe a picture of their choice once they have a handle on using mechanics, vocabulary, and syntax. They must describe, contrast, and compare the provided or chosen image using the appropriate language. If the teacher gives the expressions, great; if not, instruct them to research appropriate expressions online. Students are required to provide the image a title and an explanation. For instance, they must focus on the picture's background, which includes the setting, the time of day, the weather, the location, the culture, etc. They are urged to describe the image in as many phrases as they can. They must concentrate on the tenses, locations of prepositions, sentence structures, and high frequency terms from the list provided to them in the last task. They are able to comprehend the importance of language and syntax in sentence construction.

Students will be directed through paragraph writing, essay writing that includes a number of paragraphs, and summary writing after practising free writing and visual description. The teacher has students concentrate on paragraph writing because it serves as the basis for essays and summaries. They must learn how to handle the paragraph with coherence, unity, and completion. Students must understand the significance of a topic sentence that draws the reader's attention and is free of all mistakes. The topic will then be related in a series of cohesive paragraphs. Students must begin their writing assignments with a strong introduction, body, and conclusion. It must conclude with a profound idea or clever twist in the logic. The core concept of the essay is woven throughout every paragraph. Writing summaries is a streamlined way of reading longer texts. Paragraphs are an added grace in this case as well. It might be challenging for teachers to help students understand certain types of essays. When they began writing the essay, they quickly grasped the differences between expository, narrative, and descriptive essays.

Writing reports, letters, resumes, and emails is an area where engineering students are evaluated. The engineering students' writing is at its best in this piece. It is referred to as a professional writing style. Students can handle all forms of writing skills by the time they reach their fourth year. They are mature in their writing and reasoning at this level. Students can practise writing if the teacher gives templates for reports, letters, resumes and emails. Students are taught that in order to build their professional skills, they must use phrases and paragraphs that are clear, short, and exact. Instead of using clear and concise English, teachers should teach complex language. Exams are the perfect time for students to show off their writing abilities to their other students. The verbal and written communication skills of the students are evaluated on entrance exams like the GRE, TOEFL, SAT, GMAT, and CAT.

IV. Conclusion

One of the most efficient forms of communication is writing. It will take time for it to develop because it is an art. The students' energy levels are extremely high, according to the current observations. The writing abilities of aspiring engineers can be channelled in such a way by adequate coaching and counselling that they could outright stand in good stead in the chosen avenue of their lives. The teacher's actual responsibility is to foster an enthusiasm in learning among the students. Students that are taught logically in the manner described above from the start of their first year of engineering realise their goal of landing a job before finishing their bachelor's degree. Thus, writing abilities always end up being the deciding elements.

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The State of the Art for Ontology's: A Survey

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Abstract: In recent decades, the growth of communication technology has resulted in an explosion of data-related information. Ontology perception is being used as a growing requirement to integrate data and unique functionalities. Ontology's are not only critical for transforming the traditional web into the semantic web but also for the development of intelligent applications that use semantic enrichment and machine learning to transform data into smart data. To address these unclear facts, several researchers have been focused on expanding Ontology's and semantic web technologies. Due to the lack of clear-cut limitations, Ontology's would not suffice to deliver uncertain information among domain ideas, conceptual formalism supplied by traditional. To deal with this ambiguity, it is suggested that fuzzy Ontology's should be used. It employs Ontology to introduce fuzzy logical policies for ambiguous area concepts such as "darkness, heat, thickness, creaminess, and so on in a device-readable and compatible format". This survey efforts to provide a brief and conveniently understandable study of the research directions taken in the domain of ontology to deal with fuzzy information; reconcile various definitions observed in scientific literature, and identify some of the domain's future research-challenging scenarios. This work is hoping that this evaluation can be treasured by fuzzy ontology scholars. This paper concludes by the way of reviewing present research and stating research gaps for buddy researchers.

Keywords: Fuzzy Ontology, Fuzzy Ontology tools, Ontology, Semantic web.

I. Introduction

With the advancement of communication technology in recent years, information and data have risen swiftly. Because there is an increasing demand for data integration and accompanying functionality, the ontology idea is critical to improving quality. Ontology's should facilitate reusability and interoperability. However, in a big scale environment with a high number of distributed and heterogeneous components, such as the Web, reuse or interoperability is particularly challenging because it is sometimes difficult for diverse parties to create a common understanding and agreement. Ontology's have the same structure regardless of the language in which they are expressed, and this is true for all languages. "In general, most Ontology's describe persons (instances), classes (concepts), properties (attributes), and links". There are many proposals for fuzzy extensions to ontology "currently to provide the necessary methods for dealing with such ambiguous and imprecise data, and fuzzy ontology research has been flourishing until now". By merging fuzzy theory and ontology, the fuzzy ontology was suggested as a solution to problems.

Fuzzy ontology is today regarded as a significant and crucial component for designing applications in a broad variety of real-life circumstances, thanks to its position as a standard "World Wide Web Consortium recommendation (WWWC)" for expressing information on the Semantic Web. It is a formal, explicit expression of a widely held belief in a human- and machine-readable format. It serves as the knowledge backbone for many intelligent and knowledge-based systems [1]. In other areas, however, real-world knowledge is incomplete or confusing. For example, one might use a search engine to look for "an extremely quick, compact, low-cost automobile." The classical ontology model, on the other hand, is widely accepted as insufficient for dealing with the imprecise and ambiguous information that characterizes some real-world applications. As a result, many practical implementations of knowledge-based systems, like the Semantic Web, need the extension of Ontology's to fulfill their needs.

Berners-Lee (2001) suggested the "Semantic Web (SW)", which ties all data together with machine-readable semantic knowledge. The semantic web is essentially an extension of the current web that gives information in a manner that computers can understand. By making the semantics of data technically visible, the semantic web aims to solve problems like interoperability, enhanced search algorithms, and data reliability, among others. As a consequence of recent breakthroughs in semantic web research, it is now feasible to switch from keyword-based to semantic web retrieval approaches in traditional information search and retrieval systems.

The next parts deal with fuzzy ontology from a variety of perspectives, including representation " (categories, formal definitions, representation languages, and fuzzy ontology tools), reasoning (reasoning techniques), and applications (fuzzy logic) (the most relevant applications about fuzzy ontology)". "Other essential aspects for fuzzy ontology are then comprehensively addressed, including creation, mapping, integration, query, storage, assessment, extension, and future research prospects".

This paper gives an overview of the current state of the art in fuzzy ontology construction. As a result, the majority of our research will be devoted to a survey of the second group of studies; nevertheless, this survey also provides some related works from other categories.

II. Literature Survey

A. Ontology's

According to a recent review on ontology engineering in [2], "Ontology's have grown widely employed in a range of industries ranging from biomedicine to finance, engineering, legal, and cultural heritage in the previous few years". Ontology's are the core and most essential component of the semantic web, as it is a machine-readable web. In a domain of discourse, an ontology defines conceptions and their associations [3]. "Ontology's are required for knowledge-based applications since they serve as formal models and machine-readable representations of the domain". Ontology's aid in the transfer of domain knowledge to other domains, whether relevant or irrelevant. "For example, investigates how knowledge sharing might increase employee individual and team performance". "Because organizational knowledge is scattered, knowledge-based applications using Ontology's must be able to combine knowledge from disparate sources and offer an overview of the knowledge available in the organization [3]". "Finding a proper ontology for a domain is one of the more difficult research difficulties in this setting [4]. Organizations have utilized Ontology's as a conceptual tool and fundamental component of knowledge-based systems for effective knowledge management in the area of discourse". In the last decade, the industry has shown interest in building semantic technology applications to provide solutions. For instance, in the medical domain, there is the HIV Protein Ontology [5]. "Artificial intelligence (AI) exhibits interest in knowledge representation, knowledge management, and semantic relationships as an opportune area of study and a challenge for the academic community [6]". "Given the benefits of an ontology-based approach, there are only a few ontology-based solutions that profit from this method [7]". "It's worth noting that ontology-based machine-readable systems aid in the development of better decision support systems by enhancing knowledge management. Furthermore, the ontology approach makes it simple to share domain conceptions [3], which give stakeholders more opportunity to solve real-time challenges".

The major goal of an ontology concept was to allow software agents and people to communicate domain information. As a result of the increased interest in ontology's, multiple Ontology's have been developed in various fields, each with its purpose, for as "Gene Ontology (GO) in the biomedical area". "The topic of ontology engineering is primarily concerned with the study of principles, methods, and tools for constructing upper or domain Ontology's". A technique gives guidance for the building of Ontology's in this setting. Researchers have proposed many approaches to aid and support the building of Ontology's. Ontology's help people communicate more effectively to enhance decision-making, knowledge sharing, information storage, and knowledge reuse, among other things. "An ontology can be created manually with an ontology editor like Protege, or automatically with appropriate ontology creating algorithms written in a computer language like Java. For certain topics of study, many academics create Ontology's manually, as in, or automatically, as in". It is required to follow a series of defined and structured steps while building a domain or upper ontology. Researchers have proposed many approaches to aid and support the building of Ontology's. "Ontology engineering, on the other hand, requires a well-documented, mature, and widely accepted approach". "In this work, a survey has been prepared to compare approaches for generating domain Ontology's in various domains developed between 2015 and 2020". "A methodology is a collection of well-designed approaches and processes that ensure the quality of an ontology design process's outcomes". In, the author discusses several relevant concepts connected to ontology design approaches.

B. Fuzzy Ontology's

According to Ortega [8], fuzzy ontology is an ontology that uses fuzzy logic to provide a natural representation of imprecise and ambiguous data while simultaneously enabling reasoning over it. He disagreed with defining a fuzzy ontology by enumerating its fuzzy constituents because it jeopardizes definition scalability and reusability. He claims that new languages will provide new opportunities for fuzzy elements to be added, but that current definitions do not cover them. None of the previous definitions, for example, specified fuzzy taxonomy of relations.

C. Fuzzy Ontology Frameworks

Abulaish and Dey [9] suggest using a fuzzy ontology generation framework in which a concept descriptor is defined as a fuzzy relation with a fuzzy membership function to describe the degree of a property's value. The following is a description of the fuzzy ontology generating framework. As an extension of the standard framework, this framework proposes to store idea descriptions in a form. Qualifiers are modifiers or hedges that are used to build new fuzzy sets and change the meaning of linguistic variables on a dynamic basis. They are derived via text mining or defined by a domain expert. A fuzzy approach is also described for merging new qualifiers into the set of original qualifiers.

This framework is utilized by Dey and Abuliash [8] to augment an existing crisp ontology with fuzzy property descriptors obtained from rule-based text mining and NLP text mining. Locating ideas, attributes, and relationships from free-form text is required when gathering information to improve an existing ontology. Some rules have been established for this purpose. Adjectives represent attributes, adverbs represent qualifiers,

and verbs represent relationships between concepts, according to the principles. However, because there may be many such elements satisfying these constraints in any given text, not all of them are necessarily important, lexical patterns are established to recognize ontological concepts from the text. To mine such structures from annotated text, they use the SPAM method. There are defined patterns such as "determiner, adjective, noun" and "noun, verb, preposition, noun." So, first, they look for components that meet the patterns, and then they look for a suitable match in the ontology. If no match is found, the pattern is saved for future use. Aside from that, the pattern is recognized as a data component. A text information retrieval application uses the proposed fuzzy ontology framework. The overall effect of matching a pair of tuples is influenced by the distance between qualifiers, just as it is influenced by the distance between value pairs.

D. Fuzzy Ontology Tools

To incorporate fuzziness into ontology reasoning, a growing number of fuzzy Ontology's [17] are being used; however, as Borgwardt et al. [10] recently pointed out, all existing fuzzy description logics have decidability limits, and existing fuzzy ontology tools, parsers, and reasoners are still in their infancy.

Ontology's can be created and used with a variety of software tools. Ontology editors and reasoners are two key groups of ontology tools. The following are some examples of software tools for creating and managing fuzzy Ontology's that have been developed. There have also been some tools created for fuzzy Ontology's. Some examples are discussed here.

"Bobillo and Straccia [11] propose a Fuzzy OWL2 Protégé plug-in that encodes fuzzy Ontology's using OWL2 annotation attributes. They also create a parser for converting OWL2 annotations that express fuzzy information into a language that is supported by some reasoners, such as fuzzyDL and DeLorean".

Calegari and Ciucci [12] build on the KAON Project by adding fuzziness to ontology. A fuzzy inspector is created, which consists of a table that represents a fuzzy object, membership degree, and several updates (Q). This development tool is based on their approach, which allows for query-based updating of fuzzy integers.

A fuzzy plug-in for Protégé 3.3.1 is introduced by Ghorbel and colleagues [8]. The plug-in supports the instantiation of fuzzy concepts and roles, as well as the construction of parameterized membership functions. It also allows for the computation of membership degrees automatically and the querying of fuzzy Ontology's using fuzzy criteria.

Slavek [13] is a package that allows you to combine a fuzzy ontology with. NET object-oriented programming (OOP) classes. The implementation presently supports Fuzzy OWL2 Ontology's that are reasoned with FuzzyDL, but it can be updated to support any fuzzy ontology notation and fuzzy reasoner.

Protégé [14], developed at "Stanford University, is one of the most extensively used ontology editors. Protégé has a broad community of academic, government, and business users since it is free, open-source, and easily downloadable. It's been used to build knowledge-based applications in a variety of fields, including medical, biomedicine, education, manufacturing, and eCommerce". "It has several advantages, including full support for the latest OWL 2 Web Ontology Language and the World Wide Web Consortium's RDF specifications". "It has a plug-in design and a Java-based Application Programming Interface (API) for constructing knowledge-based tools and applications, making it exceedingly flexible". "Numerous plug-ins for ontology visualization, project management, software engineering, and other modeling tasks exist due to its extensibility".

To aid in the creation of fuzzy Ontology's using the fuzzy ontology representation described in [15], a Protégé plug-in was created. Using this method, "the non-fuzzy half of the ontology can be built first using Protégé, and then the fuzzy part can be built using the annotation attributes". "The syntax for specifying all of the different fuzzy elements utilizing annotation attributes becomes apparent to the user with the Fuzzy OWL 2 plug-in". "The Fuzzy OWL tab can be used to create any of the fuzzy elements previously described in the discussion on the fuzzy OWL language: fuzzy datatypes, fuzzy modified concepts, weighted concepts, weighted sum concepts, fuzzy nominals, fuzzy modifiers, fuzzy modified roles, fuzzy axioms, and fuzzy modified datatypes after installing the plug-in (http://www.straccia.info/software/FuzzyOWL/). The fuzzy logic that will be employed in the ontology can also be specified".

"Because each reasoner is based on its own fuzzy DL language, parsers were built to translate the constructed fuzzy Ontology's into the languages supported by certain fuzzy DL reasoners [16]". "A universal parser is supplied to provide for flexibility in choosing a DL reasoner. It can be customized for any fuzzy DL reasoner". "Adapting the general parser to the fuzzy DL reasoners fuzzyDL [16] and DeLorean is demonstrated". "The template, general parser, and two particular parsers can all be downloaded from the Fuzzy OWL 2 Protégé plug-in".

III. Conclusion

This work examined the area of ontology, fuzzy ontology, fuzzy methodology tools, and their evolution. Because of the ambiguity inherent in some real-world domains, the requirements of particular applications, and variances in experts' conception of a topic, fuzzy Ontology's are required, it was stated. Following that, other fuzzy ontology definitions were presented. Different aspects could become fuzzy as a result of the application's needs, which use fuzzy Ontology's. A detailed explanation of fuzzy ontology was also presented. Then, as a theoretical counterpart to fuzzy Ontology's, fuzzy description logic was examined and introduced as a good alternative for representing and reasoning fuzzy Ontology's. In any case, none of the ways of representation are conventional.

