A STUDY ON COMPACTION AND STRENGTH CHARACTERISTICS OF FLY ASH - GGBS MIXTURE AND USE OF THESE INDUSTRIAL WASTES IN RURAL ROAD CONSTRUCTION.

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ABSTRACT

Rapid increase in industrialization, a great concern about land pollution is taken into consideration. Till recently land disposal has been the only option available for the solid residues, which may be concentrated with toxic contaminants. The use of waste materials is a good option in finding a solution to this problem. Major by-products of thermal power and steel plant are fly ash and Ground Granulated Blast Furnace Slag (GGBS) respectively Among all the wastes, fly ash and GGBS are the wastes that are produced in large amounts in India causing disposal and environmental problem. Many investigations have been carried out to utilize these materials for geotechnical and highway constructions. In this study, different laboratory investigations i.e. compaction test, UCS test, and CBR strength characteristics for various mix proportions of fly ash –GGBS mixes for both immediate and curing conditions are carried out. For this study fly ash is mixed with various percentages of GGBS i.e 10 to 100% at 10% interval to know the compaction and strength characteristics. The results show that the GGBS has an enhanced effect on compaction and strength characteristics of fly ash with an increasing percentage of GGBS for both immediate and curing conditions. The curing conditions indicate that GGBS has a marked effect on the strength characteristics of fly ash compared to immediate conditions. To utilize industrial waste in rural road construction, soil (clay soil) from k kotapadu village from Visakhapatnam district is used for the study. In the stabilization of soil with fly ash and GGBS, the results demonstrated improvement in the strength characteristics of the clay soil, it was found that optimum GGBS (20%) gives the maximum increment in the CBR value. Based on the results obtained in this present study, it can be concluded that the combined use of fly ash and GGBS can be advantageous when compared to using them individually. IRC: SP-20:2002 following MORT&H is used for the design of this K.Kotapadu road.

Keywords - *Fly ash, GGBS, Stabilization, Compaction, UCS,CBR, Rural Roads, IRC:SP-20:2002*

Introduction

Today there is a worldwide interest, knowledge transfer, and best practice regarding the development of new improvement methods. There is a growing awareness all over the world about the extensive damage being caused to the environment due to the accumulation of waste materials from industrial plants, powerhouses, colliery pits, and demolition sites. Developmental activities by nature are often not environment friendly. The civil engineers who are forerunners of all developmental activities are advised as anyone else to follow the principles of reducing, reuse, and recycle for controlling the environmental loss, if not eliminate it. Worldwide efforts are being made to utilize waste materials for construction purposes. India has the third-largest coal-power generating capacity in the world, providing for more than 70% of the total power demand in the country. State-owned enterprise Coal India is the largest coal mining company in the world. The Indian Government is also aiming to bring coal imports down to zero and mine one billion tons annually by 2023-2024 by opening up new coal mines and restoring closed ones. Coal power is critical to India's energy security and despite the Government's ambitious target of 450 GW of renewable energy by 2030, coal will still contribute more than 50% to the country's power demand. In absolute terms, coal-power generation will increase and sustain for the next two decades at least. While coal power is not environmentally friendly due to coal mining and carbon emissions, it also produces "fly ash" as a by-product in large quantities. Imported coal has a low ash content of 5-15% whereas domestic Indian coal has an ash content of 30-45%. India produced 226 million tons of ash in 2019-2020, making it the second-largest ash producer in the world. Growing coal power generation backed by domestic coal will further boost ash generation over the next decade. Even with the latest 83% ash utilization rate - mainly going into cement, mine-filling/landfilling, bricks, blocks, tiles, infrastructure and concrete - 17% of the annual ash generation (about 38 million tons) goes unutilized and is disposed into ash ponds/dykes

and more than 1.6 billion tons of legacy ash is lying in ponds/dykes across the country. This causes significant land and water wastage, air toxicity, heavy metal leaching, ground water contamination and increases respiratory diseases and long-term health hazards. An IIT-Kanpur study on Delhi revealed fly ash as one of the major contributors to particulate matter (PM) contributing around 37% and 26% of PM10 and PM2.5 respectively. The Ministry of Environment, Forests and Climate Change (MoEF&CC) has issued various notifications and NITI Aayog has also constituted an Expert Committee for maximizing fly ash utilization. The MoEF&CC has also released a Draft Notification G.S.R. 285(E) dated 22nd April 2021 with an updated policy. However, a more focused, hands-on intervention is needed by the Government of India to maximize ash utilization and be prepared for the huge quantum of ash that will be generated in the coming decades which could result in serious pollution issues.

Expand and Specify Applications of Fly Ash: MoEF&CC has listed down various scientifically proven applications of fly ash, however, fly ash is mainly utilized from a 'cost-saving perspective rather than from a 'technical-benefit' perspective. Owing to the multiple technical benefits of fly ash in construction, fly ash must be specified mandatorily in all public and private infrastructure projects such as roads and embankments, railways, metro projects, airports, seaports, dams, and waterways from a performance standpoint to maximize utilization. Moreover, fly ash-based structures for shoreline protection and flood control should be mandated and built-in all high-risk zones in the country to protect communities from floods. Soil stabilization and improvement is another application where large quantities of fly ash can be used, while creative applications such as building artificial reefs using ash pallets to support aquatic life should be promoted with marine conservation agencies.

Ground-granulated blast-furnace slag (GGBS or GGBFS) is obtained by quenching molten iron slag (a by-product of iron and steel-making) from a blast furnace in water or steam, to produce a glassy, granular product that is then dried and ground into a fine powder. Ground-granulated blast furnace slag is highly cementitious and high in CSH (calcium silicate hydrates) which is a strength-enhancing compound that improves the strength, durability, and appearance of the concrete. Ground granulated blast furnace slag (GGBS) or pulverized fly ash (PFA) is being used by some firms rather than cement, which greatly reduces the carbon dioxide production associated with concrete. At present as per the report of the fly ash utilization program (FAUP) out of the huge quantity of flyash produced, only about 35% finds its use in commercial applications such as mass concrete, asphalt paving filler, lightweight aggregate, a stabilizer to road bases, raw material for concrete, additives to the soil, construction of bricks, etc., the remaining is a waste requiring large disposal areas, causing a huge capital loss to power plants and simultaneously causing an ecological imbalance and related environmental problems. Presently, year after year most of the countries including India are producing millions of tonnes of fly ash and blast furnace slag which are a by-product of a thermal power plant and steel industry respectively which is posing a big environmental problem. GGBS obtained from iron and steel manufacturing industries has potential cementitious reactivity. Hence in the present study, an attempt has been made to improve the strength characteristics of fly ash using GGBS.

Several studies have been done to utilize fly ash, GGBS in geotechnical and highway construction. K.V Manjunath, L.Govindaraju, P.V.Sivapullaiah (2011) investigated that the addition of GGBS and lime to black cotton soil increased the strength with curing. S.P.Singh, D.P.Tripati, P.G.Ranjith (2007) investigated that increase in GGBS quantity improves the California Bearing Ratio (CBR) strength in cement- fly ash-GGBS mix. Laxmikant yadu & R.K. Tripathi (2013) proved that the CBR value of soft soil increases with an increase in GGBS content for the soil-fly ash-GGBS mixture. Asish Kumar Pathak, Dr.V.Pandey; Krishna Murari; J.P.Singh (2014), investigated that the CBR value for soaked and unsoaked increases with an increase in the percentage of GGBS in the clay-GGBS mix. Sridharan(1997)

has studied the effect of fly ash on the unconfined compressive strength of black cotton soils found in India which are typically expansive. S.P.Singh, D.P. Tripathy, P.G. Ranjith (2007) investigated that increase in GGBS quantity improves the unconfined compressive strength in the cement-fly ash-GGBS mix. Anil. K.S & P.V.Sivapullaiah(2011) stated that UCS of soil increases with the increase in the GGBS content in the soil-fly ash-ggbs mixture for immediate and curing conditions. Koteswara Rao D(2012) found that the use of GGBS pronounced effect on the characteristics of expansive soil fly-ash-GGBS mix. Laxmikant yadu & R.K. Tripathi(2013) confirmed that the CBR value of soft soil increases with an increase in GGBS content for soil- fly ash-GGBS mixture. Based on the above studies an attempt has been made to evaluate and investigate the potential of GGBS in improving the characteristics of fly ash.

Experimental Programme

Raw Materials

Fly ash: The Fly ash used in this experimental work is obtained from National Thermal Power corporation (NTPC) Visakhapatnam Andhra Pradesh, state, India.

Ground Granulated Blast Furnace Slag (GGBS): The Slag used for the study is obtained from Visakhapatnam steel plant in the form of granulated blast furnace slag and is grounded to powder form at Toshali Cements Visakhapatnam, AP, India.

Methodology

These raw materials Fly ash and GGBS are Oven dried and mixed thoroughly for conducting the experimental program to study the strength characteristics of mixes. The engineering properties such as compaction characteristics, unconfined compressive and CBR strength of different mixes of fly ash and GGBS (as mentioned in Table1) are examined. The unconfined compressive strength tests specimens are cured by keeping them in humidity chamber for 7, 14, 28 and 56 days. The Physical properties and chemical composition of flyash and GGGBS are tabulated below in tables 2 to 4.

Table1: Details of fly ash- GGBS mixes used in experimental programme.

S.no	GGBS (%)	Fly ash (%)
1	0	100
2	10	90
3	20	80
4	30	70
5	40	60
6	50	50
7	60	40
8	70	30
9	80	20
10	90	10
11	100	0

Table2: Physical Properties of Fly ash and GGBS.

Property	Fly ash Values	GGBS Values
Sand (%)	28	2%
Fines (%)	72	-
a. Silt (%)	72	90%
b. Clay (%)	0	8%
Soil Classification	SM	SM
Liquid Limit (%)	24	40
Plastic Limit (%)	NP	NP
Plasticity Index	-	-
Shrinkage Limit (%)	34.5	42.77
Free swell Index(cc/gm)	0.25	0.33
Compression Index	0.169	0.079
Specific Gravity	1.96	2.56
OMC (%)	15.6	18.3
MDD (gm/cc)	1.493	1.768
CBR (%)	1.7	171.6

All the above properties are determined without any precuring.

Table 3: Chemical Properties of Fly ash

Compound	Formula	% Percentage
Magnesium Oxide	Mgo	0.86
Aluminium trioxide	Al203	30.48
Silica dioxide	Sio2	59.83
Calcium oxide	Cao	1.74
Titanium oxide	Tio2	6.91
Zinc Oxide	Zno	0.09

Table 4: Chemical Properties of GGBS

Compound	%Percentage
Silica (Sio2)	33.2
Alumina (Al2o3)	18.3
Ferric (Fe2o3)	0.6
Calcium Oxide (Cao)	36.6
Magnesium	10.6
Titanium	0.34
Potassium	0.91
Sodium	0.21
Loss on Ignition	3.2
Reactive Silica (Sio2)	5.99
Free Lime	6.3

Proctor Compaction Test

The moisture content versus dry density relationship for different mixes of flyash – GGBS was determined by using a light compaction test as per IS 4332(part-3) 1967. From the dry density and moisture content relationship, the optimum moisture content (OMC) and maximum dry density (MDD) are calculated.

Unconfined Compressive Strength Test

Unconfined compressive strength of the various combination of fly ash and GGBS mix is determined as per IS 4332(part-5), 1970. The specimens are prepared at their respective OMC and MDD by applying static compressive force in a constant sampler. The compacted specimens are 38mm in diameter and 76mm in height. All the samples are kept in a humidity chamber for 7, 14, 28, and 56 days. The unconfined compressive strength of cured samples is determined in a strain-controlled unconfined compression testing machine at a strain rate of 1.25 mm/min. The UCS values of different mixes of fly ash – GGBS after 7, 14, 28, and 56 days are determined and presented in table 5.

Table 5: Unconfined Compressive Strength of Fly ash – GGBS Mix for different curing periods(kpa)

Curing period % Of GGBS	0 Days	7days	14 days	28 days	56 days
0	48.8	50.2	52.37	56.73	59.49
10	65.2	82	103.2	198	261
20	128	213	354	615	720
30	152	293	492	860	1100
40	195	361	525	932	1460
50	402	714	1090	1772	2310
60	490	845	1175	1943	2600
70	600	1082	1420	2200	3020
80	750	1490	1855	2710	3540
90	801	1589	1992	2985	4005
100	910	1880	2344	3470	4900

California Bearing Ratio Test

The California bearing ratio is a penetration test, for evaluation of the mechanical strength of Roads, subgrades, and base course. It is a small-scale penetrations test where a cylindrical plunger of 5cm in diameter cross-section is penetrated into the mass of soil at the rate of 1.25 mm per minute. Observations are taken between the penetration resistances (Test Load) versus the penetration of the plunger. CBR is defined as the ratio of load sustained by the specimen at 2.5 or 5mm penetration to the load sustained by the standard load at the corresponding penetration level.

The standard load values are 13.44 and 20.16 kN respectively at 2.5mm and 5mm penetration. The CBR value of different mixes of fly ash and GGBS is determined as per IS2720 (part 16), 1979. CBR specimens are prepared by adding water corresponding to their OMC (optimum moisture content) and are compacted to their corresponding MDD (Maximum dry density) using the static compaction method. The samples are soaked in water for four days and are removed and these soaked samples were kept in a humidity chamber for 7, 14, 28, and 56 days. The CBR strength of cured samples is determined and is represented in Table 6.

Table 6: CBR values of Fly ash – GGBS Mix for different curing periods (%)

Curing Period % of GGBS	0 Days	7days	14 days	28 days	56 days
0	1.7	1.74	1.81	1.93	1.95
10	6.2	10.6	12.2	20.14	28.32
20	10.8	16.5	18.2	32.4	59.03
30	18.7	30.3	36.32	58.3	92.3
40	30.8	48.5	52.58	90.25	171.6
50	76.88	147	200	330.9	528.2
60	93.65	224.3	265.03	540.14	731.4
70	122.96	271.16	351	875.9	1036.4
80	143.64	291.2	420	1007.2	1145.9
90	159.02	312	527	1055	1234
100	171.6	331.1	590	1094.8	1372.2

2.3 Discussion

Compaction Characteristics

From the results and plots of OMC and MDD versus percentage of GGBS, it is very clear that the OMC and MDD increase as % of GGBS increases. As the GGBS is finer than fly ash and having more calcium oxide and the density of GGBS is higher than fly ash hence replacement of fly ash by GGBS will increase the dry density and OMC of the compacted mix.

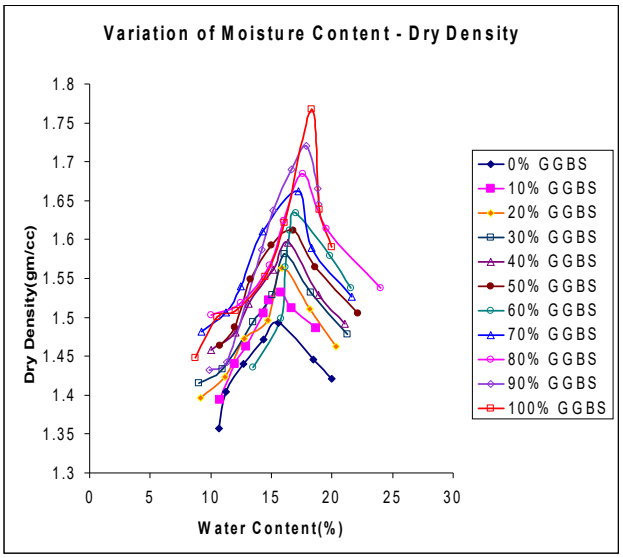


Figure1: Variation of Moisture Content-Dry Density

Unconfined Compressive Strength

The results and graphs of UCS versus percentage of GGBS indicate that 50% of GGBS has a marked effect on UCS values of fly ash- GGBS mixture compared to other percentage mixes. The development of strength is gradual up to 40% GGBS and there is an abrupt increase in strength at 50% GGBS and there onwards the increase in strength is significant. It is observed that curing increases the UCS with an increase in the percentage of GGBS. GGBS contains highly reactive siliceous and aluminous materials in a finely divided form known as pozzolana. GGBS contain free lime which undergoes pozzolanic reaction with silica and alumina resulting in gel formation, hence the addition of GGBS to fly ash is certain advantages in increasing the strength of stabilized mix, and also the addition of GGBS to fly ash makes the mix well-graded, thus increasing the compacted density and the mechanical strength of the compacted mixture. It is also observed that the strength of compacted mixes increases with curing time.

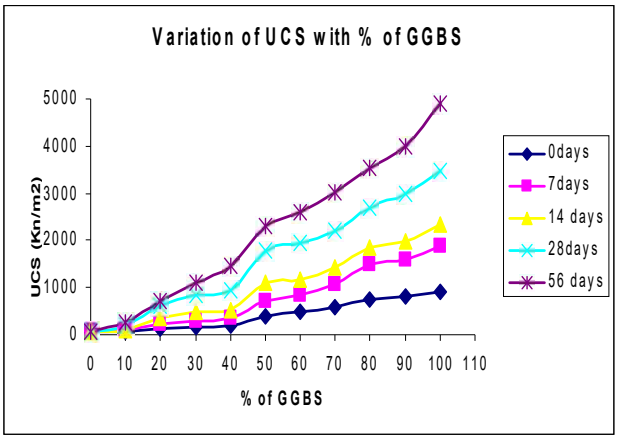


Figure 2: Variation of UCS with % of GGBS

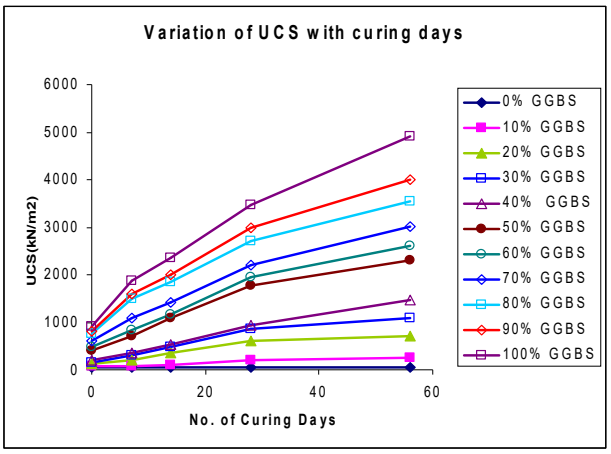


Figure 3: Variation of UCS with curing days

CBR value

The variation of the CBR strength with GGBS content for different curing periods has been shown in the Figure 4 and 5.

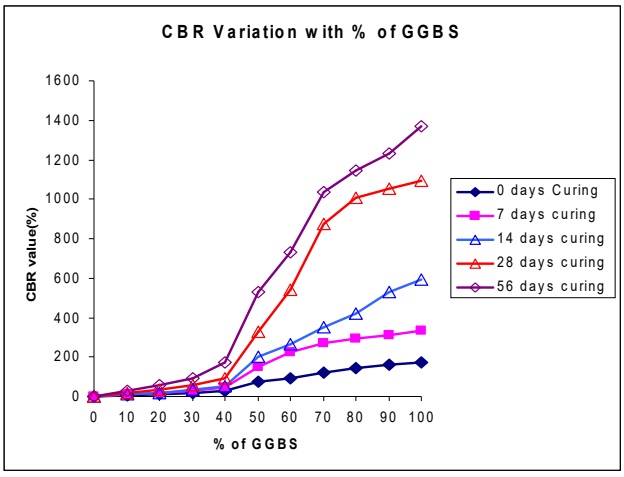


Figure 4: - CBR value variation with % of GGBS

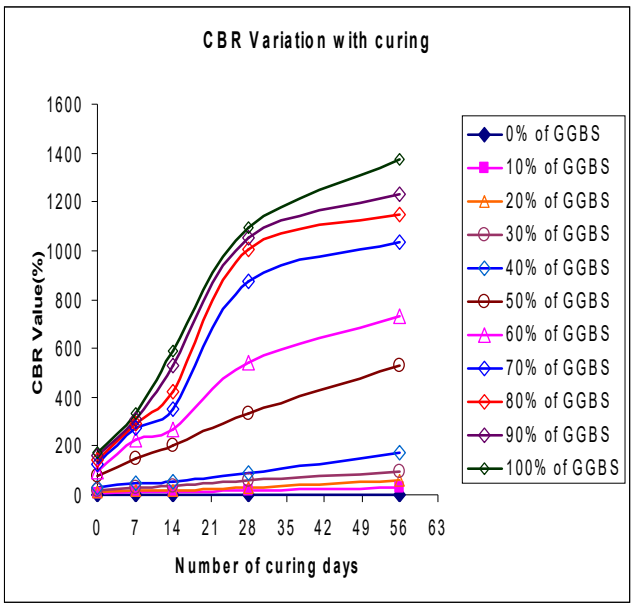


Figure 5: CBR value variation with curing

From the Figure 4 and 5, it is observed that 50% of GGBS has a notable effect on CBR value of fly ash-GGBS mixture when compared to other percentage mixes. There is a gradual development of strength up to 40% GGBS and there is an abrupt increase in the strength at 50% GGBS. The strength is significantly above 50% GGBS.

An increase in strength of fly ash with GGBS can be explained with two reasons firstly the formation of a compound, C-S-H Gel possessing cementing properties in the presence of highly reactive siliceous and aluminous materials and water, and secondly addition of GGBS to fly ash mix makes the mix well graded which in turn increases the compacted density and hence the mechanical strength of the compacted mixture. (Anil Kumar Sharma and P.V Sivapullaiah 2011) .

An increase of GGBS content in fly ash-GGBS mix increases the CBR value. For example, 100% fly ash and 0% GGBS, the CBR value is 1.7% which increased to 76.88% when the GGBS content is increased to 50%. and also, it is seen that for zero-days curing 100% fly ash, the CBR value is 1.7% and for 28 days curing the CBR value is 1.93% and for 50% GGBS Zero days curing the CBR value is 76.88% which has increased to 330.9% for 28 days curing. This increase of CBR value can be attributed to the increase in mechanical strength of fly ash –GGBS mix. GGBS consists of free calcium oxide along with reactive silica and alumina. This reactive silica and alumina undergo pozzolanic reaction with calcium hydroxide liberated curing hydration of free calcium oxide present in the GGBS sample in the presence of water. This results in the formation of insoluble C-S-H gel which is responsible for the increase in CBR value of the sample thus the addition of GGBS to fly ash is advantageous in gaining a higher CBR value.

Fly ash/GGBS Mixture as Soil Stabilizer

This section describes the suitability of the local fly ash and ground granulated blast furnace slag (GGBS) in the local construction industry in a way to minimize the amount of waste to be disposed to the environment causing environmental pollution. Here the stabilization of artificially mixed soil with different percentages of a binder consisting of fly ash and GGBS is used for the study. The performance of stabilized soil is evaluated using physical and strength performance tests like specific gravity, Atterberg's limits, California Bearing Ratio (CBR) test at optimum moisture content and maximum dry density. The soil is procured from K. Kotapadu village from Visakhapatnam district of Andhra Pradesh state. The soil has been classified as Clayey soil. Different percentages of fly ash (10%, 20%, 30% and 40%) and GGBS (0%, 10%, 20% and 30%) was added to find the variation in its original strength. From these results, it was found that optimum GGBS (20%) gives the maximum increment in the CBR value compared with all the other combinations.

Pavement Design in Rural Roads

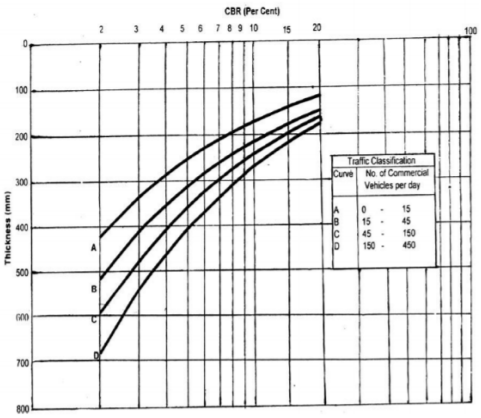
The standard codes used during the design and construction process of this K KOTAPADU road is IRC: SP-20:2002 following MORT&H. The design of rural roads is better done by IRC: SP-20:2002 than IRC 37:2001 because of the feasibility and economical saving it provides and for the simplicity in design for rural roads. Since the rural roads have specifically different conditions when compared to high volume roads, usage of SP-20:2002 is suggested by NRRDA. The materials used and their standards are also according to the above-referred codes.

Traffic Survey at K. Kotapadu Road

Traffic volume studies were also conducted at the proposed road site to determine the current traffic details and proceed to design, the count was clinical in estimating Commercial Vehicle Per Day (CVPD) which includes vehicles whose laden weight (>3T). A one-day 4-hour count was conducted following PGMSY guidelines and present CVPD is determined and projected CVPD is estimated.

Design according to IRC-SP-20:2002

The design is performed according to rural roads code considering the traffic in accordance with Equivalent Single axle load (ESAL) (8.16tonnes) application during the design life 10 years, various other parameters are considered for the design. The design traffic (A) is calculated by using the formula Design traffic (A) = P $(1+r)^{n+x}$. Calculated design traffic is 98.49 CVPD



Pavement thickness as per IRC: SP 20 2002					
CBR	Crust	0 to 15 CVPD	15 to 45 CVPD	45 to 150 CVPD	150 to 450 CVPD
2%	Base	150	150	225	225
	Sub base	275	365	370	455
3%	Base	150	150	150	225
	Sub base	200	265	330	320
4%	Base	150	150	150	150
	Sub base	125	200	260	315
5%	Base	150	150	150	150
	Sub base	100	165	210	260
6%	Base	150	150	150	150
	Sub base	60	115	150	175

Pavement thickness as per IRC: SP 20 2002					
CBR	Crust	0 to 15 CVPD	15 to 45 CVPD	45 to 150 CVPD	150 to 450 CVPD
7	Base	150	150	150	150
	Sub base	60	115	150	175
10%	Base	150	150	150	150
	Sub base	30	70	85	125
15%	Base	150	150	150	150
	Sub base	nil	30	50	75
20%	Base	150	150	150	150
	Sub base	nil	nil	30	50

Figure 6. Pavement thickness chart and tables as per IRC: SP 20:2002

From the design chart for design traffic of 98.49 CVPD and CBR value of 7%, according to the code, the total thickness of the pavement is attained as 300mm, further, this thickness can be subdivided into sub-layers following the design catalogue specified in the code for specific CBR value and CVPD details. For design traffic of 98.49 CVPD and CBR value of 7%, the thickness of 300 mm can be divided into sub-layers. After making necessary adjustments to work with ease in the field, the four layers of the pavement subgrade, subbase, base and wearing course are provided with the following specifications given in Table 7.