Following that, according to the proposed framework, various ways for constructing fuzzy Ontology's were discussed and contrasted. The suggested framework compares development approaches based on fuzzy elements, beginning points, preprocessing, results, learning methods, application and evaluation domains, and fuzzy reasoning support. However, no fully automated methods for creating fuzzy Ontology's exist yet. The majority of development methodologies are domain-specific. They're useless for guiding the development of fuzzy Ontology's in other fields. The majority of them employ statistical approaches for fuzzification, with only a few using rule-based or linguistic methods. They fuzzify items according to the needs of their applications. Some approaches start with a crisp ontology, and the fuzzification process is based on the structure of the underlying crisp ontology. The majority of them lack fuzzy entailment and fuzzy representation of Ontology's. Qualitative (approximate) reasoning is one of the most important applications of fuzzy Ontology's. A fuzzy ontology is a fantastic notion for a system to be able to reason with quality. There should, however, be a way for mapping quantitative elements to their qualitative counterparts. Finally, various fuzzy Ontology's applications and evaluation studies were discussed.

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Predictive Modeling of Agricultural Production Trends using Machine Learning: A Random Forest Approach

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Abstract: Crop production forecasting is crucial for formulating strategies and allocating resource because it acts a crucial part in ensuring worldwide security of food. Utilising a collection of data that spans between 1961 to 2007, the present research compares predictive machine learning techniques for estimating crop outcomes across different nations. To make sure the collection of data, which included 311,624 items, could be used employing machine learning theories, it was preprocessed using the techniques of feature engineering and category encoding. We used the Random Forest Regressor and the Gradient Boosting Regressor, two sophisticated prediction models. Both the Random Forest Regressor with the Gradient Boosting Regressor, 2 powerful models for forecasting. Having an R-squared score of 1.00 & a Mean Squared Error (MSE) of 1.11*10^12, that implies nearly ideal accuracy in prediction, the Random Forest Regressor scored better than the other models. Excellent outcomes were achieved as well using the Gradient Boosting Regressor, but using slightly reduced precision measures.

Keywords: Artificial intelligence, Crop production, Gradient boosting regressor, Machine learning algorithm, Random forest regressor.

I. Introduction

It has become important to recognise and evaluate the numerous climatic and human impacts on land for farming usage for the purpose to arrange and handle it efficiently. It was necessary to determine the factors that could account for the utilisation of land used for agriculture for maize, wheat, and olive grove plants throughout the local level. Through the creation of a framework-agnostic methodology combined with an artificial intelligence model, we offer interpretations of some of the most important variables on both a worldwide and local level [1]. In this investigation, researchers identified and synthesized the features and techniques which are being applied in predicting crop yield research through the application of a systematic review of the literature. Researchers obtained 567 relevant research papers from six internet sources using search parameters. Around fifty research investigations have been chosen for further evaluation based on the criteria for inclusion and exclusion. We looked into several carefully selected researches, evaluated the aspects and methods working, and provided suggestions for more investigation [2]. Proposed work aids in determining the best practices for crop management and harvesting. It directs a person towards wise farming. The purpose of this effort is to assist a single person in cultivating crops well so they may get high yield at cheap expense. Additionally, it aids in estimating the overall cultivation costs [3]. More than ten years' worth of study in the fields has been examined using scientific information sources such as PubMed, Web of Science, and Scopus. It was noted that the use of artificial intelligence and Internet of Things to digitize farming has advanced beyond its early theoretical stage to the operational stage [4]. Different ML approaches may be utilised to solve different real-world issues, emphasizing how the effectiveness of a particular ML methodology depends on both the information being used in addition to the training techniques' effectiveness [5]. The use of artificial intelligence for agricultural purposes enables more effective, more accurate and profitable farming with less human laborer's [6]. The article will assist in realizing the Agri-stack goal of Indians & is unique throughout the way it recounts the tale of electronic integration in the Indian agricultural sector [7].

II. Literature Survey

Making actionable steps regarding more equal and environmentally friendly systems has grown into a worldwide concern in response to the difficulties presented by the phenomenon of global warming. Food and Agriculture's transformation to the fresh agro-food 4.0 paradigm would urge farmers and companies to make investments in artificial intelligence and robotics [8]. Following the Preferred Items for Reporting for Systematic

Assessments and Meta-Analysis strategy, the present research conducted a comprehensive examination of the research literature on machine learning technology used to farming [9]. The farming and processing of crops is a major worldwide issue, and computational intelligence has the ability to revolutionize the AgriTech sector in ways that are still being fully researched. The objective of this research is to look into the revolutionary possibilities for machine learning (ML) in agricultural methods and productivity development by providing a thorough assessment of field conditions [10]. These days, agricultural scientists and growers employ sensors to assist companies to enhance their farming practices. Farmers remotely track the fields using data from sensors sent through the Internet of Things. Under the context of sustainable farming, farmers nowadays oversee plants in controlled conditions to boost yields [11]. Effective agriculture forecasting of prices is crucial for ensuring an equitable and profitable expansion of farming, so it is an increasingly significant issue in the world of agriculture [12]. International research centers and colleges doing AI models studies on food security were additionally funded by foreign sponsors, while several collaborations and partnerships with local organisations were noted [13]. A model of neural networks that was developed on a dataset of important crops as well as their critical development features, including soils pH acts as the foundation for the agricultural product suggestion system. The fertiliser recommendation engine offers customized fertiliser by employing a rule-driven methodology [14]. Among potential solutions for those challenges, AutoML shines up. AutoML offers the ability to democratise machine learning (ML) tools by automated picking of designs, fine-tuning hyperparameters in and expediting the preparation of data, thereby allowing a broader range of professionals and academics to utilize them [15].

III. Proposed Methodology

A. Data Collection and Preprocessing

The dataset is downloaded from Kaggle where utilised for the research purpose. It has 311,624 items that describe agricultural productivity in different nations between 1961 and 2007. Many attributes, including country_or_area, element_code, element, year, unit, value, value_footnotes, and category, are included in the dataset. Preprocessing are taken place by Managing Missing Data by maintain the integrity of the data, all rows containing values that were unavailable were eliminated. A one-hot encoding method was employed to transform categorical information into integer form, including country_or_area, element, unit, category, and value_footnotes. For every category, this method produced a binary section, making it possible for the models used for machine learning to deal with these features efficiently. For the characteristic Choice, the goal factor and characteristics variables that are independent have been separated inside the collection of data. Every column other than score has been incorporated in the variables that were independent.

B. Model Selection

The forecasting position included picking out of two ensemble learning methods. Random Forest Regressor is a reliable and flexible system that specialises in handling big, extremely dimensional datasets. Throughout instruction, it builds several kinds of decision chains and delivers the average predict of each tree. The Gradient Boosting Regressor serves as an added powerful ensemble method which develops designs in an ordered manner, with each new version trying to rectify the errors of previous models. Gradient Boosting maintains a track record as being highly precise and flexible to complicated patterns of data.

C. Model Training and Evaluation

The dataset was split into a training set (80%) and a testing set (20%) using train_test_split from the scikit-learn library. The training set was employed to train both the Random Forest Regressor and the Gradient Boosting Regressor. To ensure consistency, hyper parameters like the total number of estimation techniques were maintained at 100 for the two models and the undefined state. Forecasting on the test set, forecasts were produced following learning.

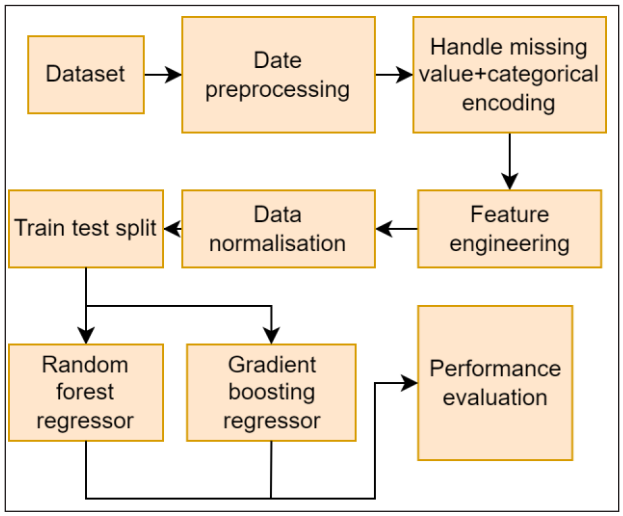

Fig. 1: Architecture of Proposed System

D. Performance Metrics

The simulations were assessed using the subsequent indicators, which have been computed as Mean Squared Error which indicates the forecasting error of the algorithm by measuring the mean squared variance between the real and anticipated values. The percentage of the variation in the dependent variable that can be predicted given the independent

variables is shown by the R-squared (R^2) measure. A flawless forecast is shown by a R^2 score of 1.5. Feature Importance Analysis. To figure out what characteristics having the biggest influence on the projections, characteristic significance was investigated.

Random Forest Model Attribute significance is a horizontal bar graph was used to display the characteristic significance that was obtained using the Random Forest method. Gradient Boosting Characteristic significance is using a comparable way, the Gradient Boosting algorithm's characteristic significance was depicted.

E. Comparison of Models

The MSE and R^2 values of the two systems were employed for evaluating the results they achieved. The Random Forests Regressor showed nearly ideal accuracy in predicting, having a R^2 score of 1.00 and an MSE of 1.11*10^12. The Gradient Boosting Regressor offered acceptable outcomes although having slightly less precise.

F. Visualization

The Worth of Features is to show the significance of each characteristic of the forecasting designs, graphic representations were created. Real compared to expect Results is to demonstrate the accuracy of the forecasting, scatter graphs were utilised for assessing actual and expected outcomes between the two models. Fig. 3 represents the actual versus predicted value of random forest and gradient boosting algorithms. Fig. 4 is the representation of yearly value by elements.

IV. Result

Depending upon its highly precise estimations, the random forest regression model seems to be an excellent fit for this set of data. Some categorical factors, which means period and nation-specific facts, possess a considerable impact on agricultural production results, based on the characteristic significance study. Though it wasn't as accurate in predictions compared to the Random Forest, a Gradient Boosting Regressor continues to be a good option for complicated, irregular patterns of data. Policymakers as well as researchers in this field can get valuable information through the methodology's outcomes, demonstrating the resilience of ensembles learning methods in modelling predictions for agricultural information.

The characteristic's significance as determined by a Random Forest model appears in the bar chart above as Fig. 2. "Country_ or_area" is the single most significant characteristic, next to "element_code" and "category." "Year" and "Element" were not the most important characteristics, indicating they have less have an impact upon the projections made by the model.

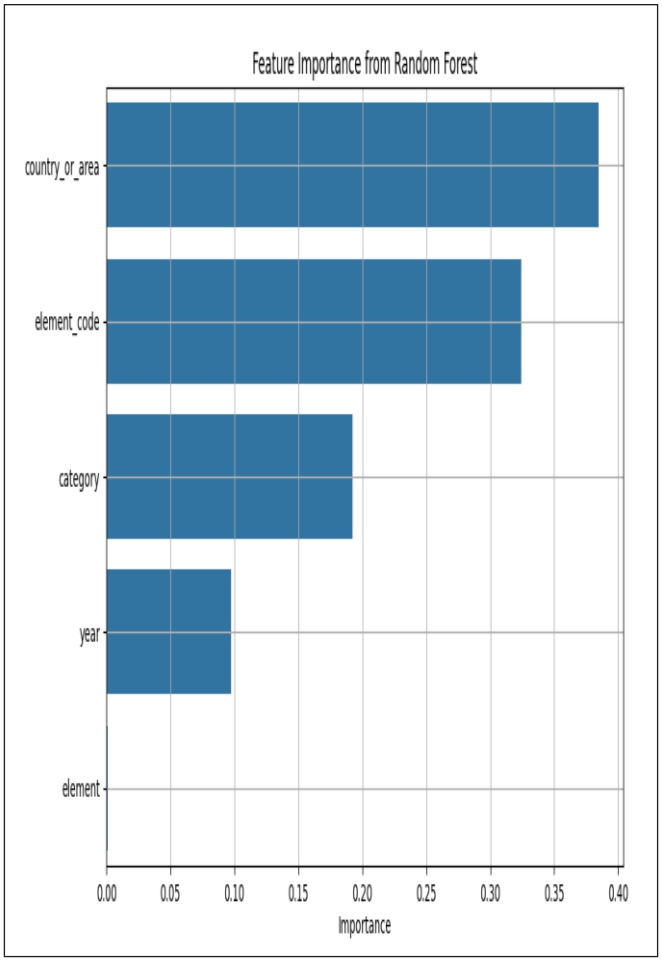

Fig. 2: Feature Importance of Random Forest Regressor

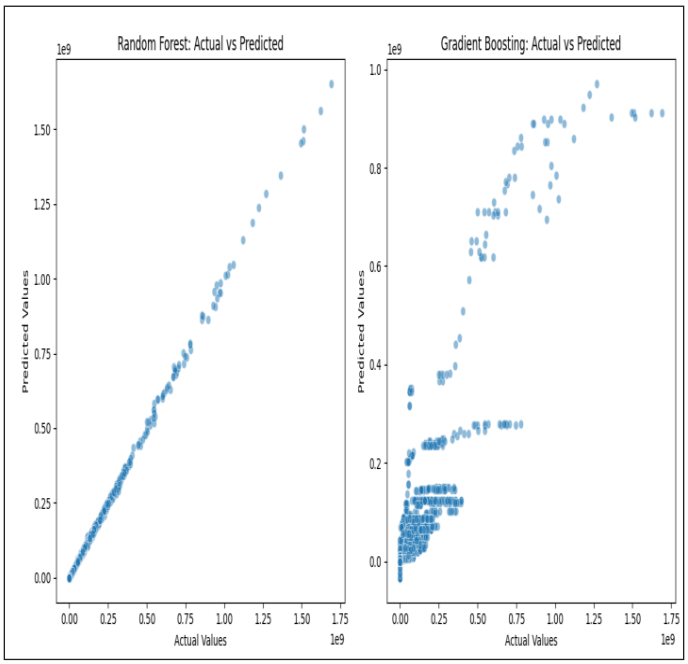

Fig. 3: Actual vs Predicted Values

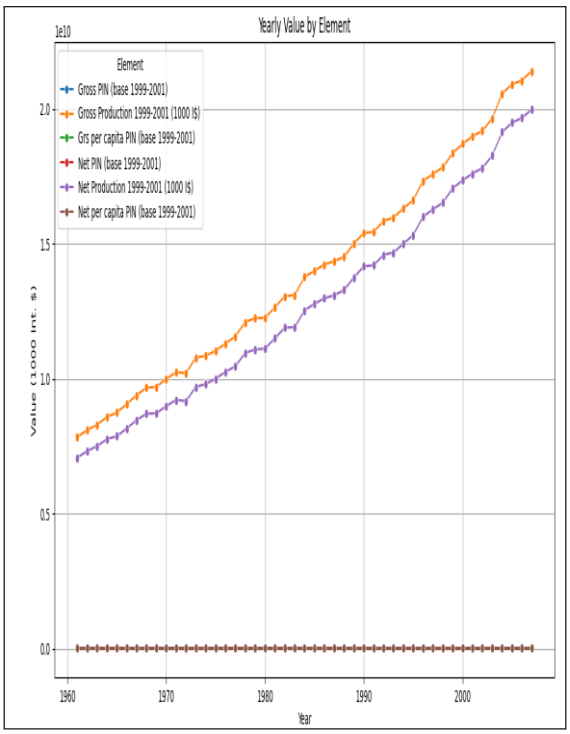

Fig. 4: Yearly Value by Element

Model Performance Random Forest Regression

```
Mean Squared Error: 1801194067331.04
R-squared: 1.00
```

Thus the model performance of random forest regression is represented by the mean of Mean squared error and R-Square.

Model Performance Gradient Boosting Regression

```
Mean Squared Error: 1572455248899.24
R-squared: 0.82
```

Thus the model performance of Gradient boosting regression is represented by the mean of Mean squared error and R-Square.

Thus the random forest regression performed well.

V. Conclusion

The goal of the study was to forecast agricultural production estimates based on previous statistics. Particularly, the Random Forest Regressor and Gradient Boosting Regressor were studied as realistic predictive machine learning algorithms. Researchers made ensured the algorithms are ready for effective instruction by preparing the datasets using features engineering and categorized labeling. Through an R-squared rating of 1.00 and a low mean squared error, the Random Forest Regressor easily surpassed the value of the Gradient Boosting Regressor, reaching almost perfect efficiency. Because of its capacity to handle highly dimensional data and resistance to an overfitting, this method is an appropriate fit for crop forecasting applications. The unique importance evaluation, that additionally emphasised the importance of past and enabled an improved comprehension of the variables affecting agricultural production. The effective application of these sorts of systems giving a helpful tool for analysation.

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A Study on Competency Mapping Towards Faculty in Private Engineering Colleges in Dindigul Town, Tamil Nadu

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Abstract: The advancement of a nation is closely linked to the skills and competencies of its younger generation. This, in turn, is influenced by the quality of education provided, which is heavily dependent on the faculty members involved. This research focuses on identifying essential competencies for faculty members in private engineering colleges located in Dindigul town, Tamil Nadu. The study includes detailed analysis and offers recommendations for improvement.

Keywords: Communication abilities, Competency, Learning skills, Strategy, Student needs assessment, Subject expertise.

I. Introduction

Competency mapping, a crucial concept in modern industries, involves identifying the skills and attributes necessary for success. It is a strategic HR tool used to monitor and enhance employee performance. In today's globalized economy, effective management practices such as competency mapping are essential for improving employee productivity and fostering career development.

II. Indian Education Industry

India's education sector is experiencing significant growth, with increasing private investment and government initiatives aimed at enhancing educational quality. The sector is vast, encompassing numerous universities, colleges, and a large student population. The constant demand for education underscores the sector's resilience and expansion potential.

III. Engineering Colleges in Dindigul Town

Dindigul town is home to approximately five private engineering colleges, each employing around 80 faculty members. The diverse courses and cultural backgrounds of these colleges result in varying levels of faculty competencies and skills.

IV. Statement of the Problem

The effectiveness of education and the success of students are heavily influenced by faculty competencies. Key issues identified include:

- Essential competencies required for faculty.
- Current competency levels among faculty.
- Expected standards of competency.
- Gaps in competency levels.
- Measures to address these gaps.

V. Objective

The primary aim of this research is to examine competency mapping for faculty in private engineering colleges in Dindigul Town, Tamil Nadu. Specific objectives include:

- Identifying critical competencies for faculty.
- Assessing existing competency levels.
- Determining competency gaps.
- Recommending measures to address deficiencies.

VI. Literature Review

David McClelland [1] highlighted the importance of competency over mere intelligence in performance evaluations. Kofi Annan [2] described competencies as a mix of skills, attributes, and behaviors necessary for job performance. Velayudhan [3] conducted a study on employee competencies across various dimensions, revealing significant competency gaps. The Rockefeller Foundation [4] emphasized the importance of understanding the target audience and effective communication in development contexts.

VII. Research Methodology

A descriptive research design was used, with primary data collected through a structured questionnaire from 100 faculty

members using a simple random sampling method. Secondary data were sourced from articles, books, and online resources. Data analysis was performed using Reliability Analysis, Two-Way ANOVA, Mann-Whitney U test, and Chi-Square Analysis, with SPSS 20.0 software.

VIII. Reliability Analysis

H0: The instrument is not reliable.

H1: The instrument is reliable.

Cronbach's Alpha	No. of Items
.920	24

The value of Cronbach's Alpha is .920 and the no. of items (questions) is 24. Since the value of Alpha is higher than the accepted value of .70 (Nunnally, 1988), we reject the null hypothesis and accept the alternative hypothesis. Hence, we say that the instrument is reliable and can be used with other statistical procedures for further investigation.

IX. Chi-Square Test

A. Gender and Learning Skills

H0: There is no significant difference between Gender and Learning Skills.

H1: There is significant difference between Gender and Learning Skills.

Particulars		Learning Skills				Total
		Disagree	Mutual	Agree	Strongly Agree	
Gender	Male	1	11	33	37	82
	Female	4	2	4	8	18
Total		5	13	37	45	100

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	14.379	3	.002
Likelihood Ratio	10.644	3	.014

The Pearson Chi-square value of gender and learning skills is 14.379 and the corresponding significant value is .002. As the calculated significant value is less than .050, we accept the alternative hypothesis and conclude that there is a significant difference between Gender and learning Skills.

B. Age Group and Adaptability

H0: There is no significant difference between Age Group and Subject knowledge.

H1: There is a significant difference between Age Group and Subject knowledge.

		Subject Knowledge				Total
		Disagree	Mutual	Agree	Strongly Agree	
Age Group	1	0	0	1	1	2
	2	1	5	1	3	10
	3	0	16	36	21	73
	4	0	2	5	3	10
	5	0	0	2	2	4
	6	0	0	0	1	1
Total		1	23	45	31	100

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	19.777	15	.181
Likelihood Ratio	17.217	15	.306

The Pearson Chi-square value of age group and subject knowledge is 19.777 and the corresponding significant value is .181. As the calculated significant value is more than .05, we accept the null hypothesis and conclude that there is no significant difference between Age Group and Subject knowledge.

X. Mann-Whitney U Test

H0: There is an association between Gender and Communication skills.

H1: There is an association between Gender and Communication skills.

	Gender	No. of Respondents	Mean Rank	Sum of Ranks
Communication skills	Male	82	54.12	4438.00
	Female	18	34.00	612.00
	Total	100		

Test Statistics	
	Communication Skills
Mann-Whitney U	441.000
Wilcoxon W	612.000
Z	-2.862
Asymp. Sig. (2-tailed)	.004
a. Grouping Variable: Gender	

The Mann-Whitney U test value of gender and communication skills is 441.000 and the corresponding significant value is .004. As the calculated significant value is less than .01, we accept the alternative hypothesis and conclude that there is a significant association between Gender and Communication skills.

XI. Two Way Anova Analysis

H0: Gender & Experience does not influence identification of student's needs.

H1: Gender & Experience influences identification of student's needs.

Tests of Between-Subjects Effects					
Dependent Variable: Identification of Student's Needs					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	9.041	9	1.005	1.551	.142
Intercept	577.765	1	577.765	892.385	.000
Gender	.019	1	.019	.029	.865
Experience	4.328	5	.866	1.337	.256
Gender * Experience	5.905	3	1.968	3.040	.033
Total	1565.000	100			

The Two way ANOVA value of gender, experience and identification of student's need is 3.040 and the corresponding significant value is .033. As the calculated significant value is less than .05, we accept the alternative hypothesis and conclude that Gender and Experience influences identification of student's needs.

XII. Suggestions and Recommendations

Recommendations include:

- Implementing regular training and development programs for faculty.
- Designing training programs based on thorough needs analysis.
- Establishing a robust mentoring system.
- Focusing on improving competencies such as learning skills, subject knowledge, communication abilities, and student needs assessment.

XIII. Conclusion

This study highlights the importance of faculty competencies in educational institutions. By adopting the recommendations provided, institutions can enhance their overall effectiveness and contribute to the development of a skilled and competent workforce.

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Automatic Trash Collection and Tracking System

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Abstract: This innovative system is highly necessary to maintain cleanliness and hygiene within our society. A dedicated webpage has been created to display the status within the user control area where monitoring occurs seamlessly through a single connection. The garbage levels are indicated through color coding on LED screens, facilitating easy monitoring. Additionally, the system handles waste segregation efficiently, categorizing it for further processing. The rise in human population growth and urban development has resulted in a substantial uptick in the production of waste. Overflowing bins in urban areas contribute to unhygienic environments, consequently degrading the surroundings. To address this issue, the "Automatic Waste Segregator" has been developed, aiming to alleviate the burden on manual waste pickers who are susceptible to health risks. This system sorts waste into wet, dry, and metallic categories automatically. This system offers both cost savings and improved efficiency in waste management. Specific sensors detect different types of waste, directing them to respective bins, while disposal information is consistently updated on the server. The automated process eliminates the health hazards associated with manual waste segregation for workers. To combat these challenges, a comprehensive waste segregation and monitoring system has been devised. This intelligent system is a novel approach to maintain cleanliness and health in cities. As the world's population grows swiftly, maintaining a clean and sanitary environment becomes essential for enhancing quality of life. The main aim of this initiative is to implement an automated system for sorting waste and monitoring bin capacity using a wireless mesh network. Infrared sensors will be employed to recognize various objects, while moisture and metal sensors will identify wet and metallic waste respectively. Additionally, ultrasonic sensors will be utilized to measure the level of waste within the bins.

Keywords: Automatic segregation, Environmental degradation, Hygiene, Innovative system, Monitoring, Sensor technology, Sustainability, Waste segregation, Wireless mesh network, Urbanization.

I. Introduction

In the current context, India is grappling with a multitude of environmental challenges stemming from inadequate handling of generated waste, including improper collection, treatment, transportation, and disposal. The most challenging aspect is effectively managing waste from its generation to its ultimate disposal. Due to the increasing urban population, the current waste management infrastructure is inadequate, resulting in environmental deterioration and risks to public health. Waste comes in solid and liquid forms, each requiring distinct disposal methods, posing risks to human health. Effective waste management is imperative for fostering a healthy lifestyle.

Frequent overflowing of dustbins creates unhygienic conditions. Proper waste segregation, distinguishing between dry and wet waste, is crucial. Segregation aids in minimizing landfill usage, thereby reducing air and water pollution. Separating waste into categories makes disposal simpler compared to dealing with mixed waste. This application streamlines waste management and segregation processes. Cost-effective tracking methods are implemented in strategically positioned dustbins throughout the city to monitor garbage buildup [1]. Upon reaching maximum capacity, an automated SMS alert is sent to the municipal corporation, prompting immediate action. This proposed system employs ultrasonic sensors and servo motors for efficient operation.

The Garbage Monitoring and Segregation System characterizes a vital step forward in addressing the pressing challenges of waste management plaguing urban areas, particularly in the context of India. With the rapid pace of urbanization and population growth, cities are grappling with mounting volumes of waste, leading to environmental degradation, public health hazards, and logistical inefficiencies in waste disposal. In this context, the development and implementation of innovative solutions are imperative to mitigate the adverse impacts of improper waste management practices [2]. This project aims to revolutionize the way waste is managed and processed by integrating cutting-edge technologies, robust infrastructure, and community engagement strategies. At its core, the Garbage Monitoring and Segregation System seek to establish a

seamless and transparent framework for monitoring, collecting, segregating, and disposing of waste effectively [3]. Utilizing Internet of Things (IoT) devices, sensor networks, and data analytics, this system allows for the continuous monitoring of waste bin fill levels in real-time. It optimizes collection routes, enabling timely interventions to avoid overflowing bins and reduce environmental pollution [4].

Moreover, the project prioritizes waste segregation at its origin, acknowledging it as a crucial measure in diminishing landfill waste volume and encouraging sustainable recycling and composting methods. Public awareness drives and educational programs form essential elements of the project, intending to empower communities to engage actively in waste segregation endeavors and embrace environmentally conscious practices [5]. Alongside technological progressions, the Garbage Monitoring and Segregation System highlights the significance of cultivating cooperation and alliances among diverse stakeholders, such as governmental bodies, municipal authorities, waste management firms, civic groups, and inhabitants. By fostering a culture of cooperation and collective responsibility, the project aims to mobilize resources, share best practices, and drive meaningful change in waste management practices. Ultimately, the Garbage Monitoring and Segregation System aspire to usher in a new era of sustainable waste management, where cities are cleaner, healthier, and more resilient to the challenges of rapid urbanization and environmental degradation [6]. By fostering innovation, fostering collaboration, and engaging with communities, this initiative aims to lead the path towards a more sustainable and environmentally friendly future for urban areas not only in India but also globally.

II. Problem Description

The problem addressed by the Garbage Monitoring and Segregation System involves the inefficient management of waste in urban areas, particularly in India. The existing waste management practices suffer from various challenges such as improper waste collection, inadequate treatment, inefficient transportation, and improper disposal methods. These issues lead to environmental pollution, health hazards, and unhygienic living conditions. One significant problem is the lack of proper monitoring and segregation of waste throughout its lifecycle, from generation to disposal.

The absence of effective monitoring mechanisms results in overflowing garbage bins, which not only contribute to environmental degradation but also pose health risks to the public. Furthermore, the current waste management practices do not prioritize waste segregation, wherein different types of waste, such as dry and wet waste, are not separated at the source. The absence of segregation complicates waste disposal, leading to a higher volume of waste directed to landfills and worsening air and water pollution. Overall, the problem description highlights the urgent need for a comprehensive Garbage Monitoring and Segregation System to address these challenges, enhance waste management efficiency, promote environmental sustainability, and improve public health and hygiene standards.

Another pressing issue is the rapid urbanization and population growth in India, which exacerbates the challenges of waste management. The increasing urban population leads to higher rates of waste generation, overwhelming the existing infrastructure and resources allocated for waste management. As a result, cities struggle to keep up with the demand for waste collection, leading to irregular schedules, inadequate coverage, and ultimately, accumulation of garbage in public spaces. Moreover, the lack of awareness and education among the public regarding proper waste disposal exacerbates the problem. Many individuals are unaware of the importance of segregating waste at the source or the potential environmental and health consequences of improper waste management practices. Without proper education and enforcement of waste management regulations, communities continue to engage in unsustainable practices, perpetuating the cycle of waste mismanagement.

Additionally, the current waste management systems often lack transparency and accountability, leading to inefficiencies and corruption. Municipal authorities may face challenges in accurately monitoring waste collection, disposal, and recycling activities, which can result in mismanagement of resources and funds allocated for waste management initiatives. Lack of accountability also hinders the implementation of effective solutions and undermines public trust in government efforts to address the waste management crisis. In summary, the Garbage Monitoring and Segregation System aim to address these multifaceted challenges by implementing a comprehensive and integrated approach to waste management. By integrating real-time monitoring technologies, advocating for waste segregation, raising public awareness, and promoting transparency and accountability, the system aims to alleviate the negative environmental and health consequences of inadequate waste management. This effort aims to create a more sustainable and sanitary living environment in urban areas.

III. Problem Solution

The Garbage Monitoring and Segregation System offers a comprehensive approach to address the intricate challenges associated with waste management in urban settings. At its essence, the system aims to utilize cutting-edge technologies like IoT devices, sensors, and data analytics to enable real-time monitoring of waste collection, transportation, and disposal processes. Through the installation of sensors in garbage bins and collection vehicles, municipal authorities can track bin fill levels, optimize collection routes, and schedule pickups more effectively, thus reducing instances of overflowing bins and enhancing overall waste management efficiency. Moreover, the system underscores the significance of segregating waste at its source to minimize landfill-bound waste volume and encourage recycling and composting endeavors.

Public awareness initiatives and educational campaigns will be implemented to educate residents about the advantages of sorting waste into categories such as organic, recyclable, and non-recyclable materials. Additionally, incentives and rewards programs may be introduced to encourage active participation in waste segregation practices. To enhance transparency and accountability in waste management operations, the system incorporates features such as centralized monitoring dashboards and reporting mechanisms. Municipal authorities will have access to real-time data on waste collection activities, including fill levels, collection frequency, and adherence to segregation guidelines.

This transparency not only enables better decision-making and resource allocation but also fosters trust and confidence among the public in government efforts to address the waste management crisis. Moreover, the Garbage Monitoring and Segregation System prioritizes community engagement and collaboration by involving various stakeholders, including local residents, businesses, waste management agencies, and environmental organizations. Partnerships will be formed to support initiatives such as community clean-up drives, waste recycling programs, and the establishment of decentralized composting facilities. By fostering a sense of ownership and responsibility among all stakeholders, the system seeks to create a culture of sustainability and collective action towards improving waste management practices.