Table7: Thickness of the Pavement Layer

Layer of pavement	Provision made	Thickness(mm)
Subgrade	Existing natural subgrade Compacted to OMC	-
Sub-base	Granular Sub Base (GSB)	150
Base	Wet Mix Macadam (WMM)	150
Wearing course/Surface course	SDBC	20

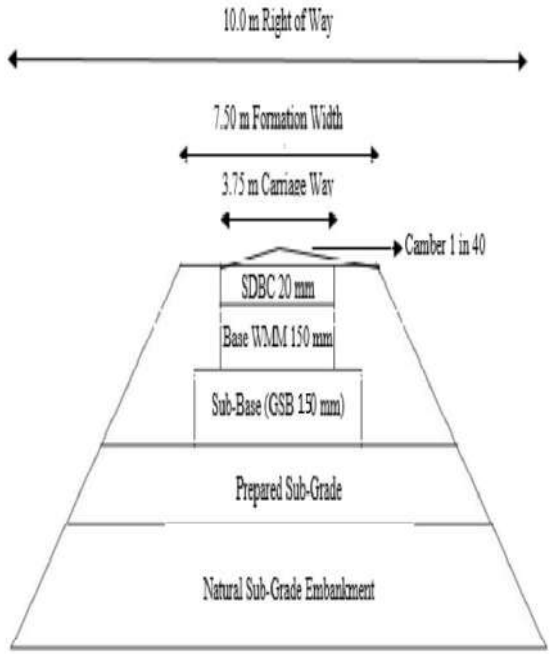


Figure7: Pavement Desgin

Conclusion

1. Fly ash is more or less well graded material having low specific gravity, the low specific gravity is due to presence of cenospheres.
2. An increase of GGBS in the fly ash mixture results an increase in MDD & increase in OMC
3. The UCS of the fly ash–GGBS mixture increases nominally with an increase in the GGBS content. The fly ash with higher percentages of GGBS shows higher strength compared with the pure fly ash or GGBS samples.
4. The compressive strength of stabilized mix of fly ash-GGBS increases with curing period indicating that the addition of GGBS to the fly ash accelerates the pozzolanic reaction.
5. The UCS results indicate that fly ash mixed with GGBS has the potential to be used in various geotechnical applications, such as in highway subgrade materials, embankments and so on
6. It is observed that the strength of the fly ash- GGBS mixture increases with increase with curing period.
7. The CBR of the fly ash GGBS mixture increase with the increase in GGBS content.
8. A CBR value of 1234% is obtained for a mix of fly ash –GGBS in the proportion of 10:90 for 56 days curing which indicates that with increase in GGBS content in the fly ash and increase in the curing period there is an enormous increase in the CBR value.
9. It appears that the selected soil can be effectively stabilized with the addition of fly ash at 30% or 20% GGBS.
10. Fly ash- GGBS mixtures are suitable for use in rural roads, embankments.
11. Based on the results of this study, the subgrade thickness provided for the rural roads evaluated by the code for the design of pavement for the rural road is 320mm

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GFRPF MATERIALS ON HYDROKINETIC TURBINES IN INDIAN RIVERS

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ABSTRACT

This paper produces a detailed description of the characteristics of a crossflow helical turbine. The prominent helical turbines have been detailed with their development and their environmental techniques as a replacement for the hydraulic turbine. The selected turbines are venturi wind turbine, Gorlov helical turbine and Lucid spherical turbine. The Venturi turbine is developed mainly for the function of power generation from the air for the urban environment which attributes to the advantages of high efficiency of power production at lower noise levels. The Gorlov turbine is found to be a prominent turbine wherein application for the extraction of hydropower from low head water currents without damaging the fish migration and depicted to be an eco-friendly turbine. The lucid turbine is functionally developed for in-pipe hydropower harvest for the power supply to nearby grid and also to develop high current density with higher efficiency. The comparison between the Gorlov and Lucid turbine describes that Gorlov works in an open environment with a low blockage ratio too high performance, whereas the Lucid turbine is found to be implanted in locations with high blockage to increase the power generation with increased water velocity in the pipelines. These two turbines have a unique feature that enables them to customize their power efficiency, performance and other attributes.

Keywords: *GHT, LST, milliwatt (MW), drag coefficient, tip speed ratio, turbulence*

Introduction

Renewable energy technologies are unsullied, which have a far less environmental impact than conventional energy technologies. [1] There has been a devastating experimental research interest developed in exploiting the advancement in technologies of renewable energy in urban locations due to the outstanding attributes of small-scale renewable energy technologies that claim to produce clean energy with non-toxic to the environment. Photovoltaics, turbines are much likely to say renewable energy technologies. A turbine may be a rotary mechanical contrivance that extracts energy from a fluid flow and converts it into subsidiary work. A turbine may be a turbomachine with a minimum of 1 moving part called a rotor assembly, which may be a shaft or drum with blades affixed. Researches made numerous turbines to work in both hydropower and wind potency. Orientation is one of the important parameters considered for harvesting renewable energy based on which turbines could be grouped into two categories with respect to their axis of rotation to orientation as horizontal axis wind turbine (HAWT) and vertical axis wind turbine (VAWT).The three-bladed horizontal axis turbine is the type of turbine most commonly linked with alternative energy at the moment (HAWT). HAWTs are vulnerable to changes in wind direction and turbulence, which [2] harm performance because the turbine must be re-positioned into the wind flow. The vertical axis turbine is primarily built for wind turbine deployment in metropolitan areas. This type of turbine is less affected by changes in wind direction because it is not required to be located in the wind direction**.** The efficiency of these turbines in generating energy, however, is lower than that of the HAWT. Savonius or Darrieus turbines are examples of this type of turbine. The working principle of HAWT is also implies to these turbines by the wind striking the turbine blades to rotate at a speed compared to the speed of wind striking. In contrast to the turbine speed belief the Darrieus turbine results with her speed than the speed of wind striking on blades. This VAWT Darrieus type turbine is constructed of straight airfoil blades with a shaft perpendicular to the airflow and affixed or supported at both upper and lower ends. This design type of Darrieus turbine exhibits advantages over HAWT turbines with less sound working and also resulted as safety turbine in establishing at urban areasOne of the efficient technologies for renewable energy extraction is the “hydrokinetic turbines”, which

extracts hydropower from the free-flowing water bodies. The hydrokinetic turbines are designed and constructed to extract hydropower which does not require the construction of dams and these turbines could be implemented in places such as ocean tides, river streams, and they also could be implemented in an urban environment. These hydrokinetic turbines have variants that could work with various low water heads and different water flow circumstances

Turbine Technologies

Design and development of Urban Venturi turbine:

At the moment, the three-bladed horizontal axis turbine is the variant of turbine that is commonly utilized with energy (HAWT). These turbines are often strepitous, which might be an unwelcome characteristic in metropolitan areas. The functional development of VAWT turbines is to generate clean renewable energy source in urban locations and these turbines doesn't requires to be oriented in the direction of wind. Besides the advantages of Darrieus turbine it doesn't reach the popularity due to the disadvantage of pulsating torque produced in the turbine rotation and also the vibration caused led to fatigue failure in the joints and also to other components. Horizontal/vertical axis turbine is felicitous for locations where the wind from one direction vigorously prevails. [7] Energy-Ball Venturi turbine is an example of a horizontal/vertical axis turbine is an innovative rotor construction consisting of six half-circular blades are composing a spherical construction with a tail. The high flow of wind converges upstream and the low flow of wind diverges downstream enabling the turbine to rotate at turbulence to extract high energy at low wind speed. The aerodynamic design implemented in the venturi turbine enables to the creation of a low-pressure area within the design to attract more airflow towards the front of the sphere and the airflow leaves the turbine radically outside through the venturi planes. Using a direct-drive generator signifies the ability to run at various speeds without a tangency element in between generators, which is advantageous in terms of maintenance and noise. Furthermore, an instantly drive system eliminates the need for a gearbox, resulting in a system that is significantly more efficient and should react to variations in the wind more quickly than an engenderer with a gearbox.[9] From the experimental investigation of Paulides et. al. (2014) its predicated upon the dimensions of the Energy Ball V200: 2 m diameter, an influence level of 25 kW was found to be an optimum. Because the turbines will turn at 2 m/s and begin generating power at 3 m/s, the most difficult task for the direct-drive generator is to understand a high efficiency over an extended speed range (Beaufort scale 2-3). The turbine transfers its maximum output of 2250 W to the grid at 19 m/s (Beaufort scale 8) and has a top survival speed of 40 m/s. The engenderer is betokened with an exterior rotor, where the outer half is the rotor with the eternal magnets, for best integration and ease of the whole design. The reduction in the value of ownership over a longer period of time will encourage the use of small wind turbines in urban areas with high wind speeds.

Gorlov helical turbine:

Hydropower has technical advantages over other known sustainable energy sources. In contrast to energy extraction from wind, hydropower energy extraction produces a high current density with greater energy per unit area. The hydrokinetic turbine is a type of reaction cross-flow turbine designed to extract hydropower from low water head levels. The hydraulic turbines are the most cost-effective and prominent technology in power generation but also causes environmental impacts and causes great damage to fish culture. As a result, hydraulic turbines that operate in a free-flow environment are necessary. [10] The main difference between high head and free flow is that the former uses wide flow apertures to catch as much water mass as possible while the latter uses low velocities and pressure. Water conduits cannot escape turbines' built-in dams since conventional turbines are intended to function at air mass. [11] The P.E. (Potential Energy) of flow is proportional to the pressure produced, and the mechanical energy of the flow is proportional to the face of velocity, according to Bernoulli's theorem.[12] Conventional turbines mostly use the P.E. component, they have so-called "high solidity" where turbine blades cover most of the within flow passage, resisting

water flow and increase water head. This causes fluid velocity to decrease and the kinetic component gets negligible. As a result, higher water heads correspond to greater efficiency. [13] In sluggish flows, the Darrieus helical turbine may generate significant torque while maintaining a broad water passage area.The experimental results and analysis of Alexander M. Gorlov (2002), concludes changes in blade angle of attack create pulsing torque, resulting in varying forces on the blades and turbine vibration, which leads to fatigue failure. Gorlov's improved helical turbine, on the other hand, uses a rotor configuration that eliminates the difficulties that Darrieus' turbine had. [14] The aerofoil sections of the blades utilised on to the turbine may achieve tangential dragging in cross-flow of water. These forces rotate the turbine within the direction of the vanguard of the blades. To prevent pulsing torques, helical blades produce a solid ring projection perpendicular to the shaft, with a width equal to the blade thickness. For such helical configurations, the torque and pulling forces imparted to blades stay constant. In power generation free or ultra-low head water flow, this helical turbine may become a more efficient, low-cost installation turbine, and environmentally beneficial.

In-Pipe spherical turbine developed by Lucid Energy (LST):

The surveillance components associated with the pipelines carrying water to observe for the analysis, inspection and water leaks forecasting and exposure in order to identify microbiological hazards and pollution in water. Most common disadvantage found in wireless monitoring systems is the batteries which is used for power supply to the sensors for the environmental measures. As these batteries and sensors don to have the accessibility to a power grid to get recharged these batteries utilized are predicted to supply power for nearly 21 days. The disadvantage of wireless monitoring systems is equalising the conflict between long-distance, information exchange, frequency band, local processing, and the swirling water levelby hydroelectric energywithin the pipes could be gathered for information gathering devices, which is terribly beneficial in subterranean and concrete metropolitan environments. [19] Saftner introduced Ampair's UW100 Pico turbine, that is a bulb type turbine that providing hydroelectricity within the pipes to signal collection components.Despite the fact that the turbine's electrical components are submerged in drinkable water, they may pollute the water and do not fulfil the requirements for hydropower extraction from pipelines. To meet these needs, [20] Lucid energy (2013) in-pipe hydroelectric power system and turbine (the United States, US 8,360,720 B2), Lucid energy developed a vertical axis turbine that doesn't affect the way of water direction and supplies power to nearby electrical components located external of pipe and this turbine could be implemented in pipelines by T-Joints. This turbine is developed to implement in pipeline with 24-96'' inch pipelines and performs more reliable at 4 ft/s. One unit of this turbine technology is capable of producing 20-100KW of non-toxic hydro energy to the nearby components or power grid. This turbine is designed to produce three-phase AC power at 240 volts. It also can handle a variety of flow conditions without any need for compressors to change back-pressure or velocity.

Experimental researches

Venturi turbines in cities: design, development, and characteristics:

Six partial rotors grouped in spherical form are composed of this turbine rotor. [22] The design proposal produces force through concentrating wind current flow and extracting no more electricity than the wind speed passing via the rotor blades.The high flow of wind converges upstream and the low flow of wind diverges downstream enabling the turbine to rotate at turbulence to extract high energy at low wind speed. The aerodynamic design implemented in the venturi turbine enables the creation of a low-pressure area within the design to attract more airflow towards the front of the sphere and the airflow leaves the turbine radically outside through the venturi planes. Fig.1 shows the working model of the Venturi turbine with a component explanation from the study of Paulideset. al. (2014).

Fig.1 Horizontal vertical axis Venturi wind turbine with a component explanation from Paulideset. al. (2014).