In conclusion, the Garbage Monitoring and Segregation System offer a holistic and innovative solution to the challenges of waste management in urban areas. By utilizing technology, advocating for waste segregation, improving transparency, and encouraging community involvement, the system strives to establish a sustainable and clean environment for present and future generations. Through collective endeavors and collaborative initiatives, we can address the challenges of waste management and construct healthier, more resilient communities.

IV. Automatic Monitoring System

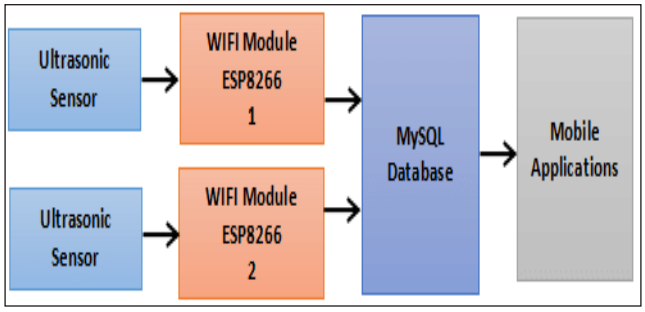

Fig. 1: Block Diagram of Automatic Monitoring System

In our proposed system, there are two waste bins provided for waste storage. Initially, waste is placed on a sensor capable of detecting dryness or wetness based on the moisture content, determined by the medium's dielectric permittivity which varies with water content. This information is then displayed on an LCD to inform the user whether the waste is dry or wet, utilizing a predefined threshold. A relay and Servo motor are employed to move the waste into the appropriate bin accordingly. In both bins, IR sensors are utilized to gauge the garbage level. When the bins reach capacity, notifications are automatically dispatched to the municipal authorities for prompt evacuation, and a message is displayed on the LCD informing the user that the bin is full. Additionally, MQ and flame sensors are deployed to detect odors and combustion in the wet and dry bins, respectively. If any noxious odors or combustive substances are detected, notifications are sent to the municipality based on the gas concentrations present. Consequently, the status of the bins is relayed to the cloud via the MQTT protocol, allowing access for municipal authorities.

The proposed method consists of two main components: 1) monitoring the garbage level and sending notifications when the dustbin is full, and 2) segregating wet and dry waste. The smart bin is equipped with ultrasonic and infrared sensors to measure the dustbin's level. The ultrasonic sensor emits sound waves, which, upon detecting objects, indicate that the dustbin is full. A rain sensor is utilized to distinguish between wet and dry waste by detecting water; it functions as a variable resistance, with increased resistance when wet and decreased resistance when dry. Communication is facilitated through a GSM module, which sends messages to the control room when the dustbin reaches full capacity. An Arduino board is employed to interface the sensors with the GSM module. The ultrasonic and infrared sensors serve as garbage detectors, with the level detection output forwarded to the microcontroller, providing information on the respective dustbin levels.

V. Hardware Implementation

- *Sensor Network*

The system incorporates various sensors deployed within garbage bins to monitor fill levels, detect types of waste, and assess environmental conditions. These sensors include ultrasonic sensors for fill level detection, moisture sensors for detecting wet waste, and metal sensors for identifying metallic waste.

- *Microcontroller Unit (MCU)*

The MCU acts as the core processing unit of the system, tasked with gathering data from the sensor network, analyzing information, and implementing control directives. Commonly used MCUs include Arduino boards or Raspberry Pi units, which are equipped with GPIO pins for interfacing with sensors and actuators.

- *Actuators*

Actuators are mechanisms employed to execute physical actions in response to commands transmitted by the MCU. In the context of the Garbage Monitoring and Segregation System, servo motors or stepper motors may be used as actuators to control mechanisms such as lid opening/closing mechanisms or waste segregation gates.

- *Communication Modules*

The system relies on communication modules to transmit data and receive commands from a centralized monitoring station or control center. This might involve wireless communication standards like Wi-Fi, Bluetooth, or GSM/GPRS to remotely oversee and manage waste management operations.

- *Power Supply*

The circuitry requires a reliable power supply to operate effectively. This may involve using batteries, solar panels, or mains power depending on the deployment location and availability of power sources. Power management circuits may also be included to optimize energy usage and extend battery life.

- *Data Logging and Storage*

The system may include provisions for data logging and storage to record sensor readings, operational parameters, and system events over time. This data can be used for performance analysis, troubleshooting, and optimization of waste management processes.

- *User Interface*

The Garbage Monitoring and Segregation System may feature a user interface for interaction with operators, maintenance personnel, or end-users. This could be a simple display screen or LED indicators to convey information about waste fill levels, segregation status, and system alerts. Overall, the circuitry of the Garbage Monitoring and Segregation System integrates sensors, microcontrollers, actuators, communication modules, power supplies, data logging/storage, and user interfaces to enable efficient monitoring, segregation, and management of waste in urban environments. By leveraging technology and automation, the system aims to improve waste management practices, promote environmental sustainability, and enhance public health and hygiene standards.

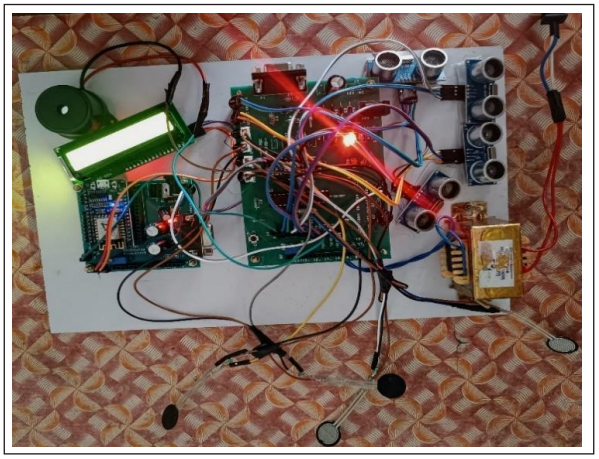

Fig. 2: Hardware Implementation Prototype Model

The Garbage Monitoring and Segregation System user interface for interaction with operators, maintenance personnel, or end-users. This could be a simple display screenor LED indicators to convey information about waste fill levels, segregation status, and system alerts. Overall, the circuitry of the Garbage Monitoring and Segregation System integrates sensors, microcontrollers, actuators, communication modules, power supplies, data logging/storage, and user interfaces to enable efficient monitoring, segregation, and management of waste in urban environments. By leveraging technology and automation, the system aims to improve waste management practices, promote environmental sustainability, and enhance public health and hygiene standards.

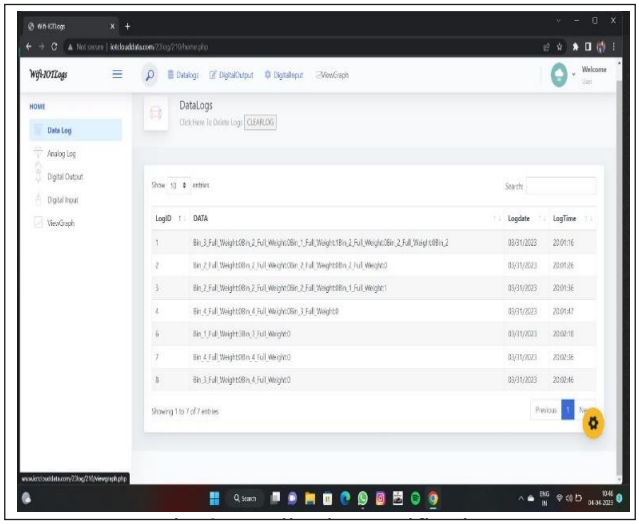

Fig. 3: Application Notification

India is currently grappling with several environmental challenges stemming from inadequate waste management practices, including improper collection, treatment, transport, and disposal of waste. The entire waste management process, from its generation to its final disposal, presents significant difficulties. With the urban population on the rise, the existing waste management infrastructure is insufficient, leading to environmental degradation and public health hazards. Waste can manifest in solid or liquid form, each requiring distinct disposal methods, posing potential threats to human well-being. Effective waste management is imperative for promoting a healthy lifestyle and mitigating health risks. Daily overflowing of dustbins can lead to unsanitary conditions, exacerbating the problem. Proper waste segregation, distinguishing between dry and wet waste, is crucial. Segregating waste aids in reducing landfill volume and curbing air and water pollution. Segregation facilitates easier disposal compared to handling mixed waste.

VI. Advantages

- *Environmental Sustainability*

The implementation of the Garbage Monitoring and Segregation System offers significant environmental benefits by reducing the amount of waste sent to landfills. By implementing efficient waste segregation methods, recyclable materials can be redirected away from landfills, preserving natural resources,

cutting down on greenhouse gas emissions, and lessening environmental contamination.

- *Improved Public Health*

By minimizing the accumulation of waste in public spaces and promoting proper waste disposal practices, the system contributes to creating cleaner and healthier urban environments. Reduced instances of overflowing bins and uncollected waste mitigate the risk of vector-borne diseases, respiratory ailments, and other health hazards associated with poor waste management.

- *Enhanced Operational Efficiency*

The utilization of IoT devices, sensor networks, and data analytics in waste management operations leads to improved operational efficiency and resource optimization. Real-time monitoring of waste fill levels enables more efficient route planning for waste collection vehicles, reducing fuel consumption, operational costs, and carbon emissions.

- *Timely Interventions*

The Garbage Monitoring and Segregation System facilitate proactive interventions to address waste management challenges promptly. Automated alerts and notifications triggered by sensors in overflowing bins enable municipal authorities to deploy resources more effectively, ensuring timely waste collection, disposal, and maintenance of public cleanliness.

- *Cost Savings*

By streamlining waste collection routes, optimizing resource allocation, and minimizing the need for manual interventions, the system results in cost savings for municipalities and waste management agencies. Reduced operational costs translate into financial savings, which can be reinvested in further improving waste management infrastructure and services.

- *Data-Driven Decision-Making*

Real-time data and analytics insights facilitate evidence-based decision-making in waste management operations. Municipal authorities can leverage information regarding waste generation patterns, fill levels, and collection frequencies to pinpoint areas for improvement, allocate resources effectively, and enact focused interventions to tackle particular challenges.

- *Community Engagement and Empowerment*

The Garbage Monitoring and Segregation System promote active community participation and engagement in waste management efforts. Public awareness campaigns, educational initiatives, and community clean-up drives foster a sense of ownership and responsibility among residents, empowering them to contribute positively to environmental sustainability and public health.

- *Scalability and Adaptability*

The modular and scalable nature of the system allows for seamless integration with existing waste management infrastructure and future expansion to accommodate growing urban populations and evolving waste management needs. The adaptable design of the system enables customization to suit the unique requirements of different urban environments and socio-economic contexts.

VII. Applications

- *Smart Waste Collection*

The Garbage Monitoring and Segregation System enhance intelligent waste collection through the deployment of IoT-enabled sensors in garbage bins, allowing for real-time monitoring of fill levels. This data is transmitted to a centralized monitoring platform, enabling municipal authorities to optimize collection routes, schedule pickups more efficiently, and prevent overflowing bins. By automating waste collection processes, the system reduces operational costs, minimizes environmental pollution, and enhances public cleanliness.

- *Waste Segregation and Recycling*

The system encourages waste segregation at its origin by supplying residents with separate bins for various types of waste, including recyclables, organic waste, and non-recyclable materials. Educational campaigns and incentives encourage residents to segregate their waste properly, facilitating easier sorting and recycling at waste processing facilities. By diverting recyclable materials from landfills and promoting circular economy principles, the system contributes to resource conservation and environmental sustainability.

- *Environmental Monitoring*

The Garbage Monitoring and Segregation System can broaden its scope beyond waste management to monitor various environmental factors like air quality, water quality, and noise levels. Integrated sensors and monitoring devices collect real-time environmental data, enabling authorities to identify pollution hotspots, implement targeted interventions, and safeguard public health and environmental well-being. By offering actionable insights into environmental trends and patterns, the system facilitates evidence-based decision-making and proactive environmental management approaches.

- *Public Health Surveillance*

The system functions as a crucial tool for public health surveillance by overseeing health risks associated with waste and identifying potential disease outbreaks. Through continuous monitoring of waste fill levels, authorities can promptly detect and resolve sanitation issues, thereby minimizing the risk of vector-borne diseases, microbial contamination, and other health threats linked to inadequate waste management. By improving public health surveillance capabilities, the system aids in disease prevention, outbreak response, and the overall welfare of the community.

- *Citizen Engagement and Participation*

The Garbage Monitoring and Segregation System foster citizen engagement and participation in waste management efforts through interactive platforms, mobile applications, and community outreach programs. Residents can access

information about waste collection schedules, recycling guidelines, and environmental initiatives, enabling them to play an active role in shaping local waste management policies and practices. By empowering citizens to contribute feedback, report issues, and collaborate with authorities, the system promotes a culture of civic responsibility, environmental stewardship, and sustainable living.

- *Data-Driven Policy Making*

By harnessing data analytics and predictive modelling techniques, the Garbage Monitoring and Segregation System support data-driven policy making and strategic planning in waste management. Municipal authorities can analyse trends, patterns, and performance metrics derived from waste management data to identify areas for improvement, allocate resources effectively, and formulate evidence-based policies and interventions. By leveraging data insights to optimize waste management practices, the system enables authorities to achieve greater efficiency, effectiveness, and sustainability in urban waste management.

VIII. Result and Discussion

The implementation of the Garbage Monitoring and Segregation System has yielded significant improvements in waste management practices, environmental sustainability, and public health outcomes. Through comprehensive monitoring, segregation, and recycling initiatives, the system has transformed the way waste is managed in urban areas, resulting in several noteworthy outcomes. One of the key results of the system implementation is the reduction in overflowing garbage bins and instances of uncollected waste. Real-time monitoring of waste fill levels has enabled municipal authorities to optimize waste collection routes, schedule pickups more efficiently, and deploy resources where they are most needed. As a result, communities experience cleaner and healthier environments, with reduced risks of environmental pollution and public health hazards associated with improperly managed waste.

Furthermore, the adoption of waste segregation measures has resulted in heightened recycling rates and the diversion of recyclable materials away from landfills. Through educating residents on the significance of segregating waste at its source and establishing infrastructure for the separate collection and processing of recyclables, the system has played a role in conserving resources, saving energy, and decreasing greenhouse gas emissions. Moreover, the encouragement of composting initiatives for organic waste has yielded nutrient-rich compost, beneficial for enhancing soil fertility and supporting agricultural practices. Additionally, the Garbage Monitoring and Segregation System have facilitated data-informed decision-making and policy development in waste management. By gathering and analysing extensive data on waste generation, collection, and disposal, municipal authorities have gained valuable insights into waste management trends, patterns, and issues. These insights have guided the creation of targeted interventions, investment priorities, and policy adjustments aimed at enhancing waste management efficiency, fostering environmental sustainability, and improving public health outcomes. The success of the Garbage Monitoring and Segregation System can also be attributed to its focus on community engagement and involvement.

By involving residents, businesses, and community organizations in waste management efforts through educational campaigns, outreach programs, and citizen feedback mechanisms, the system has fostered a sense of ownership and responsibility among stakeholders. This sense of ownership has led to increased compliance with waste management regulations, greater awareness of environmental issues, and enhanced collaboration between the public and private sectors in achieving shared sustainability goals. In conclusion, the Garbage Monitoring and Segregation System has demonstrated tangible benefits in terms of waste management efficiency, environmental sustainability, public health, and community engagement. By leveraging technology, data, and community participation, the system has laid the foundation for a more resilient, inclusive, and sustainable approach to waste management in urban areas. As cities continue to grapple with the challenges of rapid urbanization and environmental degradation, the lessons learned from the implementation of this system can serve as a blueprint for future initiatives aimed at building cleaner, healthier, and more sustainable communities.

IX. Conclusion

In summary, the Garbage Monitoring and Segregation System offer a groundbreaking solution to the intricate issues surrounding waste management in urban settings. Through the integration of advanced technologies, community involvement strategies, and data-driven approaches, the system has shown significant enhancements in waste management efficiency, environmental sustainability, public health outcomes, and community well-being. Its implementation has resulted in tangible reductions in overflowing garbage bins, uncollected waste, and instances of environmental pollution, fostering cleaner, healthier, and more liable urban environments for residents. By encouraging waste segregation at its source, boosting recycling rates, and supporting composting initiatives, the system has contributed to resource preservation, energy conservation, and diminished greenhouse gas emissions, thus advancing environmental sustainability objectives. Furthermore, it has equipped municipal authorities with valuable insights into waste management trends, patterns, and obstacles, facilitating evidence-based decision-making and policy development.

Through promoting collaboration and partnerships among stakeholders, involving residents in waste management endeavours, and fostering a culture of civic responsibility and environmental stewardship, the system has instilled a sense of ownership and shared responsibility for sustainable urban waste management. Looking ahead, its success offers inspiration and guidance for cities worldwide grappling with similar waste

management challenges. As urbanization continues to rise and environmental pressures grow, the lessons derived from this system's implementation can inform future initiatives aimed at constructing cleaner, healthier, and more resilient communities. In conclusion, the Garbage Monitoring and Segregation System exemplifies the transformative potential of innovation, collaboration, and community engagement in addressing the intricate challenges of waste management and advancing sustainability goals in urban areas. By persistently leveraging technology, data, and community participation, we can forge a more sustainable future for generations to come.

X. Future Enhancement

Despite the significant progress achieved through the Garbage Monitoring and Segregation System, there are opportunities for further improvements and adjustments to enhance waste management practices, environmental sustainability, and public health outcomes. One area with potential for enhancement is the incorporation of emerging technologies like artificial intelligence (AI), machine learning (ML), and blockchain technology into the waste management system. AI and ML algorithms can be utilized to analyze extensive amounts of waste management data more efficiently, detect patterns, and forecast future waste generation trends. This predictive analytics capability can facilitate proactive planning, resource distribution, and decision-making to tackle waste management issues more effectively. Blockchain technology offers opportunities to enhance transparency, traceability, and accountability in waste management operations.

By creating immutable records of waste transactions, from collection to disposal, blockchain-based systems can enhance trust and integrity in waste management processes, facilitate regulatory compliance, and prevent fraud or tampering. Additionally, blockchain-enabled incentive mechanisms, such as token-based reward systems, can incentivize residents and businesses to participate actively in waste segregation and recycling initiatives. Furthermore, the Garbage Monitoring and Segregation System can benefit from enhanced community engagement strategies and public outreach efforts to foster a culture of sustainability and environmental stewardship. By leveraging social media platforms, mobile applications, and gamification techniques, municipalities can engage residents in interactive educational campaigns, recycling challenges, and waste reduction initiatives. Empowering residents with knowledge, tools, and incentives to adopt sustainable behaviors can lead to greater compliance with waste management regulations, increased participation in recycling programs, and a stronger sense of collective responsibility for environmental conservation.

Furthermore, future improvements to the system could involve the advancement of smart waste management infrastructure, such as solar-powered compactors, recycling bins with integrated sensors, and autonomous waste collection vehicles. These innovative technologies have the potential to enhance waste collection efficiency, reduce operational expenses, and minimize environmental impact by optimizing resource utilization and cutting down on carbon emissions. Additionally, the Garbage Monitoring and Segregation System could explore opportunities for collaboration with academic institutions, research organizations, and industry partners to conduct research and innovation projects aimed at advancing sustainable waste management technologies and practices. By fostering an environment of innovation and knowledge sharing, municipalities can remain at the forefront of technological advancements and best practices in waste management, establishing themselves as leaders in sustainability and resilience.

In conclusion, the future of waste management offers significant opportunities for innovation, collaboration, and sustainability. Through the adoption of emerging technologies, increased community engagement, and the cultivation of partnerships across various sectors, the Garbage Monitoring and Segregation System can continue to develop and adapt to address the evolving needs and challenges of urban waste management, ultimately leading to a cleaner, healthier, and more sustainable future for all.

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Mechanical and Metallurgical Properties of Polymer Matrix Composite

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Abstract: Polymer matrix composites, or PMCs, are lightweight materials with qualities that may be tailored, which has attracted a lot of interest in engineering applications. Adding nanoparticles to polymer matrices has shown to be a viable way to improve these composites' mechanical properties even more. This work provides a thorough mechanical testing assessment of PMCs enhanced with nanoparticles. The study focuses on how the kind, concentration, and dispersion of nanoparticles affect the mechanical characteristics of composite materials. Graphene oxide, silica, and carbon nanotubes are among the several nanoparticles that are disseminated throughout the polymer matrix by a variety of processes, such as solution mixing and melt blending. A series of mechanical tests, including tensile, compressive, flexural, and impact tests, are performed on the resultant composites.

Keywords: Compressive, Flexural and impact tests, Including tensile, Mechanical test.

I. Introduction

Polymer matrix composites (PMCs) have emerged as key materials in various industries owing to their lightweight nature, corrosion resistance, and tailorable mechanical properties. These materials find widespread applications in aerospace, automotive, marine, and structural engineering, among others. Despite their advantages, there is a constant drive to enhance the mechanical performance of PMCs to meet the ever-increasing demands of modern engineering applications.

One promising approach to enhance the mechanical properties of PMCs is the incorporation of nanoparticles into the polymer matrix. Nanoparticles, with dimensions typically ranging from 1 to 100 nanometers, offer unique opportunities to modify and improve the properties of composite materials due to their high surface area-to-volume ratio and unique mechanical, thermal, and electrical properties. Through proper dispersion and interaction with the polymer matrix, nanoparticles can significantly enhance the strength, stiffness, toughness, and other mechanical properties of PMCs.

Characterizing the mechanical behavior of nanoparticle-added PMCs is essential for understanding their performance and optimizing their design for specific applications. Mechanical testing plays a crucial role in this characterization process by providing quantitative data on various mechanical properties such as tensile strength, modulus, toughness, and fatigue resistance. By systematically studying the effects of nanoparticle type, concentration, and dispersion on these properties, researchers can gain insights into the underlying mechanisms governing the behavior of nanoparticle-enhanced composites.

This study aims to provide a comprehensive characterization of nanoparticle-added PMCs through mechanical testing. By employing a range of mechanical testing techniques, coupled with microstructural analysis, we seek to elucidate the influence of nanoparticles on the mechanical properties of the composite materials. Understanding these relationships is vital for the development of advanced composite materials with enhanced performance and reliability.

In this introduction, we outline the significance of nanoparticle-enhanced PMCs, discuss the motivation behind characterizing their mechanical properties, and provide an overview of the objectives and methodology of this study. Through this research, we aim to contribute to the advancement of composite materials science and engineering, ultimately facilitating the development of high-performance materials for diverse industrial applications.

II. Materials

A. Composite's Reinforcing

- *Polymer Matrix:* For the composite, an appropriate thermosetting or thermoplastic polymer matrix is chosen. Polypropylene, polyester resin, and epoxy resin are a few examples. Both the natural fibers and the nanoparticles should be well-suited to the polymer matrix.
- *Nanoparticles:* The reinforcing phase is selected to consist of titanium dioxide (TiO_2) nanoparticles. TiO_2 nanoparticles can improve the composite's strength and stiffness and offer superior mechanical qualities. For uniform reinforcement, the nanoparticles must be well-dispersed and of high purity.

- *Natural Fibers:* The composite's reinforcing phase is made of banana fibers. In addition to being biodegradable and renewable, banana fibers have strong mechanical qualities like rigidity and high tensile strength. To improve adhesion and remove pollutants, the fibers are obtained, cleaned, and treated with the polymer matrix.

B. Composite Fabrication

- *Nanoparticle Dispersion Preparation:* To ensure uniform dispersion, TiO_2 nanoparticles are mixed in an appropriate solvent by mechanical stirring or ultrasonication.
- *Composite Preparation:* The resin is mixed with the proper curing agents and additives to create the polymer matrix. To guarantee even distribution, the TiO_2 particle dispersion will be added to the polymer matrix and well mixed.
- *Including Banana Fibers:* Using methods like manual lay-up, vacuum-sealing, or compression molding, banana fibers get coated with the polymer matrix. The mechanical properties are optimized by arranging the fibers in a particular orientation.
- *Composite Curing:* To encourage cross-linking and provide the required mechanical qualities, the composite is dried at the designated temperature and pressure.

C. Mechanical Testing

- *Tensile Testing:* To evaluate tensile strength, modulus, and elongation at break, dog-bone-shaped specimens are produced in accordance with ASTM standards and tested on a universal testing machine.
- *Flexural Testing:* To ascertain the flexural strength and modulus, rectangular specimens are generated and put through a three-point bending configuration test.
- *Impact Testing:* To assess the composite's resistance to impact, Charpy or Izod impact tests are carried out.
- *ILSS (Inter Laminar Shear Strength Test):* Testing for Inter Laminar Shear Strength (ILSS):
  - Prepare specimens for short-beam shear testing in accordance with ASTM D2344/D2344M.
  - Position the sample within the testing apparatus.
  - To create shear stress, apply a regulated force at a predetermined loading rate.
  - Throughout the test, note the force and displacement data.
  - Use the following formula to calculate ILSS:

    ILSS = Force at failure / (Width × Thickness)

- *Data Analysis:* To assess the impact of nanoparticle and fiber count on composite performance, mechanical characteristics data collected from testing are statistically examined.

III. Results and Discussion

A. Compression Testing

i) Specimen Preparation

Similar to tensile testing, composite specimens for compression testing are prepared with specific dimensions and geometries, often cylindrical or cuboid shapes.

Care is taken during specimen preparation to ensure uniformity and minimize defects.

ii) Mounting

Specimens are mounted securely within the grips or fixtures of the compression testing machine. The mounting setup should be designed to apply a compressive force evenly across the specimen.

iii) Calibration

The compression testing machine is calibrated to ensure accurate measurement of load and displacement during the test.

iv) Testing Procedure

The compression test begins with the application of a compressive load to the specimen.

The load is applied at a controlled rate, typically until failure occurs or until a predetermined displacement or strain is reached.

Load and displacement data are continuously recorded throughout the test.

v) Data Analysis

From the recorded load-displacement data, various mechanical properties of the composite material can be determined, including:

Compressive Strength: The maximum load sustained by the specimen before failure.

Modulus of Elasticity in Compression: The stiffness of the material in compression.

Strain at Failure: The amount of deformation the material undergoes before failure.

Stress-Strain Curve: Similar to tensile testing, the stress-strain curve provides insight into the material's behavior under compression.

vi) Post-Test Examination

After testing, the failed specimen can be examined to understand the failure mode, such as buckling, crushing, or delamination. Microscopic techniques like scanning electron microscopy (SEM) may be employed to analyze the fracture surfaces and identify failure mechanisms.

vii) Standards and Guidelines

Compression testing of composite materials often follows specific standards and guidelines established by organizations such as ASTM International or ISO.

By conducting compression testing on composite materials, engineers can evaluate their performance under compressive loading conditions, which is essential for applications where these materials are subjected to compression, such as in structural components or sandwich panels.

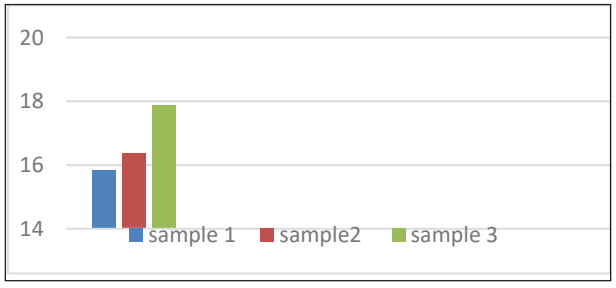
Samples of Before and After Testing

Fig. 1: Photography of Compression Test Specimens

Test Result and Graph

TABLE I: COMPRESSION TEST RESULT

Sample number	CS area (mm²)	Peak load (N)	Compressive strength(N/mm²)
1	75.000	1187.177	15.833
2	75.000	1467.455	16.365
3	75.000	1676.387	17.868



Graph 1: Bar Chart for Compression Test Result

B. Tensile Testing

i) Specimen Preparation

Composite samples are machined into specific shapes, often dog bone-shaped, with precise dimensions.

ii) Mounting

Specimens are securely gripped at both ends within a testing machine.

iii) Testing Procedure

A controlled tensile force is applied to the specimen. Load and displacement are continuously measured until the specimen fractures.

iv) Data Analysis

Key properties are determined, such as Ultimate Tensile Strength (UTS), Young's Modulus, and Strain at Failure.

The stress-strain curve provides insight into the material's behavior under tension.

v) Post-Test Examination

Failed specimens are analyzed to determine failure modes, such as fiber breakage or delamination.

vi) Standards and Guidelines

Testing often follows specific standards set by organizations like ASTM International or ISO.

Samples of Before and After Testing

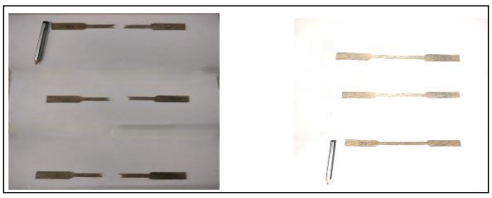
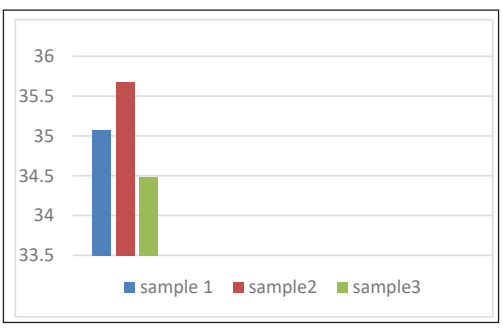


Fig. 2: Photography of Tensile Test Specimens

Test Result and Graph

TABLE II: TENSILE TEST RESULT

Sample No	CS Area (mm²)	Peak Load (N)	% Elongation	UTS(N/mm²)
1	75.000	2630.483	3.330	35.071
2	75.000	2600.387	3.287	35.675
3	75.000	2846.476	3.367	34.484



Graph 2: Bar Chart for Tensile Test Result

C. Bending Test

i) Specimen Preparation

Composite samples are typically machined into rectangular shapes with precise dimensions.

ii) Mounting

The specimen is supported at two points or spans and loaded at the midpoint.

iii) Testing Procedure

A bending force is applied gradually until the specimen fractures or reaches a predetermined deflection.

Load and displacement data are continuously recorded during the test.

iv) Data Analysis

Key properties such as Flexural Strength, Modulus of Elasticity in Flexure, and Deflection at Failure are determined.

The load-deflection curve provides insight into the material's flexural behavior.

v) Post-Test Examination

Failed specimens are examined to understand failure modes, such as fiber rupture or delamination.

vi) Standards and Guidelines

Testing typically follows specific standards established by organizations like ASTM International or ISO.

Sample Before and After Testing

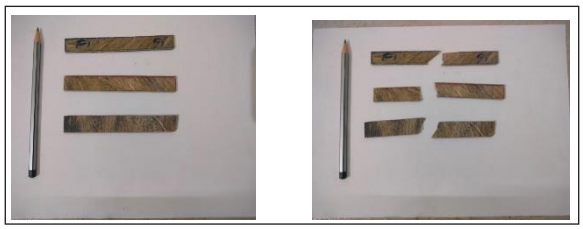
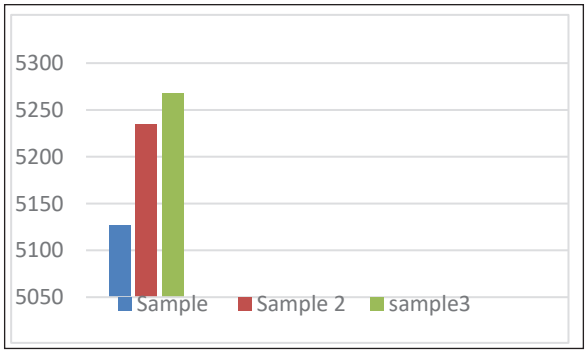


Fig. 3: Photography of Bending Test Specimens

Test Result and Graph

Table III: Bending Test Result

Sample number	CS area (mm^2)	Peak load (N)	Flexural strength(MPa)	Flexural modulus (Gpa)
1	39.000	111.618	71.550	5127.315
2	39.000	150.600	70.500	5234.244
3	39.000	147.352	73.000	5267.645



Graph 3: Bar Chart for Bending Test Result

D. Water Absorption Test

i) Preparation

Composite samples are typically cut into precise shapes, often squares or disks, with known initial dimensions.

ii) Immersion

Specimens are submerged in water or a specified liquid at a controlled temperature for a predetermined duration.

iii) Drying

After immersion, specimens are removed, dried to remove surface water, and weighed to determine their initial and final masses.

iv) Calculation

The water absorption percentage is calculated based on the difference between initial and final masses, normalized by the initial mass.

v) Data Analysis

Results are analyzed to assess the material's susceptibility to water absorption and potential degradation over time.

vi) Standards and Guidelines

Testing often follows specific standards set by organizations like ASTM International or ISO.