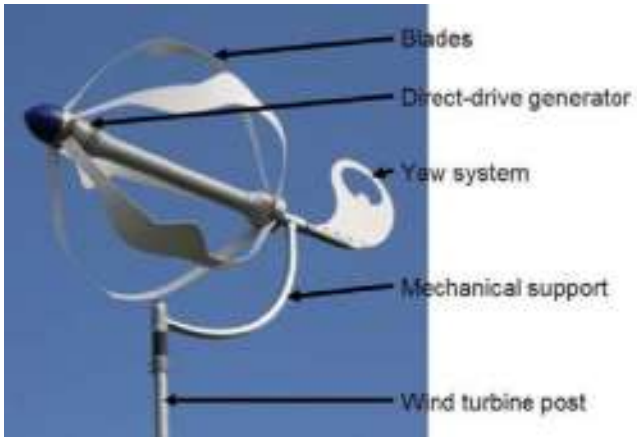


Table 1: Study results of Paulideset. al. (2014) at a wind speed of 12 m/s, the performance values are as follows:

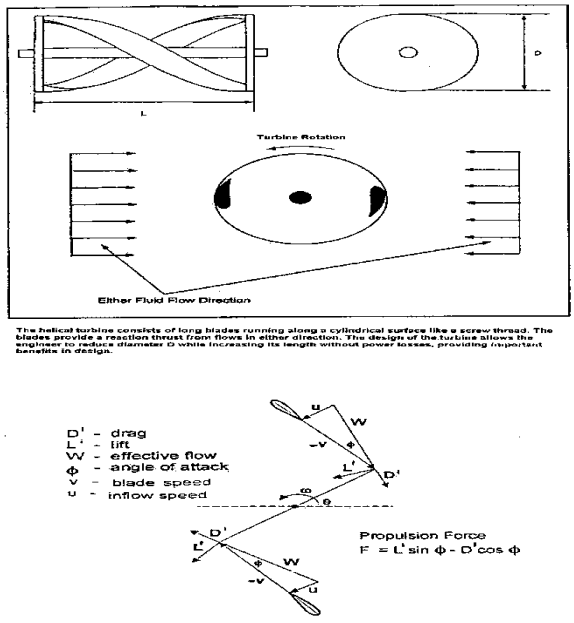
Type	Power output (KW)	Area (m2)	Specification P/A (KW/m2)
Wes Tulipo	2.60	19.6	0.17
Montana	3.90	19.6	0.20
Turby	1.25^1	5.30	0.24
Ropatec	1.90^2	6.60	0.23
Energy Ball V100	0.18	0.95	0.18
Energy Ball V200	0.75	3.14	0.24

The significant feature is that this turbine takes air from a broader area, which travels through the turbine's cortical zone to generate energy. This turbine's efficiency is assessed in terms of yield, that is the amount by square metre of rotor area of kilowatt-hours produced. As aevaluation in comparison of Venturi turbines of HVAWTs, a summary has been generated, and the features are provided in table 1. Other individual differences, such as noise generation, maximum operating speed, turbine swept area, employed generator type, and so on, do not appear to have been taken into account during this study.The statistics taken directly from Paulides et al. (2014) manufacturers' data for current systems with a particular variable of 12 m/s are shown in Table. 1.

3.2. Gorlov Helical Turbine Construction and Specifications:

From the experimental investigation of Alexander M. Gorlov (2002), the Gorlov helical turbine eliminates the pulsating torque that eventually produced in Darrieus turbine by passage to big mass water flow through the rotor passage and resulted in 35% efficiency in power generation to hydraulic turbines and could be oriented in both the axis. Alexander M. Gorlov (2002) fabricated the turbine with a diameter of 1m, 1.25 metres long and the substance implemented is aluminium coated using blue antifouling preventing the frictional loss and barnacles in the design. The Hydro-pneumatic Power Laboratory at North Eastern University fabricates then tested this design using double and triple-blade turbines.

Fig.2 Double helix turbine schematic diagram from Alexander M. Gorlov (2002)



The spiral shaped turbine shown in fig.2 illustratesthatthe only thing that determines the direction of the turbine is the blade orientation of aerofoil portions that provide a tangential internal pressure in the transverse flowing water and spin blades to the front. [26] The turbine was built with the blade's vertical to the main shaft of Alexander M. Gorlov(2002). This results in a whole ring that is effectively regulated all around turbine and thus has a constant torque and push forces from the blades

into the shaft. Some small and medium-sized blades have been built and tested in North Eastern University's Hydropneumatics Power Laboratory, and research has led to the construction of an ideal twin-turbine method.

Fig.3 Triple helix twin-turbineof Gorlov turbine from Alexander M. Gorlov (2002)

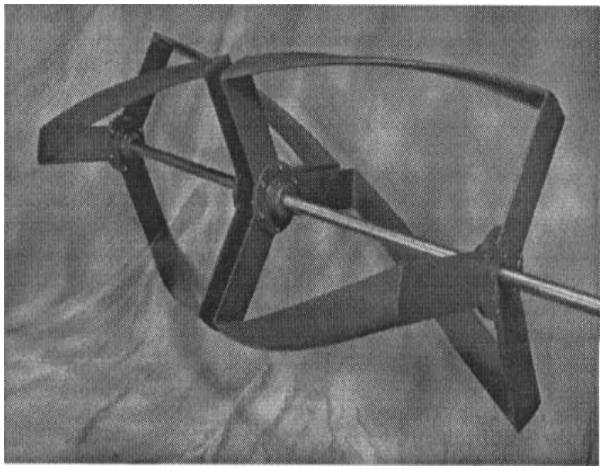


Fig.4 Power Output Vs Water Velocity of Gorlov turbine from Alexander M. Gorlov (2002)

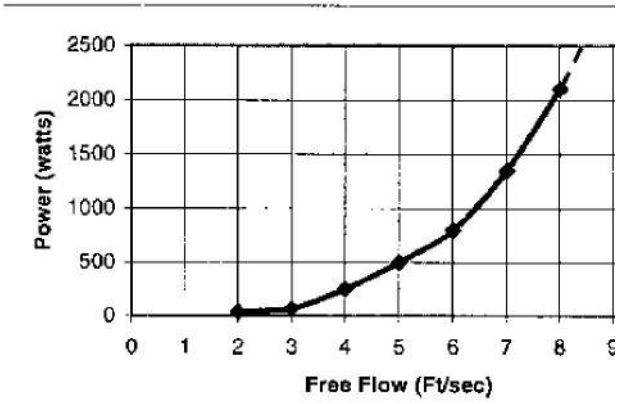


Fig.5 Turbine Efficiencyof Gorlov turbine from Alexander M. Gorlov (2002)

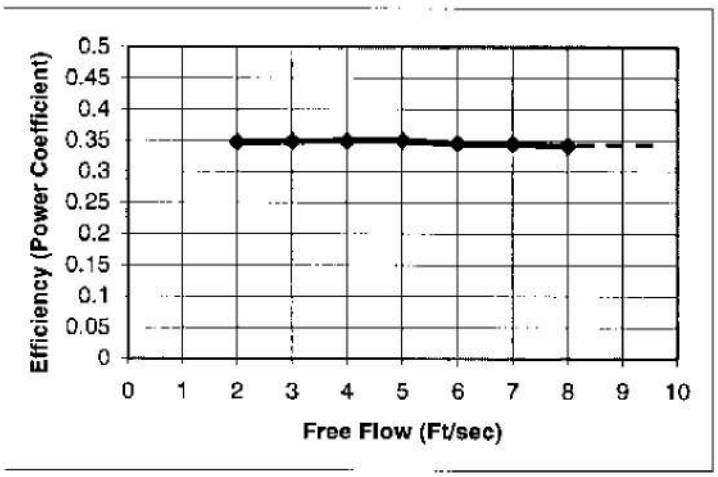


Fig.6 Peak turbine power Vs Water headof Gorlov turbine from Alexander M. Gorlov (2002)

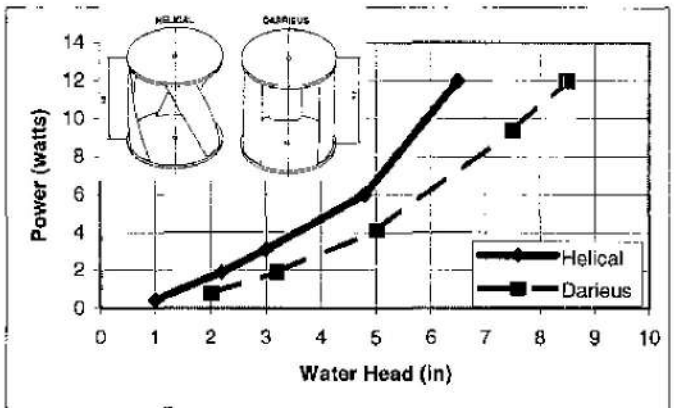


Fig.7 Peak turbine efficiency Vs Water headof Gorlov turbine from Alexander M. Gorlov (2002)

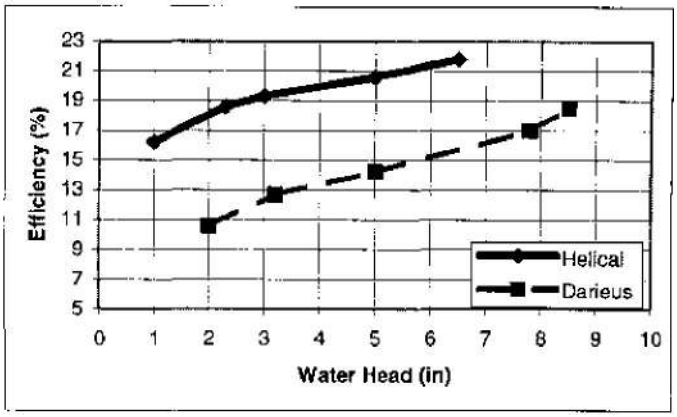


Figure 3 illustrates a dual arrangement with two triple turbines installed on a single shaft. The data from the charts demonstrate that this turbine has a constant efficiency of 35% when tested at various water velocities. Figure 4 illustrates the Gorlov turbine's power production

in free flow, whereas Figure 5 illustrates the turbine's efficiency. According to an experimental investigation, the lower water runoff resistance across the rotor is of importance to the DarrieusTurbine.According to Alexander M. Gorlov (2002), the blades of the helical turbine can cover the whole circular path with the same geometry and sturdiness regardless of the fluid velocity vector.The water resistance is determined by the solidity of the blades[27] defined as the projection of blades on a plane perpendicular and R.p.m of turbine rotation.The uniform rotation of helical turbines over Darrieus turbine pulsation can be explained in this way. Figures 6 and 7 show how Gorlov and Darrieus turbines perform in terms of water levelvsEfficiency and power peak turbine from Alexander M. Gorlov (2002).

Fig.8 Water elevations (dynamic heads) in front of the turbine (no load)of Gorlov turbine from Alexander M. Gorlov (2002).

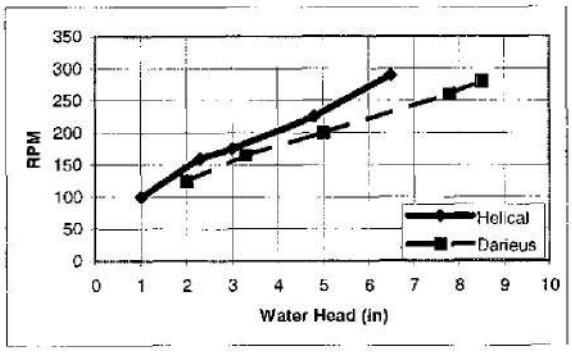


Figure 8 shows the measurements for helical turbine including the Darrieus turbines, and the data shows that the [28] proportion of water head level at 150 R.p.m for Darrieus and Helical turbines with no load and full load circumstances is 1.5.In conclusion, the helical turbine has less resistance to water movement than that of the Darrieus turbine, which has greater resistance.

The design of a lift-based Lucid helical turbine and its attributes:

J. Chen et. al. (2013) fabricated a vertical axis turbine for the implantation in the pipeline of 100 mm diameter intended to produce 80 W power at 1.5 m/s water velocity and water head level to 5m is tested. This design is a simulation-based design where the experimental model is designed using CAD software and then analysed the performance of the design under various circumstances. The material stainless steel which doesn't toxic the water quality is been utilized as material and fabrication has been processed by CNC method.The prototype of J. Chen et. al. (2013) was installed in an exceedingly lab system for real-time testing which is shown in fig.9.

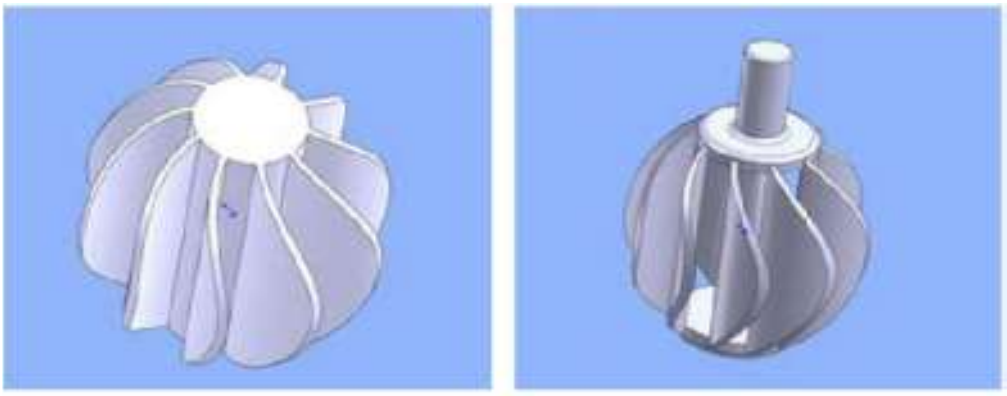
Fig.9Whole testing rig of J. Chen et. al. (2013)

This solution comprises a superior circulation loop, a pump which can operate at half its total potential during the last 8-10-hours test, a 1.6 m^3 storage tank, valves and sensors as well as a pump which can work at half its max potential throughout the ultimate 8-10-hour test. There are numerous speed drives to control the pump's revolution speed, as well as valves to adjust water pressure and flow rate, in the pipe in question, which generates a 37kw pump with an 82m water head and an 81m3/h flow rate. To monitor the temperature and pressure inside the pipe, sensors are mounted at the intake, outlet, and various points.NACA4415 [30] was chosen as the simulation material for the airfoil, and several spherical drag and lift-type water turbine supported vertical axis wind and water turbine turbines were proposed during this simulation.