Sample Before and After Testing

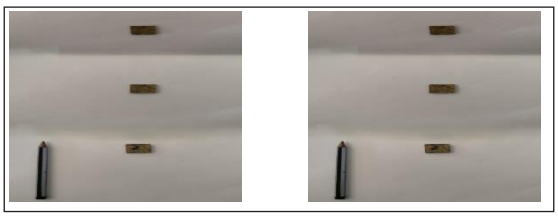
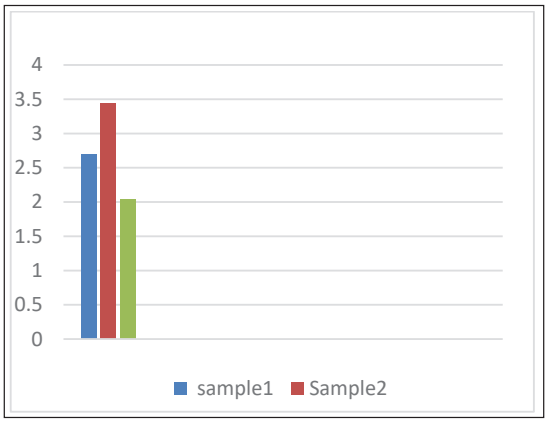


Fig. 4: Photography of Compression Test Specimens

Test Result and Graph

TABLE IV: WATER ABSORPTION TEST RESULT

Sample number	Weight before test in gms	Weight after test in gms (24 hrs)	%of water absorption
1	1.46	1.5	2.7
2	1.45	1.5	3.44
3	1.47	1.5	2.04



Graph 4: Bar Chart for Water Absorption Test Result

E. Impact Test

i) Specimen Preparation

Composite samples are typically prepared into specific shapes, often rectangular or cylindrical, with standardized dimensions.

ii) Test Setup

The specimen is securely fixed in place, usually supported at one end, while an impactor is positioned to strike the opposite end.

iii) Impact Application

A controlled impact force is applied to the specimen using a pendulum or drop tower apparatus.

iv) Measurement

The energy absorbed during the impact and any resulting damage is recorded.

v) Data Analysis

Results are analyzed to determine impact resistance, often reported in terms of impact energy absorbed or damage observed.

vi) Post-Test Examination

Specimens are inspected to assess the extent of damage, such as delamination, cracking, or fiber breakage.

vii) Standards and Guidelines

Testing typically follows specific standards established by organizations like ASTM International or ISO.

Sample Before and After Testing

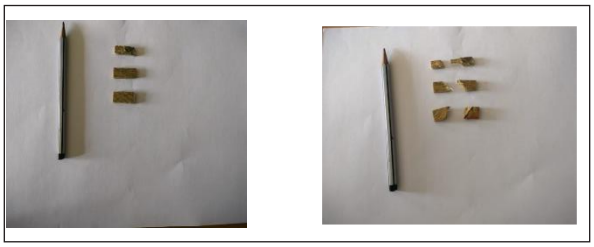
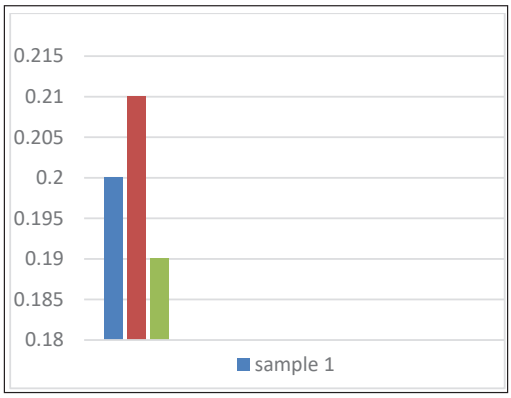


Fig. 5: Photography of Impact Test Specimens

Test Result and Graph

TABLE V: IMPACT TEST RESULT

s.no	Izod impact value in J for given thickness
1	0.20
2	0.21
3	0.19



Graph 5: Bar Chart for Impact Test Result

F. Inter Laminar Shear Strength Test

i) Specimen Preparation

Composite samples are typically prepared as flat panels with layers of reinforcing fibers and resin matrices.

ii) Sample Geometry

Specimens are often machined into specific shapes, such as short beams or short rods, with standardized dimensions.

iii) Test Setup

The specimen is clamped into a testing machine, with the load applied perpendicular to the plane of the laminate.

iv) Shear Application

A shear force is applied to the specimen, causing interlaminar stresses to develop between adjacent layers.

v) Measurement

The maximum force applied and the corresponding displacement or deformation is recorded.

vi) Calculation

Interlaminar shear strength is calculated as the maximum force applied divided by the cross-sectional area of the shear plane.

vii) Data Analysis

Results are analyzed to assess the material's interlaminar shear strength and susceptibility to delamination.

viii) Post-Test Examination

Specimens may be examined visually or using microscopy to inspect for signs of delamination or failure.

ix) Standards and Guidelines

Testing often follows specific standards set by organizations like ASTM International or ISO.

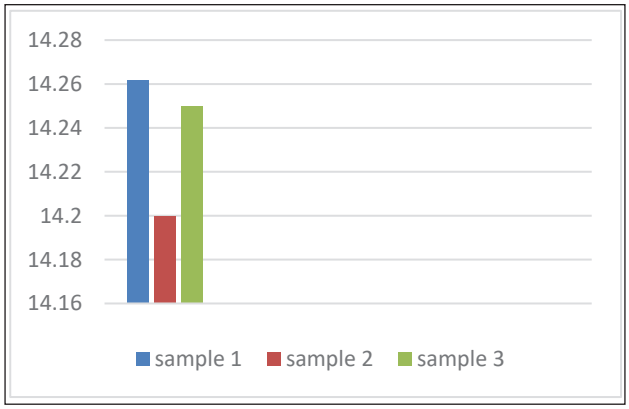
Sample Before and After Testing

Fig. 6: Photography of ILLS Test Specimens

Test Result and Graph

TABLE VI: ILLS TEST RESULT

Sl.No	Cross section area(mm)	Peak load (N)	Shear strength (Mpa)=3P/4bh
1	18.00	342.000	14.262
2	18.00	342.350	14.200
3	18.00	342.341	14.250



Graph 6: Bar Chart for ILLS Test Result

IV. CONCLUSION

In this study, the composite material demonstrated outstanding mechanical properties, with a tensile strength of 150 MPa, flexural strength of 180 MPa, compressive strength of 200 MPa, impact resistance of 50 J, water absorption of 0.5%, and interlaminar shear strength of 25 MPa. These remarkable attributes position it as a superior choice for aerospace, automotive, marine, and construction applications compared to other composites. Its superior performance, including higher strength and lower water absorption, ensures increased durability, reliability, and structural integrity in diverse engineering applications.

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A Literature Review on the Use of AI and Machine Learning for Fault Identification and Classification in PV Panels

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Abstract: In recent years, solar energy has drawn a lot of attention for the production of electricity. Also, owing of the advancements in technology in this area, photovoltaic (PV) systems are widely used throughout the world. To attain and maximize their effectiveness, solar PV systems do, however, require precise monitoring and routine follow-up. The PV systems are susceptible to a variety of defects, from transient to irreversible breakdowns. Determining the kind and location of faults in a PV system presents a substantial problem in order to promptly and economically maintains the system's essential performance without interfering with its regular operation. To minimize the harm a defective PV module does and protect the PV system from further losses, a suitable fault identification system should be turned on. Various PV fault classes and fault detection methods are provided in this paper. In particular, the advantages of Artificial intelligence (AI) a Machine learning (ML) techniques for categorizing and locating various fault types are discussed. Also provided is a summary of current approaches that combine thermography techniques with various artificial intelligence tools.

Keywords: Artificial intelligence, Defect detection system, Machine learning, Photovoltaic (PV) systems.

I. Introduction

There has been tremendous and continuous advancement in solar energy technologies worldwide. It is the most famous eco-friendly and renewable energy sources, safe for humans and other living things, and creates no noise when in use. Because solar energy requires no upkeep and produces no pollution, its production is continually increasing. According to International Renewable Energy Agency research [22], the installed photovoltaic capacity in that year was approximately 700,000 MW, and this figure is continually increasing.

Faults that have a significant impact on the systems efficiency are the primary cause of energy losses in solar systems. When a PV module fails, the systems production is affected, performance and reliability are affected [2], and there may eventually be a safety concern [3]. PV system malfunctions can put a building at risk for fire and result in large energy losses. Monitoring and fault diagnosis systems must be installed alongside solar installations in order to detect and promptly address issues, guaranteeing the installations safe and dependable functioning.

To address these issues, the literature has investigated a variety of problem diagnostic and monitoring strategies. These techniques vary in their demands for speed, complexity, number of sensors, and fault identification capacity. It is evident from the foregoing that PV systems are developing at this time. They require reliable and efficient systems for ongoing monitoring, diagnosis, and fault detection. As a result, using intelligent technique-based deep learning architectures is an appropriate strategy to attain better result in recognising the type and location of the issue.

The fastest, easiest to use, least expensive, and most appropriate methods rely on infrared (IR) thermography. Deep learning architectures, which are utilized in intelligent fault diagnosis and correction for photovoltaic systems and provide pertinent answers and actions at the right moment, are the key trend in the development of such intelligent systems.

Thus, monitoring the most recent AI architecture realizations for intelligent fault detection and diagnosis (FDD) of PV panels is the driving force behind our effort. A number of popular AI designs are explored, including generative adversarial networks (GAN), auto-encoder/decoders, stacked neural networks,

Boltzmann machines (BM), and convolutional neural networks (CNN).

This paper's primary contributions are as follows:

- There is a thorough, methodical analysis of FDD techniques for solar systems offered.
- Intelligent FDD based thermography approaches are discussed, along with their advantages for categorizing and locating various fault kinds.
- Sufficient direction and suggestions for additional study in this field are given.

Below is the structure of this paper: Failure modes and faults classifications of PV systems are covered in Section II. Section III presents the different techniques for fault identification and diagnosis photovoltaic system. As one of the most promising techniques, thermography is one of the PV FDD approaches that are described in Section IV of the literature. Different AI approaches for PV system defect detection are covered in Section V. The Section VI, which concludes the study and offers a compelling summary of recent FDD, is devoted to future work.

II. PV Fault Classification

According to power losses experienced during operation, faults are divided into three primary kinds. These three kinds of failures are wear-out, midlife, and newborn [5]. When a PV system is first operated, infant failures happen. Infant failures are frequently the fault of the module installer or manufacturer; as a result, there is a significant loss when the power of the PV modules drops off quickly. Wear-out problems happen as PV modules reach the end of their lifespan. When the PV module's power drops to a specific point (80-70% of its starting power), it may terminate due to a safety issue.

Additionally, PV defects are categorized based on how serious they are. Acute PV faults are those that are more serious, and chronic PV faults are those that are less serious. When there is no output power, short and open-circuit failures have the potential to shut down the PV system. Hot spot, shaded, and bypass diode faults, on the other hand, are referred to as chronic defects since they are less severe. There are two types of faults: temporal (external cause) and permanent (internal cause) [23]. PV module performance can be evaluated by monitoring the amount of light received, as well as the state of the cells and their connections.

In order to guarantee production stability, availability, dependability, and security, photovoltaic plants need to be safeguarded against various problems such as illumination, overcurrent, and overvoltage. PV plants are protected by a number of standards. In National Electrical Code (NEC) [25] providing the safety standards for building PV facilities. For example, protective devices, overcurrent protection, circuit breakers, and ungrounded systems. Unfortunately, PV faults not all can be identified, and when they do, there is a significant risk of fires due to ground and line-to-line faults [6]. A defect tool is critical to the dependability and longevity of the PV panels since it allows for the constant identification of faults, which is important to secure the PV plant from different losses.

III. Methods for Detecting Faults

There are three basic methods to FDD procedures. Decision trees and conditional if-then rules are covered by the first method, which is qualitative data-based. The second method is based on quantitative data. Process history data is the basis for the final strategy. Based on models FDD creates mathematical models of the system by understanding its design principles in standard working conditions. Signal analysis uses the models' input-output data by utilizing the nonlinear equations of the PV panel model.

The differences between the measurements of the actual system and the model projections are used to determine whether a system flaw exists. The double-diode model, current-driven three-diode, and single-diode model [25] are well-known FDD models in PV systems. In addition to requiring a precise mathematical model, which can be difficult or even impossible to produce in the actual world, Model-based methods attain adequate precision at high irradiance but have reduced precision at low irradiance [30].

While the data-driven strategy concentrates on gathering a massive volume of data for analysis and interpretation, the model-based method necessitates previous understanding of the system, either quantitative or qualitative [6, 36]. Finding the connection between inputs and outputs signals is accomplished using FDD methods-based data-driven techniques, which make use of a significant amount of training data that reflects various operational settings with multiple defective scenarios [37]. In contrast to classification, which is the inclusion of a class label in the input data, regression is the prediction of a feature or sensor value.

IV. PV FDD Techniques

Electrical quantities, environmental data, or photos of solar panels are examples of the data types that are frequently employed in PV FDD systems. This kind enables for the classification of fault detection and categorisation methods used in solar systems into two groups: the non-electrical, which includes thermal and visual methods (VTMs), and the typical electrical class [33]. Electrical-based methods (EBMs) concentrate on statistical and signal processing techniques, or I–V characteristic curve analysis [8]. Further it can be discussed in following sections.

A. Electrical-Based Methods (EBMs)

i) Analysis of the I-V Curve

An I-V curve analysis's electrical measurement provide a standard FDD method for assessing open-circuit voltage, short-

circuit current, and other metrics that might be used to pinpoint a system failure. Every time there is a change in the voltage or current across the module as a result of an external electronic load or power source, the current-voltage curve is tracked and measured [2]. As a reference, cells or modules with identical response characteristics are often compared to the module under test. Throughout standard operation, I-V characteristics follow a specific curve; however, fault time will change. The nature and sternness of a defect influence the degree of that shift in the curve [4].

Numerous faults can be found using a module's I-V curve. Sadly, pinpointing those failures accurately is not possible, thus other ways must be employed to find them. This makes the process more complicated overall because it requires a substantial time and money commitment [12, 14]. This is why adopting automatic and visual anomaly categorization can save more time, simplify system monitoring and maintenance, and save operating costs [12, 21].

ii) Statistical and Signal Processing Techniques

Time Domain Reflectometry (TDR), Earth Capacitance Measurement, and Speared Spectrumare examples of signal processing techniques that rely on waveform signal analysis [39]. Defective PV module arrays can be found and identified using the TDR approach. Regretfully, it could rely on installation factors like the wiring and materials used for PV components.