The proposed designs were subjected to a computational study.:

The design criteria for solid-drag turbines include rotor dimensions and number of blades. Figure 10 shows the proposed drag-type turbine models and simulated models by J. Chen et. coll. (2013).

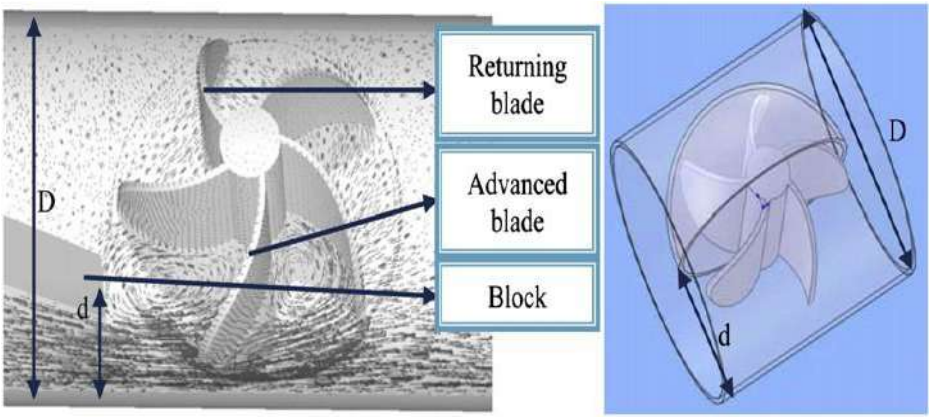
Fig.10 Proposed models of Drag turbine type of J. Chen et. al. (2013)



(a) Solid turbine (b) Hollow turbine

Observing the performance of the first iteration test, J. Chen et al. (2013) found that, with the exception of hollow drag-type turbines, drag-type turbines create more power than lift-type turbines for the same conditions. The drag-type turbine works by influencing the most resistive force with the returning blades. [31] Installing the block inside the pipeline around the blades is a new innovation. As a result, a portion of the water head energy is converted to K.E., causing the water flow to narrow. The working principle of the proposed design of J. Chen et. al. (2013) is shown in fig. 11.

Figure.11 Working principle of proposed design of J. Chen et. al. (2013)



Vertical block, long slanted block, short slanted block, and eye-shaped opening are the four types of blocks used in pipelines, and the models that are made are in J. Chen et. al. (2013) is depicted in fig.12. The blocking ratio is defined because of the ratio between diameter of turbine and diameter of pipeline.The facility output of drag type turbines is frequently raised by raising the block ratio, according to the second-iteration test results. According to the results of J. Chen et. al. (2013), the eye-shaped block has been tested and gives a power output of 32.2 w with a block ratio of 0.9 for more waterhead. All simulation tests have been disseminated from recent combinations like a hollow drag turbine and blocks.

Fig.12 Four types of blocks used in pipelines in experimental investigation of J. Chen et. al. (2013)

The hollow turbine with slanted eye-block, according to information provided by the third-iteration implementation, produces a significant improvement in power output while consuming less than 12m of water. The highest energy output is 88.2 W, at 5m water head level, and the tested turbine has 12 blades, according to implementation of the third iteration. When comparing simulation study outcomes to check results, the facility output and pressure drop are higher.[33] This combination of a hollow drag-type turbine and an eye-slanted block can meet the need for power to surveillance networks and it is conveniently integrated into the pipeline through T-joints in pipes and power output. [34] Table 2 shows the test results J. Chen et. al. (2013) as well as the specifications discovered during the tests for the built and tested models. In J. Chen et al. (2013), the entire assembly of a lift-type in-pipe Lucid spherical shaped turbine in dynamic environments is shown in Fig.13.

Table 2. Tested drag type turbines and the specifications of J. Chen et. al. (2013)

Drag type turbine design	**Max power (W)**	**Head drop (m)**
1st gen: 5-blade solid turbine (B86 mm) þ vertical half-block	0	0
1st gen: 5-blade solid turbine (B92 mm) þ 80% short slanted block	12.0	N/A
2nd gen: 6-blade solid turbine (B92 mm) þ 90% slanted eye-shaped block	32.2	5.82
3rd gen: 12-blade (B92 mm) hollow turbine þ 90% slanted eye-shaped block	88.2	4.85

Fig.13 Lucid Energy lift-type turbines of Lucid energy.Inc.

Discussion

Researchers are currently focusing on helical and spherical turbines, followed by hydraulic turbines. These hydrokinetic turbines have great characteristics that allow researchers to tweak their performance to suit a variety of working conditions. Hydrokinetic turbines of this sort can be used in a variety of environments with low head water supplies. These turbines are being developed and implanted in metropolitan areas to capture hydropower from free-flowing water bodies that have been freely dissipated, according to studies.

Conclusion

The venturi turbine is a prominent technology that might be deployed in urban areas for energy harvesting, and it is a potential cost-effective replacement for HAWT type turbines. The Darrieus turbine is a form of VAWT that is primarily developed for urban regions. The shortcomings of the Darrieus turbine led to the invention of the Gorlov turbine, which sparked several studies on helical turbines and small-scale energy extraction. Gorlov helical turbines have a 35% efficiency above hydraulic turbines, and this technology has been found to be environmentally favourable for fish migration. The eminent technology of Lucid spherical turbine, which is an in-pipe line turbine, can gather and feed hydro energy from the water transmitted through pipes to the surrounding power grid or to electronic components. These hydrokinetic vertical axis turbines offer high efficiency and the advantages of producing more power density for less money while requiring less maintenance and installation.

Acknowledgement

First and foremost thanks to god for the blessings to my research work to gain knowledge and to complete the work. I show my gratitude to all the research workers for providing an idea to extract green energy for useful purposes.

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IOT BASED INDUSTRIAL AIR POLLUTION MONITORING & CONTROLLING SYSTEM

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ABSTRACT

Pollution is the presence of harmful chemicals and foreign bodies in a system such as the atmosphere. Harsh chemicals coming from production facilities, smoke, fumes from foundry, etc. This has numerous negative effects on health, human safety and efficiency of workers. Additionally, pollution leads to climate change, acid rainfall. Online monitoring solutions of environmental polluting parameter using Internet of Things (IoT) techniques help us to gather the parameter values such as pH, temperature, humidity and concentration of carbon monoxide gas, etc. using sensors and enable us to have a keen control on the pollution caused by the industries. Current systems use many big mechanical devices to collect data. These devices are not economical, easy to use and periodic collection of data is not possible. Frequent human intervention is also required. This paper introduces a Raspberry Pi *based online pollution monitoring of industries for the control of pollution caused by untreated disposal of waste, machine exhaust, smoke and fumes due to production of goods.*

Introduction

Air pollution refers to the release of pollutants into the air that are detrimental to human health and the planet as a whole. Air pollution can be defined as the presence of toxic chemicals or compounds (including those of biological origin) in the air, at levels that pose a health risk. In an even broader sense, air pollution means the presence of chemicals or compounds in the air which are usually not present and which lower the quality of the air or cause detrimental changes to the quality of life (such as the damaging of the ozone layer or causing global warming).

The Internet of Things, or IoT, refers to the billions of physical devices around the world that are now connected to the internet, all collecting and sharing data. Thanks to the arrival of super-cheap computer chips and the ubiquity of wireless networks, it's possible to turn anything, from something as small to something as big as an aero plane, into a part of the IoT. Connecting up all these different objects and adding sensors to them adds a level of digital intelligence to devices that would be otherwise dumb, enabling them to communicate real-time data without involving a human being. The Internet of Things is making the fabric of the world around us smarter and more responsive, merging the digital and physical universes.

Literature Review

- The major cause of air pollution in cities is due to vehicles. Vehicular pollution leads to a vital increase in the emission of loads of myriad toxins into environment. The
- commercial systems available in the market are devices that use the semi-conductor sensors at the smoke emission outlets of vehicles and this system detects the pollutant levels and also indicates this level to the owner of the vehicle with a meter. When the pollution level increases beyond a particular threshold level, alarm will start ringing in the vehicle to indicate that the limit has been attained and the vehicle will automatically stop running after certain time [3][11].
- This type of individual usage system does not help the public to get into an awareness zone. Bharat stage emission standards are the emission standards set by the Indian Government to regulate air pollutants from internal combustion engines in motor vehicles. Also, over the years, several regulations have been made by the Government to regulate and reduce the emission from vehicles but in vain. Also, other cost-effective measures were introduced to control the air pollution by calculating the levels of each and every pollutant [5][7][10].
- Based on the observed values, the air quality index for that region is calculated and the values are made available through a web page. But the main disadvantage of this system is that, users are not provided with a portable application to view pollution levels then and there and also a

pictorial format is missing for easy view [8][1].

- Further a low-cost wireless monitoring system was developed to measure the levels of harmful gases based on a multilayer distributed model using Arduino platform and Xbee. In addition, to achieve data transmission, a software component was built using C/C++ language. The data is collected and sent to a webpage to make the data available real time. The system is quite complicated since various software languages have been used in this system i.e., Java for computer system and C/C++ for conversion of analogue data to digital form [9][6].

Problem of the Work

- With the tremendous increase in the level of population and mechanization, air pollution has increased many folds. This results in deterioration of individual health thereby by directly affecting health of entire population.
- We live in an era where technology and sensors can be deployed at various locations which can sense and collect the data. The big data can be uploaded to the cloud which facilitates monitoring from any part of the globe.
- The presence of harmful gases like CO2, Smoke, CO, Butane and LPG above a particular limit may turn fatal which can lead to severe accidents. This type of accidents can be prevented by implementing an effective pollution monitoring system.

Objectives

- To build a robust system that can measure the industrial pollution and help to reduce it and to decrease human interference in monitoring the industrial pollution to reduce pollution and provide a healthy environment for the workers to work in.
- To make the industrial pollution monitoring a wireless system.
- To protect the environment from industrial pollution.
- To build a robust system that evaluates the industrial pollution continuously and indicates when there is an increase in the emissions and takes action to control it using wireless technology that is IOT.

Methedology

The sensors are connected to the Raspberry Pi. The sensors output value are interfaced with internet of things. A web page is created and it contains all the readings and observation of the sensor devices.

The proposed work starts with the monitoring section. The data is fetched from the sensors. The DHT-11 and Sensors are connected to the raspberry PI board. In the coding section, when the serial input is given to the raspberry pi board it fetches the data from the sensor and shows it in the raspberry pi monitor. The serial input is provided to the raspberry pi board by cloud. 'H' is the serial input to the raspberry pi board for fetching the humidity value, 'T' is for temperature and 'P' is for Ph value. Next, the data collected from the raspberry pi board is inserted into the table 'Iot' in the "MYDB" database using the cloud coding. The server is started. The website fetches the sensor values stored in the database and shows it in the website columns.

Hardware Used

Raspberry PI: The Raspberry Pi is a small, cheap, tiny computer on a single circuit board, and has been designed in such a way that it consumes less power than the regular computer. The raspberry pi consists of the micro-USB power, display port, micro-SD slot, HDMI, port, audio video jack, CPU, GPIO pins. Through the micro-USB power, the power supply for the raspberry pi is given.The Raspberry Pi is a low cost, **credit-card sized computer** that plugs into a computer monitor or TV,and uses a standard keyboard and mouse. It is a capable little device that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python. It's capable of doing everything you'd expect a desktop computer to do, from browsing the internet and playing high-definition video, to making spreadsheets, word-processing, and playing games.

Fig1: Raspberry pi

It works on the solid electrolyte cell principle. When the sensor is exposed to carbon monoxide the various electrode reactions takes place. When the surface temperature is high, then the sensor behaves as a single cell with two sides which is used to output voltage signal.

The MQ7 Gas Sensor module is useful for gas leakage detection. They are used in gas leakage detecting equipment's in home and industry, are suitable for detecting of Carbon Monoxide. Due to its high sensitivity and response time, measurements can be taken as soon as possible.

Data Collection

Data Collection Process

- Using our IoT based pollution monitoring and control device we will monitor the air pollution level across several parts of the industry in real time.
- We will create a real time map of the pollutants such as CO2, humidity, temperature.
- We will compare these pollutant figures with the Central Pollution Control Board's standards
- This data will help the industry implement changes to reduce pollution and improve worker safety

The Central Pollution Control Board of India specifies the safe limits of pollutants industries in India can let out into the environment.

Result

Result: IoT based air pollution monitoring and controlling device

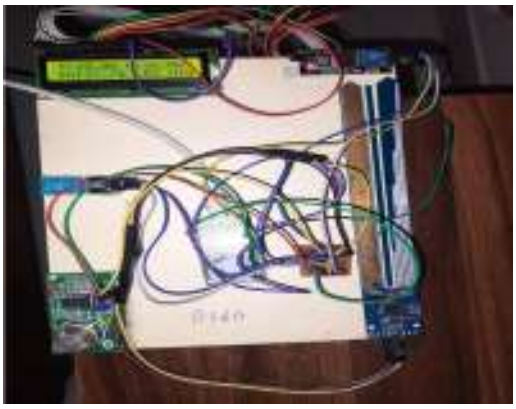

Fig 2: Pollution monitoring device assembled

Fig3: Pollution Monitoring device

This is a device that can measure CO2 readings, humidity and temperature in a particular area.

Analysis

Carbon Monoxide

The focus dimension of carbon monoxide present in condition is estimated in units 'parts per million (ppm)' and %. The transformation is appeared as follows.

Table1: CO2 source concentration

Level of Carbon Monoxide	Source
0.1 ppm	Natural atmosphere level
0.5 to 5 ppm	Average level in homes
5 to 15 ppm	Near properly adjusted gas stove in homes
100 to 200 ppm	Exhaust from automobiles in the city
5000 ppm	Exhaust from a home wood fire

Carbon Monoxide source concentration

Table2: Conversion from ppm to %

ppm	Percent (%)
0 ppm	0%
5 ppm	0.0005%
50 ppm	0.005%
500 ppm	0.05%
1000 ppm	0.1%

Conversion from ppm to percentage
% Concentration = ppm / 10,000
Percent concentration of substance X within another substance Y = ppm concentration divided by 10,000

Temperature

Table3: Temperature sample data

Temperature in degree Celsius	Source
28*C	Indoor room temperature in Bangalore Urban
32*C	Outdoor temperature
38*C	Mechanical workshop

The temperature sensor provides an output of 10mV per degree Celsius, with an accuracy of 0.5°C at25°C. It can be powered by any DC voltage in the range 4V-30V. The operating range is –55°C to +150°c.
Suppose at 20°C,
We will get 20 x 0.01 = 200 mV, or 0.2 volts.

Table4: Temperature to voltage conversion

Temperature in °c	Output voltage in mV
5	50
10	100
20	200
50	500
100	10000

Conversion of Output in mV per degree Celsius

Humidity

Relative Humidity = (density of water vapor / density of water vapor at saturation) x 100%
If actual vapor density =10 g/m3, at 20°C. Saturation vapor density =17.3 g/m3, then the relative humidity is,
RH= (10 g/m3/17.3 g/m3) x 100% =57.8%
Put the sensor in water we get its maximum raw ADC value, suppose we use 10bit ADC then raw ADC value is in the range 0 to 1023.
If we get raw ADC value 1023 for RH 90 i.e., 2970 mV
then 1023 = 90
1023 * x = 90
x = 0.0879765395894428
%RH = (raw ADC value * 0.0879765395894428)
e.g. - if raw ADC value = 920 then 920 * 0.0879765395894428 = 80.93841642228739 % RH

Table 5: Temperature to humidity relationship

Temperature in °c	Relative Humidity in %
+40°	45%
+30°	40%
+20°	35%
+10°	30%
+0°	25%
-10°	20%

Conclusion

- The proposed system designed, shows the output of sensing the carbon monoxide gas in air, humidity and temperature of the environment.
- The sensor output is pushed to the cloud and can be viewed through the internet. This is a successful system which is very useful in industries to detect pollution.
  - This system is user friendly and cost effective.
  - The results of the paperproves that this system can be implemented in any industry for the safety of workers and the environment
  - Directly Implementable System (Real-time Approach)
  - High Reliability and Real-time Detection
  - An idle system for commercial implementation

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AN INVESTIGATION ON THE GENERATION OF ENERGY USING REPULSIVE POWER OF A PERMANENT MAGNET

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ABSTRACT

Nowadays every country concentrating on the effective utilization of renewable energy in place of conventional energy due to the shortage and hazards of effects of their fossil sources. This provides an opportunity to produce various alternative clean energies. This research aims to create rotational kinetic energy by using permanent magnets. In this investigation, 20 cube shape magnets are used and arranged systematically to generate rotational energy without external energy input. Specifically, neodymium permanent magnets are used as a powerful and cheap source of the magnetic field with ease in availability. The effect of flux density, angle of rotation, and speed on the energy generation was determined. The obtained values were compared with the simulation results.

Keywords: *Flux density, permanent magnet, angle of rotation, and energy*

Introduction

Population growth with modernization increases the need for energy. Fossil fuels which will diminish in upcoming years are widely used for the generation of energy. In the year 2017, 73.5% of electricity produced worldwide using fossil fuels. The remaining 26.5% of electricity generated using renewable sources [2]. Hesitation regarding the use of fossil fuels should be the prior step to reduce the emission of carbon dioxide (CO_2). Ease in availability and eco-friendly nature, renewable energy resources are perfect for a pollution-free environment. It will take time to switch completely from none renewable energy resources to renewable energy resources. Indian Government aiming to attend 175 GW of electricity using renewable energy resources [1]. To fulfill the need for energy many Indian states implementing renewable energy production. For supplying electrical power to remote areas like in Rajasthan (India), the proposed Hybrid Energy System (HES) is a better option. In HES, solar panels and wind turbines are used to generate the main proportion of power and for backup power, batteries are used [9].To reduce CO_2 emissions, nuclear power generation is an alternative to fossil fuels. But in 2011, Fukushima Daiichi nuclear disaster shows how it will harmful to the ecosystem [5]. Apart from that, it is possible to convert fossil fuel energy to other carbon-free energy carriers like electrons or hydrogen without emitting CO_2. But it limits to a certain extent and not much suitable for practical cases [3].By studying the above cases, the best way to cut down on the excessive dependence on fossil fuels is to integrate them with renewable energy sources. The proposed Home Energy Management System (HEMS) try to enhance energy management in residential homes and it will help to save the energy cost [7]. Likewise, another concept was proposed to generate electricity from high headwater in a building of height 15m using a macro hydro turbine [8]. Nowadays, the trend of electric vehicles (EVs) is growing for energy cost saving and emission reduction. Therefore, the integration of renewable energy with the electric grid system is an important task [4], [16]. Other than the solar, wind, and hydro energy, many small-scale applications are proposed to use such as wearable electrode-free triboelectric generators for harvesting biomechanical energy [14], self-powered smartwatch [15], and Bedini SSG free energy generator [11].By knowing the importance of renewable energy resources, this paper focus to investigate the generation of energy using the repulsive power of the permanent magnet. In this investigation, 20 cube shape magnets are used and arranged systematically to generate rotational energy without external energy input. Specifically, neodymium permanent magnets are used as they are powerful and the cheap source of the magnetic field with ease in availability [17]. This proposed model will be applicable to use in appliances like fan, wind ventilator and by using turbines it can generate electricity for multiple uses without producing any harmful byproducts. This leads to saving

power which is getting from non-renewable energy resources.

Design Architecture

Setup has minimalistic parts which are a set of permanent magnets (NdFeB: N5214), stator, stator lead, rotor, rotor lead, nut, bolt. The stator is an immovable part and the rotor is a movable part. Rotor has a ring-like shape having four projectors to support the rotor in the casing. Rotor has a disk shape incorporating the stepped shaft. The inside and outside diameters of the stator are 70mm and 95mm respectively. Rotor has a diametral size of 50mm. The thickness of the stator and rotor 11mm each. 10mm square grooves are made on the stator and rotor for placing the magnets on that. To hold the magnets at that position closing leads are provided on the stator and rotor. The stator and rotor are placed concentric to each other. A set of 8 magnets is mounted on the rotor and another set of 12 magnets is mounted on the stator. Magnets are mounted in such a way that the stator's magnet and rotor's magnets facing the north pole towards each other to get the repulsive action. At the time of design, theproblem of free movement is encountered. To get rid of this situation magnets are placed in an inclined position in such a way that when a rotor magnet comes in front of a stator magnet, they make an angle of 10º between them. The main requirement of this setup is the magnet of cube shape of the side of 10mm. Parts apart from magnets are made up of Mitsubishi Plastic-E002.

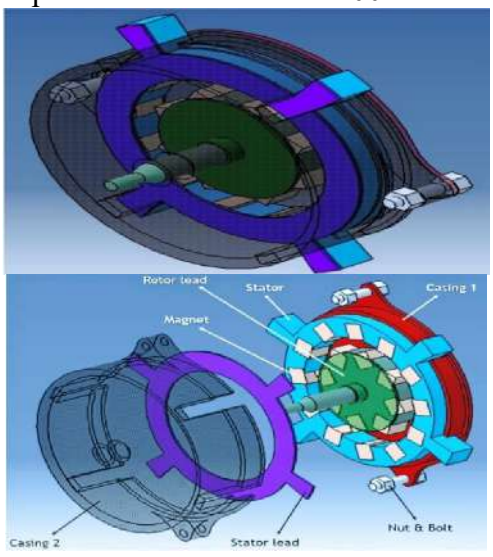

Fig. 1. Detailed model assembly
Fig. 2. Assembled parts nomenclature

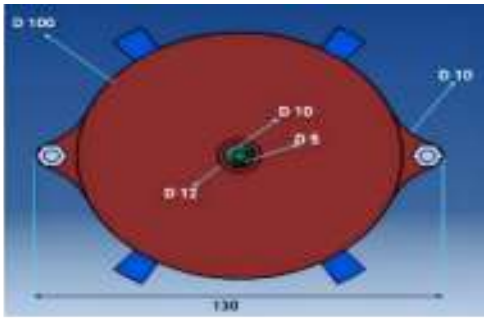

Fig. 3. Front view with dimensions in mm

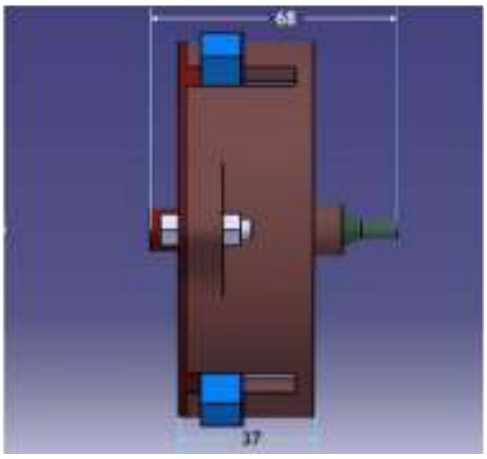

Fig. 4. Side view with dimensions in mm

Working Model

To understand the working of the model, there is a need to divide the circular model into 24 equal angular parts, that is each part maintaining a 15° angle. At an instant of time, only 4 alternate magnets denoted by red color in fig. 6, in the rotor get repulse due to magnets placed in the stator which leads to rotating the rotor. After 15° rotation of the rotor, the remaining 4 alternate magnets indicated by blue color as shown in fig. 6, in the rotor get repulse which again leads to rotating the rotor.Likewise, every 15° rotation of the rotor, alternate 4 magnets in the rotor get repulse. This action remains continuous until it is stopped externally. This causes continuous rotation of the rotor without stoppage.

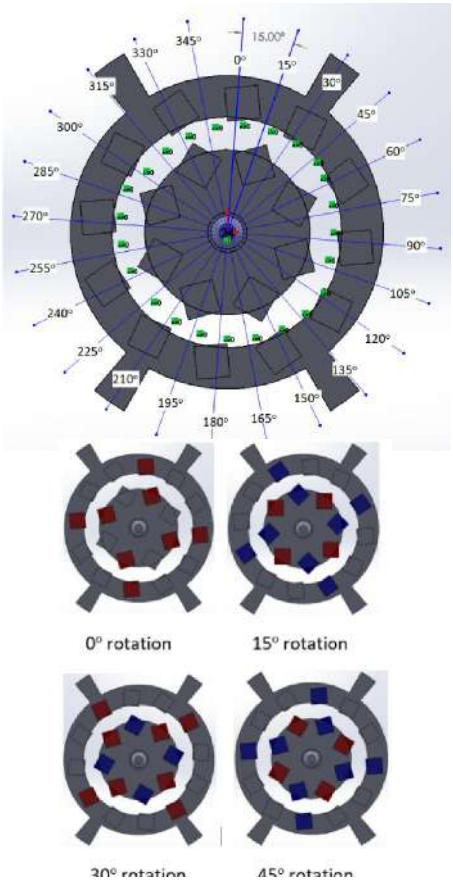

Fig. 5. Angular divided parts
Fig. 6. Position of alternate rotor magnets

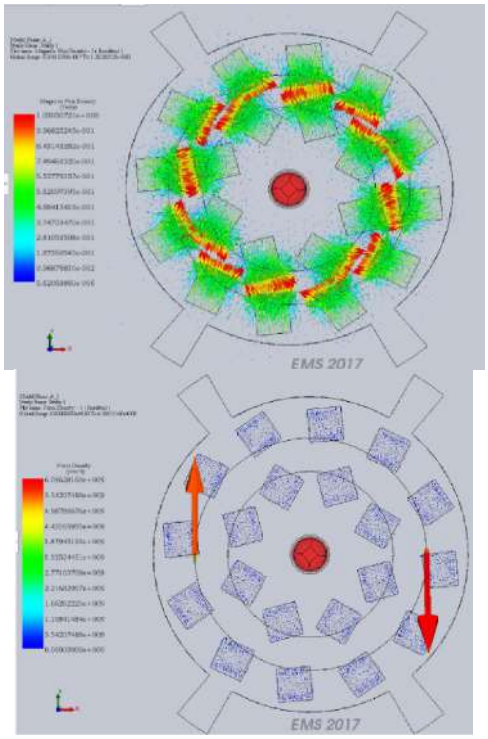

Fig. 7. Magnetic flux density
Fig. 8. Magnetic force density

Analysis

Setup is designed with the help of CATIA V5 and Solidworks software and analysis is done with the help of Emworks extension in Solidworks. The designed model's rotor rotates along Z-axis and assembly is made in XY-plane. The process of repulsion gets repeated after every 15° rotation of the rotor; hence the analysis is carried on the first movement of the rotor from 0° to 15°. So, we took the analysis on three positions, that is 0°, 5°, and 10° rotation of the rotor to get precise results.