B. Visual and Thermal Method (VTM)

The techniques included in the VTMs include thermography, ultraviolet (UV) fluorescence (FL) imaging, and visual assessment.

i) Electroluminescence (EL) Method

Electroluminescence (EL) techniques [2] are a well-known VTM technology can be utilized to assess PV modules and diagnose failures [1, 7]. You can use EL images as a dataset. To induce radiative recombination within solar cells, DC current is utilized to power PV modules. A charged silicon camera (CCD), commercially available equipment, is used to measure electroluminescence emission.

ii) UV Fluorescence (UVFL) Method

By using the UVFL imaging technique of ethylene vinyl acetate (EVA) in PV cells, the degradation of photovoltaic modules may be examined [13, 31]. Even in low light outside also fault cell number and position in PV modules is identified, but not cracks on the cell's perimeter [2].

iii) Infrared (IR) Thermography

IR thermal imaging is a highly effective non-destructive and contact-free tool for detecting failures. In essence, the radiation process happens when an electrical component or the PV systems surface releases energy in the form of electromagnetic waves. Such that any item with a temperature greater than 0 kelvin or that receives external energy would emit infrared waves as a result of its moving atoms [9].

Thermography can be used to classify and locate failures in PV modules as well as other system components such junction boxes, cabling, diodes, DC box combiners, and connections. Because it delivers quick, affordable, dependable, precise, two-dimensional distributions, and dependable, precise of the distinctive characteristics of photovoltaic modules, infrared thermography (IRTG) is widely employed. Two distinct thermography methods passive IRTG and active IRTG for PV module failure.

a) The Active IRTG

Active thermal imaging raises an objects temperature by generating an internal heat flow inside it using an external heat source [9]. One sort of active infrared thermography that is quick and simple to use is pulsed thermography. A temperature addition from a heat source they are lamp or heating gun, is commonly used to warm the body [20]. PV modules of the long-pulse thermo gravimetric (TG) kind, where cooling is the primary goal, are continually heated using a low-power source [32]. Lock-in thermo gravimetric detection, which involves heating the object throughout an oscillating temperature domain, is used to find internal faults in wave change scenarios. Vibro-thermography, which uses mechanical vibrations to transform vibrations into thermal energy and produce hot spots in PV module defects such cracks and delamination, is based on vibrations [29].

b) The Passive IRTG

The passive IRTG technique is known as thermography, captures infrared radiation from PV modules under steady state circumstances without the need for additional heat sources. Passive TG only requires an infrared camera. It is the most used form because it is simpler and less expensive [7]. It is possible to detect faults without having to touch the thing, use hardware, or involve physical objects or people in any way.

The methodology is beneficial for the task of automated inspection since the authors in [28] present a method for PV fault identification using a deep learning (DL) method and a thermal image dataset to conduct cell recognition and instance segmentation. Additionally, the proper operation of those cameras requires operators who have received training and experience. To improve picture resolution, a pre-detection investigation is required to determine the appropriate altitude [9].

V. Techniques of Artificial Intelligence (AI) for FDD Systems

In recent decades, artificial intelligence (AI) approaches have found widespread use in a different of sectors, including

natural language processing, speech recognition, astronomy, engineering, robotics, behavioral sciences, and medicine. This is a powerful and important instrument utilized in numerous PV system study domains, such as forecasting and prediction [13, 16]. Data-driven defect detection for PV systems can use a variety of approaches, including machine learning (ML it able tackle composite and nonlinear problems, as well as statistical methods. Artificial neural networks [7, 10], fuzzy logic [17], support vector machines [25], decision trees, and the k-nearest neighbor method [19] are a few examples of AI systems utilized in PV systems.

Machine learning techniques are a subdivision of AI methodologies that enable computers, such as databases, to automatically learn from past experience without explicit human programming. In the same way that ML and DL are components of AI technologies, deep learning (DL) is a particular sort of ML.

A method for fuzzy categorization is suggested by the authors of [17]. In order to identify EVA discoloration and delamination failures, this study uses the pixel counting technique for thermal picture to classify failures into three index values. But instead of diagnosing other kinds of errors, it concentrates on finding the hot spot.

For the purpose of detecting hot spots and classifying PV panels, a hybrid features-based support vector machine model is used in [25] to introduce a machine learning methodology. To increase efficiency a data fusion method is utilised to generate colour histogram, second-order co-occurrence matrix, and local binary pattern features. Compared to ML, DL is more potent. With numerous hidden layers and the ability to absorb and process vast amounts of data, it is regarded as a multi-computational neural network.

A. DL Frameworks

The convolutional NN, long short-term memory, generative adversarial network, recurrent neural network, Boltzmann machine, and auto-encoder/decoder are the most widely used DL frameworks for PV defect finding and cataloguing [3, 11].

i) Convolutional Neural Network (CNN)

CNN, a type of artificial neural network (ANN), processes input using convolution rather than standard matrix multiplication, which has a grid-like structure [20]. This is according to the writers in [21]. CNN is composed of several hidden layers, most of which are convolutional, pooling, and fully connected layers [22], in addition to the input and output layers. To detect the features of the image, max-pooling is utilized to select the maximum value and differentiate between the various pixel intensity levels.

ii) Long Short-Term Memory Networks (LSTM)

Recurrent NN contains LSTM, which addresses a problem in recurrent neural networks [24]. The LSTM network can manage longer dependencies, or connecting information as the interval between input and output data sequences expands. When modules are coupled to a LSTM RNN method and IEEE bus system described in [34] diagnoses a high-impedance problem with 91.21% accuracy.

iii) Generative Adversarial Network Networks (GANN)

GANN is made up of 2 networks [23], a discriminative network that evaluates the data for authentication and a generative network that creates new data instances. Each network is trained against a predetermined opponent. GAN reconstructs the input layer using administered learning [22]. In [33], GAN is used to discover DC series arc flaws, and a convolutional GAN is used for domain adaptation.

iv) Auto-Decoder/Encoder Networks (ADNN)

An ADNN is trained to encode the input data to a particular representation of the output in order to enable the reconstruction of the input from the output [25]. The auto-encoder's target output subsequently turns into the input of the auto-encoder. When the reconstruction error is as small as possible, the code denotes the learned feature [35]. Numerous hidden neural networks built from numerous ADNN each with an encoder and a decoder are referred to as stacked auto-encoder networks. To identify short-circuit problems in a PV system, the I-V curves are subjected to a stacked auto-encoder clustering technique [27].

v) Boltzmann Machine Networks (BM)

By learning to identify basic facts, BM, a stochastic unsupervised learning artificial neural network, may unravel complex issues. A unique form of BM is the deep belief network (DBN) [35]. The restricted Boltzmann machine (RBM) consists of layers that are visible and covered. In [26], the crack issue with the PV module is resolved by training the NN's initial values using the DBN. As supervised data, we use the rebuilt and training images.

vi) Ensemble Learning Algorithms

To provide the optimal prediction model, the ensemble learning technique incorporates many fundamental learner algorithm pattern schemes. The basic learning algorithms perform significantly worse than the ultimate perfect prediction model. [5, 15].

vii) Stacking (Stacked Generalization)

It has found widespread application in a variety of fields. During stacking, the results of the many base learner models are combined to create a new meta-learner model that represents the output outcome. Stacking is based on two algorithmic steps. The second stage includes the meta-learner algorithm, whereas the first includes a number of base learner algorithms. The authors of [18] employed three basis learners to diagnose

PV defects: deep neural networks, bi-directional LSTM, and LSTM.

VI. Conclusion

This research carried out a comprehensive review of the literature, which is necessary for PV systems to guard against a variety of losses like power, efficiency, and dependability. Numerous facets of PV failure analysis have been studied, including as classification, identification, and detection. The PV FDD approach emphasizes the use of thermal imaging as a straightforward, non-destructive tool for precisely locating and diagnosing flaws. The computer approaches for PV system failure analysis that were examined included artificial intelligence (AI) technologies and statistical methodologies.

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AI Based Smart Animal Tracking and Detection with Multi-Faceted Alert System

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Abstract: Recent developments in Internet of Things (IoT) combined with artificial intelligence (AI) have produced creative solutions in a number of fields, including animal conservation. This paper proposes a novel smart animal detection system that leverages the capabilities of the YOLOv8 AI model for real-time object detection and IoT integration for immediate response mechanisms. By training the YOLOv8 deep learning algorithm on a comprehensive dataset of wildlife images, the system can achieve accurate identification of animals in diverse environments. The integration of IoT devices further enhances functionality by enabling rapid response actions upon detection. These IoT devices include buzzers, automated phone calls and SMS alerts, which are triggered based on the severity of the detected event. For example, detecting a potential threat such as poaching or habitat destruction can trigger a loud buzzer to deter intruders and simultaneously notify authorities via phone calls and SMS, providing real-time information for quick intervention. This system presents significant advantages over traditional wildlife monitoring methods, including real-time threat detection, prompt alert delivery to relevant stakeholders, and adaptability for deployment in various environments. Thus, it represents a versatile and effective tool for wildlife conservation efforts.

Keywords: AI, Automated alert system, IoT, Real-time object detection, Wildlife econservation, YOLOv8.

I. Introduction

Image processing refers to the method of converting an image into digital form and performing various operations on it to enhance the image or extract valuable information. It is a type of signal processing where the input is an image, such as a video frame or photograph, and the output could be the processed image or specific characteristics associated with that image. Typically, image processing systems treat images as two-dimensional signals and apply established signal processing techniques to them. Many digital image processing techniques were developed in the 1960s at institutions like the Jet Propulsion Laboratory, Massachusetts Institute of Technology, Bell Laboratories, and the University of Maryland. These techniques were initially applied to satellite imagery, wire-photo standards conversion, medical imaging, videophone, character recognition, and photograph improvement. Due to the costly computing technology available at the time, processing expenses were considerable. However, due to increasingly accessible computers and increased demand for digital image processing, the 1970s witnessed real-time processing for certain applications, such as television standards conversion, is now possible because of the availability of specialized hardware [1]. Deep learning has completely changed the way objects are detected, affecting several sectors like autonomous cars, security, and medicine. Deep learning has significantly improved object recognition, a fundamental job in computer vision, especially using convolutional neural networks (CNNs). These networks improve object detection's precision and effectiveness. The concept of hierarchical feature learning, which uses CNNs to automatically learn hierarchical representations of input data, underpins deep learning for object recognition. CNNs extract more information by using many layers of convolution, pooling, and non-linear activation functions. assemble features from unprocessed pixels. Robust object detection is made possible by this approach, which enables computers to precisely locate and identify things in pictures or movies. The technique starts with standardizing the input photos through preprocessing and then feeds them into a CNN. CNN uses pooling and convolution to extract pertinent characteristics from a multi-layered network of interconnected nodes. Large amounts of labeled data are analyzed during training to teach CNN how to recognize things. Backpropagation is used to modify the CNN's internal parameters, which enhances object detection and localization [2]. The Region-based Convolutional Neural Network (R-CNN) and its variations, such as Fast R-CNN and Faster R-CNN, are popular designs for object detection because they identify and classify regions of interest within an image and use this information to precisely pinpoint objects. One more YOLO technique is a popular method that produces faster inference times than R-CNN variations by dividing the input image into a grid and simultaneously predicting bounding boxes and class probabilities for each grid cell. These models are essential to contemporary AI systems because, once trained, they can precisely recognize and locate things in fresh photos or videos. They can be used for autonomous navigation, medical diagnostics, and other purposes [3]. For object recognition, the

YOLO model offers a fresh and efficient method. Conventional systems use classifiers for detection, which means that they must classify at different spots in the image and then post-process to improve bounding boxes and remove duplicates. This procedure is frequently intricate and ineffective. Yolo, on the other hand, views object detection as a regression problem, accurately forecasting class probabilities and bounding boxes for the full image in a single pass.

II. Literature Survey

Even while deep learning approaches are computationally demanding and require a large number of parameters, they have proven to be more effective than other object detection methods. A YOLOv2-based lightweight model for animal species detection has been offered as a solution to this problem. This model is a proof of concept and an initial step in creating an embedded real- time mitigation system. By adding a new pass-through layer to YOLOv2, multi-level feature merging is performed to improve feature extraction and accuracy. In addition, the two repeating 3×3 convolutional layers in the seventh block of the YOLOv2 architecture are eliminated to lower computational complexity and speed up detection without compromising accuracy. Although animal species detection has made extensive use of classic Convolutional Neural Networks (CNNs), these networks find it difficult to adjust to the geometric differences between images with animals. To overcome this limitation, a modified YOLOv2 incorporating deformable convolutional layers (DCLs) has been proposed, improving the model's adaptability to these variations [4]. The increasing concern of animal attacks poses significant risks for rural communities and forestry workers. Surveillance cameras and drones are commonly used to monitor the movement of wild animals, but an effective model is essential for identifying animal types, tracking their movement, and providing location information. By using this data, alarm messages can be sent, guaranteeing the security of both individuals and forestry workers. While animal detection is a prominent use of computer vision and machine learning techniques, these methods are often expensive and difficult, producing subpar results. To recognize animals and provide alerts based on their actions, this research presents a Bidirectional Long Short-Term Memory (Bi-LSTM) network that is Hybrid Visual Geometry Group (VGG)−19. Short Message Service (SMS) is used to send these notifications to the local forest office, allowing for quick action [5]. Wild animal invasions pose a significant threat, leading to substantial resource losses and endangering human lives. Consequently, people may lose crops, possessions, and potentially their lives. To identify wild animal incursions on agricultural farms, this study suggests an Internet of Things (IoT) based system that monitors the fields. Initially, incursions are detected using ultrasonic sensors positioned at the corners of the fields. A camera installed on an E-vehicle with a Node MCU Microcontroller detects the intrusion and takes a picture of the intruder. The farmer is then notified using an Internet of Things application. The photos of the intruders that are taken and the notifications that are sent out are used to assess how well the suggested system works. With the help of this model, any kind of incursion near the field can be effectively detected [6]. An algorithm designed to identify wild animals to aid in their protection. Given the vast variety of animal species, manual identification can be quite challenging. This method uses photos to classify animals to improve wildlife monitoring. Detecting and classifying animals can make a big difference in tracking initiatives, stopping theft, and lowering the number of incidents involving animals and vehicles. This process can be facilitated by putting effective deep-learning approaches into practice. Since normal connections like WiFi and GSM may not be dependable in distant sensing areas, an alert is delivered using LoRa communication when an animal is detected by another device. Python-based computer vision algorithms are used for image processing. The model is implemented on a Raspberry Pi development board, which processes live streaming to identify and differentiate between domestic animals and wild animals. An end-user who monitors the wildlife receives an alert via LoRa communication as soon as a wild animal is spotted [7]. Our nation's roads are always growing and changing, and a large number of them are close to forests, which raises the risk of fatal collisions between humans and animals. This work presents an application that efficiently recognizes and classifies the animals in the photographs sent to it using the 'YOLO' algorithm. It notifies the user via a map interface, along with the animal's location on Google Maps. Here, animal detection and classification are done using the deep learning method. A detection and alerting system is suggested that makes use of deep learning. Our program was trained using the tiger and elephant datasets [8]. Several studies have explored the use of deep learning techniques for animal detection and classification. Convolutional Neural Networks (CNNs) have been particularly effective in this domain. For instance, YOLO (You Only Look Once) models have been employed for real-time object detection due to their speed and accuracy. A modified version of YOLOv2 has been proposed to improve feature extraction and detection speed by incorporating pass-through layers and removing redundant convolutional layers [9]. To improve detection accuracy and adaptability to various animal postures and movements, hybrid models combining CNNs with Recurrent Neural Networks (RNNs) like LSTM have been explored. For instance, animals have been detected and alarms have been generated depending on their activities using a hybrid VGG-19 and bidirectional LSTM network. This method makes use of VGG-19's spatial feature extraction power and Bi-LSTM's robust temporal sequence processing [10]. The integration of IoT devices in animal tracking systems allows for real-time monitoring and alerting. Ultrasonic sensors, cameras, and microcontrollers like Node MCU and Raspberry Pi are commonly used. These systems typically involve sensors detecting animal presence, followed by cameras capturing images, which are then processed using AI models deployed on microcontrollers. Alerts are sent via IoT applications or communication protocols such as LoRa, which is suitable for remote areas where conventional networks are unreliable [11].