At 0^0 position of the rotor: The inclined position of magnets assists flux to flow in the necessary direction to kick the opposite magnet. From the figure 7, it can be observed that the maximum flux density is obtinedinbetween magnets at this location. This causes maximum repulsion between 4 rotor magnets and 4 stator magnets. As shown in figure 8, the resultant force generated indicated by the red arrow tends to move the rotor clockwise. This results in the rotating movement of the rotor. The results generated from the analysis of Force, Torque, and Energy output are shown in Tables 1- 3.

Table 1. Results of force analysis

Rotor position	Fx-axis (N)	Fy-axis (N)	Fz-axis (N)
0^o position	-8.629449e-002	2.278964e-001	-1.548574e+001
5^o position	1.069578e+000	-7.615131e-001	-1.496871e+001
10^o position	6.626442e-001	-3.926900e-001	-1.445300e+001

Table 2. Results of torque analysis

Rotor position	Tx-axis (N-m)	Ty-axis (N-m)	Tz-axis (N-m)
0^o position	-1.091311e-002	-3.329427e-002	3.382043e-002
5^o position	-1.797313e-005	1.376612e-002	3.520421e-003
10^o position	-1.940273e-002	-6.458140e-003	2.132732e-002

Table 3. Energy output

Rotor position	Energy (J)	Co-Energy (J)
0^o position	6.931043e+000	6.931043e+000
5^o position	6.920771e+000	6.920771e+000
10^o position	6.929273e+000	6.929273e+000

At 5^o position of the rotor : At this position, as shown in figure 9,flux density between magnets is comparatively lower than previous but the rotor already has inertia due to the repulsion at the first position. Also, magnets in the stator repulse the magnets in the rotor to some extent which further tends to move the rotor. The forces (Fx and Fy) generated at this position are more than the previous position which is shown in Tables1-3.

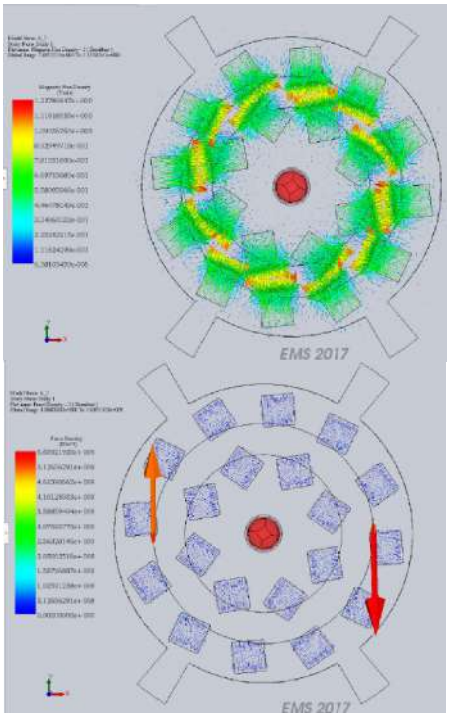

Fig. 9. Magnetic flux density
Fig. 10. Magnetic force density

At 10^o position of the rotor : The results generated in this position were shown in the above tables, the values are in between the previous two positions. Due to the inertia, the rotor reaches the 15^o position and the process of repulsion again started just like when the rotor is at the 0^o position.

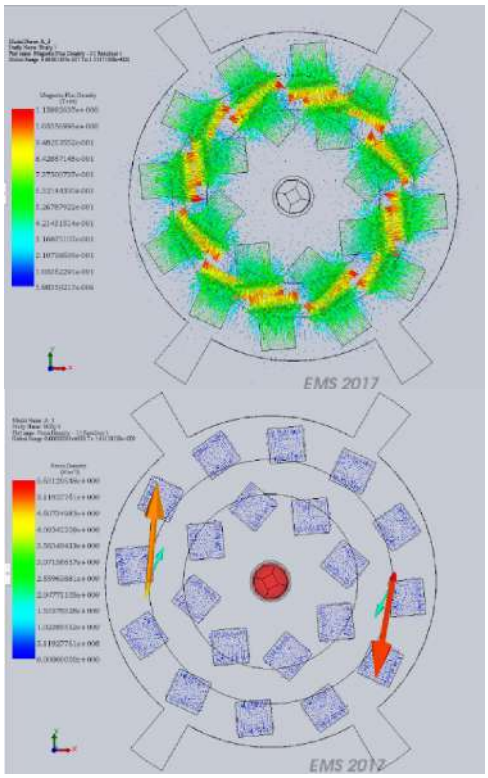

Fig. 11. Magnetic flux density
Fig. 12. Magnetic force density

Theoritical Analysis

As the model is designed in XY-plane and rotor to rotate in the z-axis, torque along the z-axis is required. From analysis results, it is clear that the energy developed is nearly the same at all positions of the rotor.

Average Torque at positions 0^o, 5^o, and 10^o,

$$T_{avg} = \frac{T_0 + T_5 + T_{10}}{3}$$

$$T_{avg} = \frac{(0.03382) + (0.0035204) + (0.021327)}{3}$$

$$T_{avg} = 0.0195558 \text{ Nm}$$

Average Energy at positions 0^o, 5^o, and 10^o,

$$E_{avg} = \frac{E_0 + E_5 + E_{10}}{3}$$

$$E_{avg} = \frac{6.9310 + 6.9208 + 6.9293}{3}$$

$$E_{avg} = 6.92703 \text{ J}$$

The action of repulsion is repeated after every 15^o rotation of the rotor and getting the same results that have been generated for positions 0^o to 15^o. Therefore, the value of torque and energy will be the same for the whole 360^o rotation of the rotor.

Total Torque, **T = 0.0195558 Nm**

Total Energy, **E = 6.92703 J**

At every second the Energy production is 6.92703 J. Therefore, the Power produced is given by,

Power, **P = 6.92703 Watt**

Speed of rotor is given by,

$$N = \frac{60 \times P}{2 \times \pi \times T}$$

$$N = \frac{60 \times 6.92703}{2 \times \pi \times 0.0195558}$$

N = 3382.5394 rpm

Speed**, N = 3382.5394 rpm**

Conclusion

This paper explores the alternative way to generate energy using minimalistic parts. Energy generation is possible only due to the specific arrangement of magnets otherwise stocking encounters. As it works on the repulsive power of magnets, it doesn't require separate energy input to rotate the rotor. Having an ample amount of availability of permanent magnets, this model equipment can be easily manufactured. The results get from the examination of this model are satisfactory. The OutputSpeed obtained from this model is good enough to drive many high-speed applications. But the generated torque is very low which limits its usage. By implementing the Gearbox, it will able to generate good torque by reducing its speed. After that, it can be used in fans, coolers, exhaust, and plenty of similar applications. Apart from that, it is possible to store energy in batteries using turbines. Increasing the size of magnets will result in high torque and speed which will give chance to implement in high torque applications.

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ANALYSIS OF RESIDUAL STRESS IN MANUAL METAL ARC WELDING UNDER DIFFERENT WELDED JOINT POSITIONS

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ABSTRACT

Welding is considered as one of the vital fabrication procedures used till date. There are various welding techniques used for applications till date. Joining any two materials using welding are done by heat or heat along with pressure or with pressure alone. Among the welding techniques used Arc welding is one of the kind that has a various range of applications in which manual metal arc welding had been used and there are some studies shown that there are some residual stress acting upon the welded joints and these could bring fractures when not evaluated. These stresses are evaluated by Optical techniques such as holographic interferometry, electronic speckle pattern interferometry (ESPI), ESPI is typically used as a non-destructive measurement technique. Some studies are done that Non-destructive Analysis in simulation software's can find the residual stresses in welding joints in 3D structures created. This is the study of such residual stresses in simulation taking the parameters used in real time such as operating temperature, welding temperature, cooling time, input voltage and current. There will be a brief study of the changes exhibited in stress when the voltage and current of the welding apparatus is changed, graphs had shown the variation in the stress and optimization is done for better results. The simulation software's used are CATIA, ANSYS and SIMUFACT Welding. For optimization of results Taguchi method in Minitab Software is used.

Keywords: *Manual metal arc welding (M.M.A.W), Non-destructive analysis, Simulation studies and SIMUFACT welding.*

Introduction

Welding is a permanent joining of two materials to form a single element. There are many advantages of welding. Various types welding are present and various joints can be produce through welding. Arc welding is used for ferrous materials and not for nonferrous materials. Simulation studies had been done to study the residual stress Thermal-elastoplastic finite element method was once built to simulate the process of variable polarity plasma arc welding (VPPAW) for aluminum alloy plates. The stress fields and welding temperature of the plates with different butt joint parameters were analyzed using a 3D double-ellipsoidal heat source model, results showed that the unfitness of the joint had a greater impact on the welding residual stresses [1]

ESPI was used to measure residual stress on the welded part of butt-welded A36 specimens with CO_2 welding. Residual stresses on the welded parts of specimens were obtained from the phase map images obtained by ESPI. The results confirmed that residual stresses of welded parts can be measured by ESPI [2] Manual Metal Arc Welding of carbon steel plates was studied through finite element analysis of residual stresses in butt welding of two similar plates is performed with the ANSYS software. The residual stress distribution and magnitude in the axial direction was studied and fine agreement between the computation and experimental results is obtained [3] temperature distribution and stress analysis had been done with developed model by using the temperature dependent material properties for Stainless Steel SS304. This work can be used for selecting process parameters for reducing residual stresses by simulation process. [4] Finite Element Modeling (FEM) analysis using SYSWELD had been carried out to study residual stresses in 316 LN stainless steel weld joint made by TIG welding process and there is good agreement between the model predictions and the experimentally observed values of temperature, residual stresses and distortion [5] finite element analysis was performed to predict the residual stress distribution in a single-U butt weld of a Cr- Mo-V steel cylinder using ANSYS. The influence of welding residual stress on creep behavior is been studied by continuum damage mechanics (CDM) theory [6]. Stresses are created by heating effects that occur during the welding process. Post weld heat treatment (PWHT) is one of most convenient method for stress relief of welds [7]. Weld residual stresses are to be noticed as they reduce reliability. Accurate prediction is essential and is carried out by mean of finite element analysis usually [8]. Observed that mechanical properties have been

correlated with microstructure, residual stresses and corrosion behavior of ferritic stainless steel weldments [9]. Residual stress exists on any welded area. This residual stress can cause the welded material to crack or fracture. This could be reduced by controlled by ESPI [10] as well as simulation are the one of the ways to find the residual stress in advance.

Specification

Rectangular Plate	150X75 mm^2
Base Plate	150X150 mm^2
Material Used	Stainless Steel
Software Used	CATIA, ANSYS, SIMUFACT

Modeling

The concept of welding the plates, the initial part is to be the modeling of the plates and its base required. Firstly the modeling starts with two rectangular plates of 150X75 mm^2 and its base as 150X150 mm^2. This is done in CATIA modeling. The modeling should be in one file so that the alignment of the weld plate becomes easier to do. Later they can be saved individually.

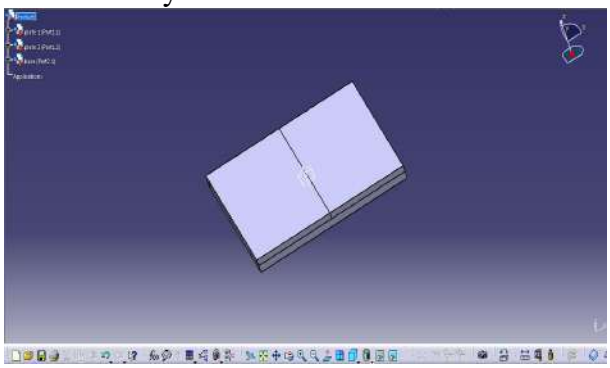

Fig-1 Two rectangular plates with its base in CATIA model

Meshing of the plates is necessary because for analysis purpose the file should be in NASTRAN format so that this meshing is done in ANSYS Workbench for that the CATIA modeled welded plates are to be imported to ANSYS meshing. For this the initially the geometry should be individually imported in the meshing geometry.

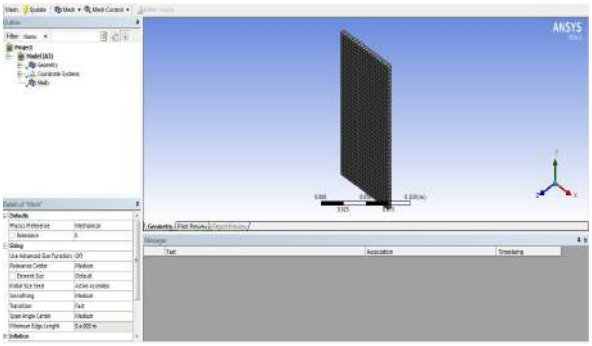

Fig-2 rectangular plate after meshing in ANSYS

The different welding parameters by using which the analysis part is done are as follows welding current and welding voltage. Welding current is the most influential parameter because it affects bead shape, controls the rate at which electrode is melted and therefore also controls the deposition rate, heat affected zone, the depth of penetration, and the amount of base metal melted. Penetration and reinforcement increase with the increase in welding current. Welding voltage varies with the length of the arc between the electrode and molten weld metal. With the increase in arc length, the arc voltage increases because lengthening of the arc exposes more of the arc column to the cool boundary of the arc. Also, the arc column continuously loses the charge carriers by radial migration to the cool boundary of the arc and therefore, imposing a greater requirement of potential for maintaining appropriate charge carriers between the electrode and weld plate.