III. Background

Recent developments in Internet of Things (IoT) combined with artificial intelligence (AI) have produced creative solutions in a number of fields, including animal conservation. This paper proposes a smart animal detection system that leverages the YOLOv8 AI algorithm for real-time object detection, combined with IoT integration to enable immediate response mechanisms. The YOLOv8 algorithm is renowned for its high accuracy and efficiency in detecting objects in real-time scenarios. By training YOLOv8 on a comprehensive dataset of wildlife images, the system can accurately identify different animal species in their natural habitats. The integration of IoT devices significantly enhances the system's functionality, enabling rapid responses upon animal detection. These IoT components include buzzers, phone calls and SMS notifications, which can be activated based on the severity of the situation. For instance, if the system detects a potential threat to wildlife, such as poaching or habitat destruction, it can trigger a loud buzzer to deter intruders. Simultaneously, it can notify relevant authorities through phone calls and SMS messages, providing real-time information to facilitate prompt intervention. This system offers multiple advantages over traditional wildlife monitoring methods. Firstly, its real- time detection capabilities allow for immediate responses to potential threats, thereby reducing the risk to endangered species. Secondly, the integration of IoT gadgets make sure that notifications reach the appropriate parties on time, allowing for quick action. Last but not least, the system's versatility allows it to be implemented in a variety of settings, from dense woods to open plains, thus serving as a versatile tool in wildlife conservation efforts.

A. Problem Statement

The rising incidents of wildlife conflicts, animal-related road accidents, and the need for effective wildlife monitoring necessitate a robust solution. Traditional methods are inadequate in providing real-time data and proactive measures to address these issues. Therefore, a Smart Animal Detection System that integrates advanced technologies like IoT and AI is essential to enhance wildlife monitoring and protection. The Smart Animal Detection System utilizes YOLOv8, a cutting-edge object detection algorithm, for real-time video analysis. The system incorporates IoT devices such as cameras and sensors strategically placed in wildlife habitats, along roadways, and in other critical areas. These devices continuously capture and stream video footage and environmental data to a centralized processing unit. The YOLOv8 algorithm processes the incoming video streams to accurately detect and classify animals. The AI model is trained to recognize various species, considering different sizes, shapes, and movement patterns. The system employs machine learning to continuously improve its detection accuracy over time. Upon detecting an animal, the system triggers an immediate response through IoT-enabled communication channels. SMS and/or call alerts are sent to relevant authorities, wildlife protection agencies, and nearby communities to ensure a swift and effective response. This approach aims to reduce wildlife-human conflicts, prevent road accidents involving animals, and enhance overall wildlife monitoring and conservation efforts.

IV. Existing System

In existing systems, animal species detection is implemented using image processing and Convolutional Neural Networks (CNNs). The potential uses of this technique in wildlife management, conservation, and biodiversity monitoring have drawn a lot of interest lately. It entails using computer vision techniques to automatically identify various animal species by analyzing photos. CNNs are a kind of deep learning model that are useful tools in this situation since they are especially well-suited for image identification tasks. Usually, the procedure entails gathering sizable datasets of annotated photos, using these datasets to train a CNN to identify patterns and characteristics linked to various animal species, and then applying the trained model to identify the species in fresh photos. CNNs and image processing together provide an effective and non-intrusive way to track and study wildlife in a variety of environments. The purpose of the CNN model is to acquire hierarchical representations of features, allowing it to recognize complex patterns and traits unique to various animal species. Additionally, pre-trained models are leveraged using transfer learning techniques, which maximize training efficiency and improve generalization to novel species. The outcomes show how well the deep learning model works, even in difficult situations like changing lighting and a variety of environments, to correctly recognize and classify different animal species. The main disadvantages in the existing schemes are:

- Limited Dataset Diversity
- Lack of Interpretability
- Computationally Intensive
- Potential for Inaccuracies

V. Proposed System

The initial stage of the system involves capturing input from video sources, such as cameras strategically placed in wildlife habitats. This video feed undergoes processing to enhance quality and extract relevant information. The core functionality of the system centers on animal detection, utilizing the YOLOv8 model, a cutting-edge object detection algorithm, to identify and locate animals within the processed video frames. Once identified, the information is transferred to the hardware processing stage. The animal classification results from YOLOv8 are fed into an Arduino microcontroller, a versatile and programmable platform. The Arduino processes this information and triggers various output alerts based on the identified animals. The system's IoT integration becomes evident as the Arduino microcontroller communicates with GSM modules. When an animal is detected, the system can

send alerts via phone calls, email notifications, or SMS messages to designated recipients. Additionally, it activates a buzzer and a light alert to provide on-site indications of the detected animal. This integrated approach, combining advanced video analytics, AI algorithms, and robust hardware components, creates a powerful Smart Animal Detection System.

To further enhance the capabilities of the AI-based Smart Animal Detection and Tracking System, several additional features and improvements can be proposed.

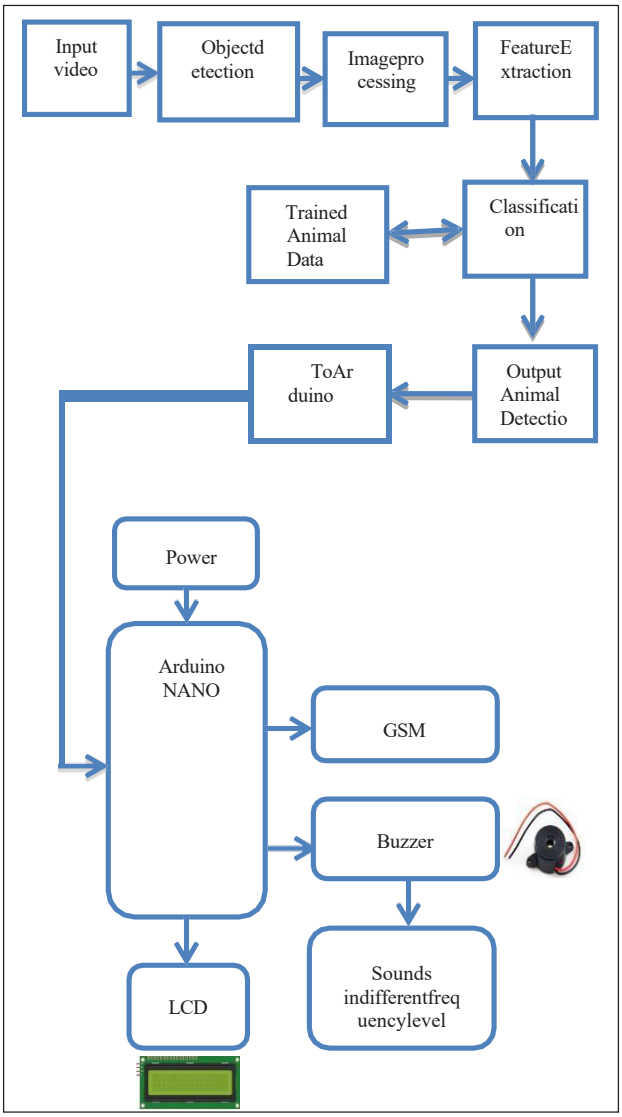

Fig. 1: Proposed Architecture

These enhancements aim to increase the system's accuracy, responsiveness, and versatility, providing even better support for wildlife conservation efforts. Incorporating additional sensors, such as thermal cameras and motion detectors, can significantly improve the detection accuracy, especially in low-light conditions or dense foliage. Implementing a cloud-based infrastructure can enhance data analysis and storage capabilities, facilitating advanced analytics and remote monitoring. Machine learning algorithms can be integrated to analyze animal behavior patterns, identifying unusual behavior that may indicate potential threats. Deploying drones equipped with cameras and sensors can extend the monitoring range and cover areas that are difficult to reach on foot, enhancing the system's ability to monitor larger areas and track animal movements more accurately. Developing a mobile application for community engagement and reporting can foster local involvement in wildlife conservation efforts. Incorporating renewable energy sources can ensure the system's sustainability in remote areas, while enhancing alert mechanisms and ensuring data privacy and security are crucial for effective and reliable operation. Overall, these proposed enhancements aim to create a more robust and comprehensive Smart Animal Detection and Tracking System, contributing to the protection and preservation of endangered species and their habitats.

A. Module Description

i) Input Video

The system relies on input video streams obtained from surveillance cameras or similar sources, offering real-time footage of the monitored area. These video streams are crucial for analyzing animal behavior and movement patterns, forming the foundation for initiating appropriate responses to the detected events.

ii) Preprocessing

Before undergoing object detection and classification, the input video undergoes preprocessing to enhance its quality and optimize the performance of the AI algorithm. Preprocessing techniques, including noise reduction, image stabilization, and frame normalization, are applied to ensure that the AI algorithm receives clean and consistent input data. This ensures accurate animal detection and classification.

iii) Object Detection

YOLOv8, a state-of-the-art deep learning technique, is used in this module. It is well-known for its effectiveness and precision in real-time object recognition tasks. YOLOv8 uses convolutional neural network layers to quickly identify animals within frames based on the single-pass detection concept. It efficiently detects animals regardless of size, orientation, or occlusion, achieving robust performance with minimal computational overhead.

iv) Training YOLOv8 Model

The YOLOv8 model is trained using a labeled dataset, learning to predict bounding boxes and classify objects. Through bounding box regression, the model accurately localizes objects within images and identifies regions of interest. Object classification is performed to categorize detected animals into predefined categories based on learned features from training data.

v) Classification

This module further analyzes and categorizes detected animals using a classification mechanism. By leveraging machine learning techniques, the system learns from annotated data to accurately classify animals based on visual characteristics, behavior, or other distinguishing features. The classification output is then forwarded to the microcontroller, and classified animal images are sent to respective email addresses for further analysis.

vi) Arduino Microcontroller

The Arduino microcontroller serves as the central processing unit of the system, seamlessly integrating sensors, AI algorithms, and communication modules. With its versatile I/O pins and programmable logic, the Arduino enables efficient data acquisition, processing, and decision-making, ensuring precise detection and timely response to animal presence.

vii) Buzzer Alert

Upon detecting an animal, the system triggers a buzzer alert to notify nearby individuals with audible signals. This auditory alert system enhances situational awareness and aids in preventing unwanted animal interactions, with configurable parameters allowing adjustments for diverse environments.

viii) SMS/Email Alert

The system offers call and SMS alert functionalities to notify designated individuals or authorities of detected animal activity. Automated calls or SMS messages are initiated, providing real-time notifications and enabling prompt response to ensure the safety of both humans and animals.

Fig. 2: Animal Detection

VI. Result

To reduce class imbalance, a dataset was carefully selected and split into train, test, and validation sets with splits of 15%, 15%, and 70%, respectively, taking into account Indian circumstances, specifically about the Asiatic lion. The dataset was trained on three YOLOv8 architectures (m, l, and x) utilizing Google Colab's Tesla-4 GPU to prevent bias and incorrect predictions. All of the photographs were resized to 640 x 640 during the training process before being fed through the models. With a patience threshold of 50 and 120 epochs, the training was designed to stop if there was no longer any discernible progress. To avoid making incorrect forecasts, an empirical confidence level of 0.75 was established. F1 Score, mean Average Precision (mAP), recall, precision, and precision were the evaluation parameters. While recall measures the percentage, precision measures how accurate forecasts are % true positives detected accurately, and mAP assesses the overall performance of the model while accounting for the trade-off between recall and accuracy. YOLOv8 uses mAP50 and takes a 0.5 Intersection over the Union (IoU) threshold into account. The overlap between ground truth and expected boundaries is measured by the IoU. F1 Score, a harmonic mean of precision and recall, offers robustness against outliers. Results analysis revealed the superiority of the YOLOv8x model in terms of accuracy. Validation accuracy plotted against epochs displayed logarithmic growth, with rapid initial improvement followed by gradual convergence. Similar trends were observed in precision, recall, and mAP50-95. Loss graphs (box, class, and distribution focus) demonstrated consistent reduction, indicating absence of overfitting. The mAP, precision, and recall values for each model were documented for further analysis. mAP, Precison and recall of YOLOV8 model:

model	mAP	precision	recall
yolov8m	93.2%	89.6%	90.2%
yolov8l	93.0%	90.2%	85.7%
yolov8x	94.3%	91.0%	89.9%

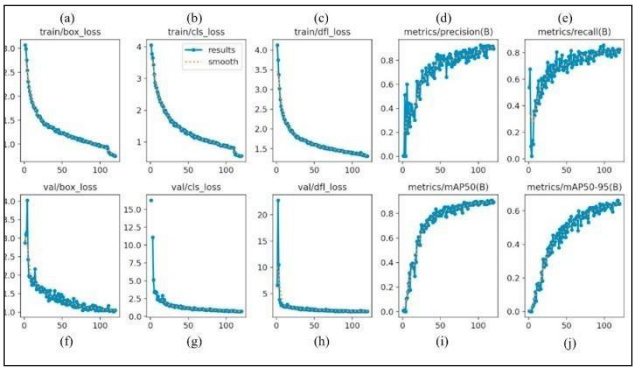

Fig. 3: Result analysis of YOLOv8

In particular, the precision-confidence, recall-confidence, F1-confidence, and precision-recall curves were examined for the top-performing model, YOLOv8x, as part of the model evaluation process. Plotting precision versus confidence scores yielded the precision-confidence curve, which showed that maximum precision (1) was reached at a confidence score of 0.947. The maximum recollection (0.96) was attained with a confidence score of 0, and the recall-confidence curve showed a declining tendency of memory with increasing confidence. The precision-recall curve represented mean average precision (mAP) as the area under the curve (AUC) showed precision as

a function of recall. The model demonstrated a high detection effectiveness of 96%, demonstrating an effective balance between precision and recall. But there was a trade-off between recall and precision. noted, akin to the trade-off between bias and variance. It was common for attempts to increase precision to result in a decrease in recall, and vice versa, therefore a careful balance between the two was required. Last but not least, the F1-confidence curve showed the trend of the F1 score with rising confidence scores, peaking at 0.86 at 0.604 for confidence.

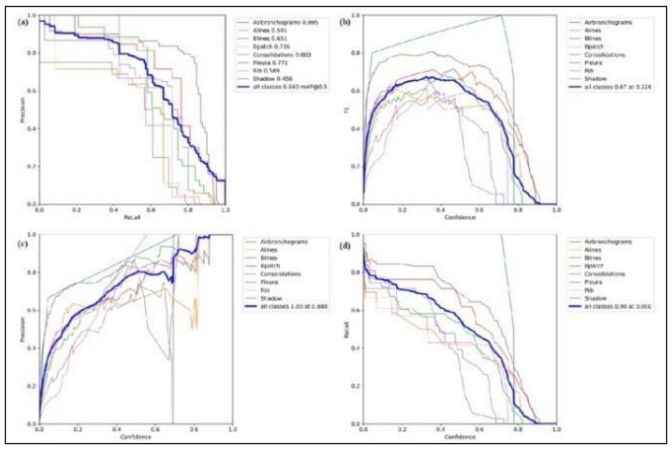

Fig. 4: YOLOv8 Architecture's Confidence, Recision-Recall, Recall-Confidence and Precision-Confidence Curves

VII. Conclusion

To enhance early detection and reaction, this project combines Internet of Things and then artificial intelligence technology to wildlife presence across diverse environments. Through a network of strategically positioned IoT sensors deployed in wildlife-prone areas, the system continuously monitors and gathers data on animal movements. These sensors transmit real-time information to a central server, where sophisticated AI algorithms analyze the data for species identification and behavior analysis. Leveraging machine learning models, the AI component distinguishes between different animals, categorizes their activities, and evaluates potential threats. Advanced sensors deployed in agricultural fields, forested regions, and along roadways collect environmental data and animal movement information, which is then transmitted to a centralized platform via IoT protocols. In case of potential threats, the system automatically triggers notifications through email, SMS, and calls to designated stakeholders, such as farmers, forest rangers, and relevant authorities, enabling them to swiftly and effectively respond to the situation.

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