The analysis part has been carried out by using in SIMUFACT Welding software.

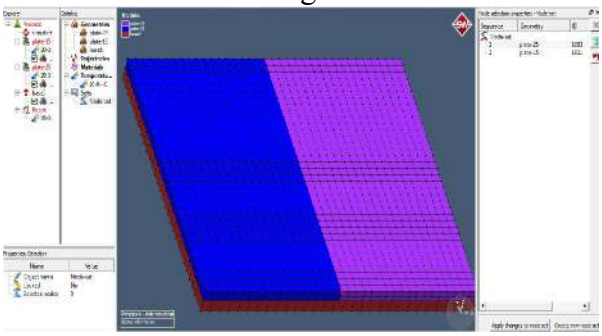

Fig-3 Node point setting in Simufact

General steel S235-SPM-sw grade is selected. This process is repeated by changing one of the welding parameter and keeping the remaining parameters constant.

ANALYSIS

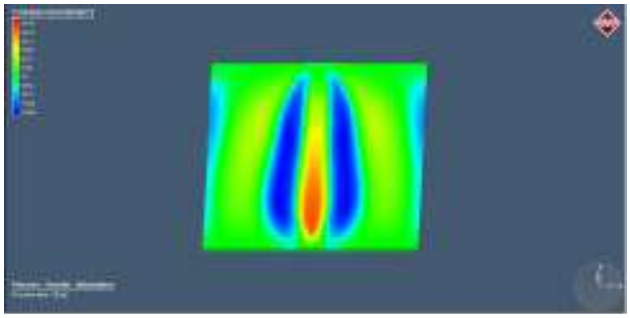

Fig-4 Y-direction normal stress for 180V, 24Amps, 5mm/s and 5mm

Analysis for general conditions is made and further comparisons are made.

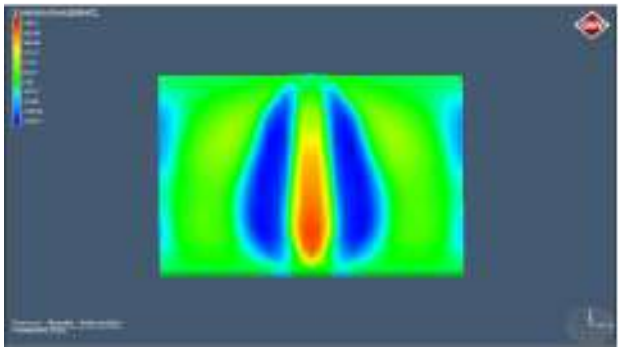

Fig-5 Y-direction normal stress for 170V, 24Amps, 5mm/s and 5mm

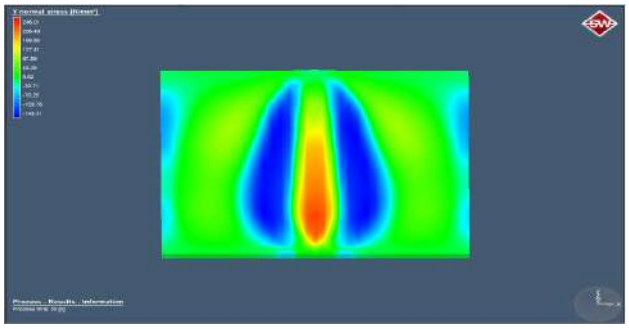

Fig-6 Y-direction normal stress for 170V, 24Amps, 5mm/s and 5mm

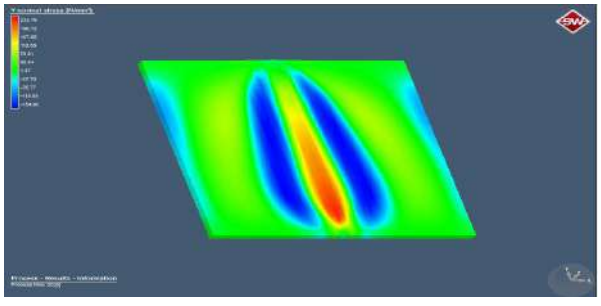

Fig-7 Y-direction normal stress for 160V, 24Amps, 5mm/s and 5mm

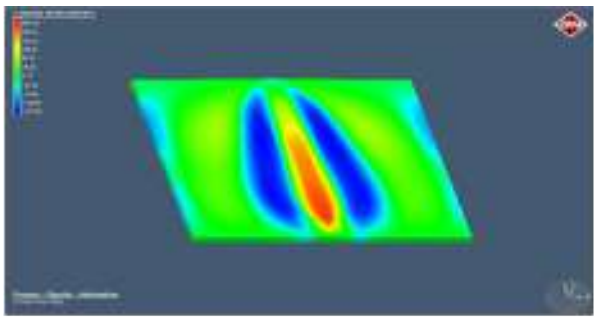

Fig-8 Y-direction normal stress for 150V, 24Amps, 5mm/s and 5mm

Varying voltage Analysis is done and the above images shows the analysis results.

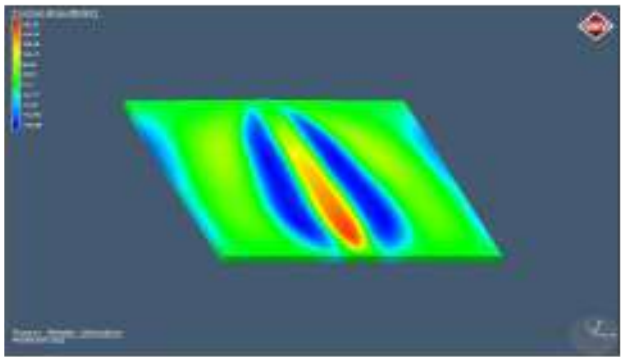

Fig-9 Y-direction normal stress for 180V, 22Amps, 5mm/s and 5mm

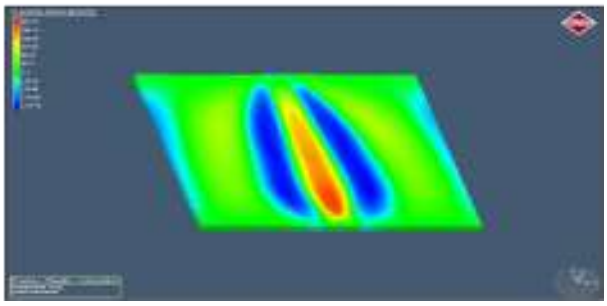

Fig-10 Y-direction normal stress for 180V, 21Amps, 5mm/s and 5mm

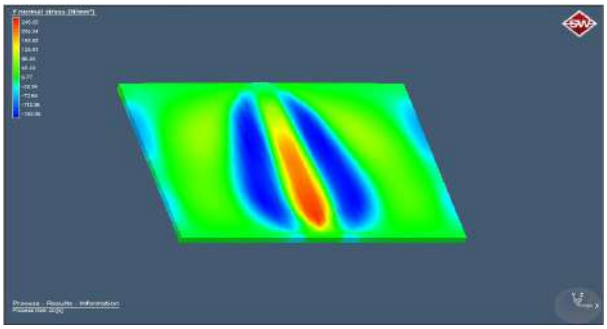

Fig-11 Y-direction normal stress for 180V, 20Amps, 5mm/s and 5mm

These are the analysis for varying current. From the above images we can see the stress variation.

Results and Discussion

The main constant parameters which are taken as are voltage 180V, current 24Amps, velocity 5mm/s and thickness 5mm. When these parameters are applied to the plates then the maximum residual stress obtained is 237.59N/mm^2 and the effective stress obtained is 217.08N/mm^2

Horizontal direction

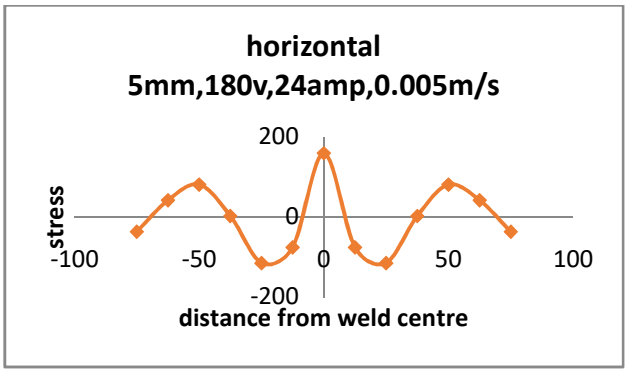

Fig-12 Horizontal stresses for constant parameters

Vertical direction

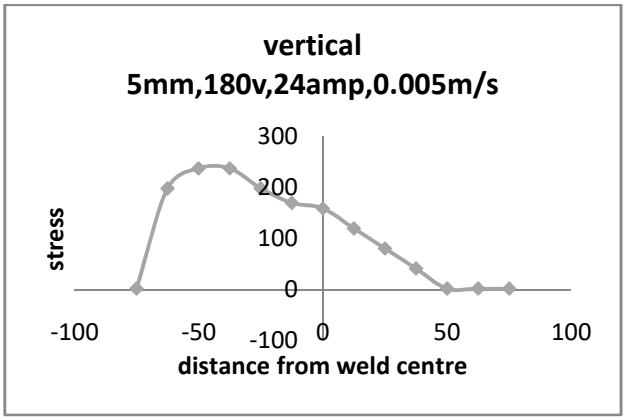

Fig-13 vertical stresses for constant parameters

So from the above graphs it is clear that the horizontally the stresses decreases moving forward towards the centre it reaches the maximum stress and again it drops to the minimum position and for the vertical position also the same effect will repeats.

Varying voltage

By varying voltage and keeping other three parameters i.e., current, thickness and velocity the same analysis is made.

So by taking 170V voltage we get the maximum stress as 246.01 N/mm^2 and effective stress as 225.56 N/mm^2.

Horizontal direction

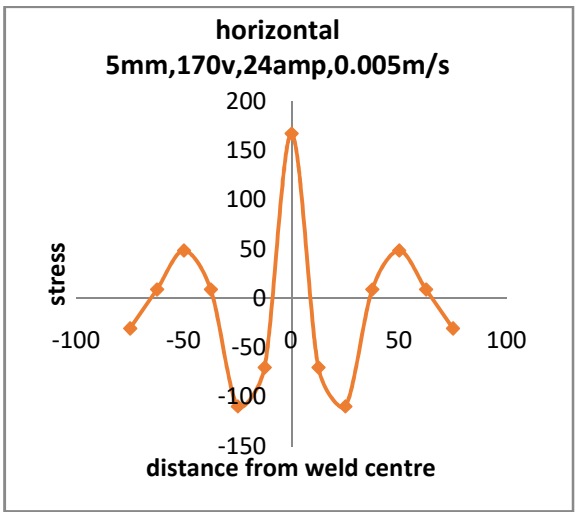

Fig-14 Horizontally varying stresses at 170Volts

Vertical direction

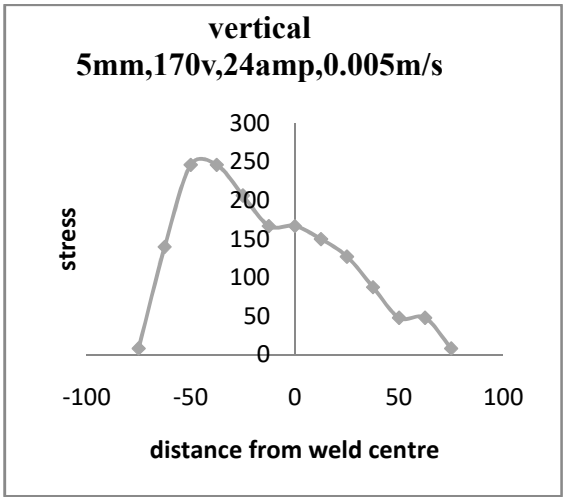

Fig-15 Vertically varying stresses at 170Volts

So from the above graphs it is clear that the horizontally the stresses decreases moving forward towards the centre it reaches the maximum stress and again it drops to the minimum position and for the vertical position also the same effect will repeats.

By taking 160V voltage we get the maximum stress as 235.79N/mm^2 and effective stress as 217.29 N/mm^2.

Horizontal direction

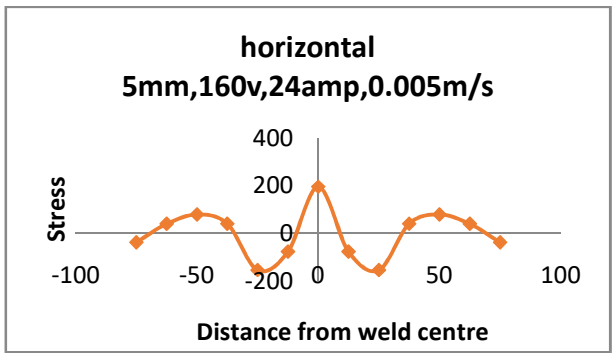

Fig-16 Horizontally varying stresses at 160Volts

Vertical direction

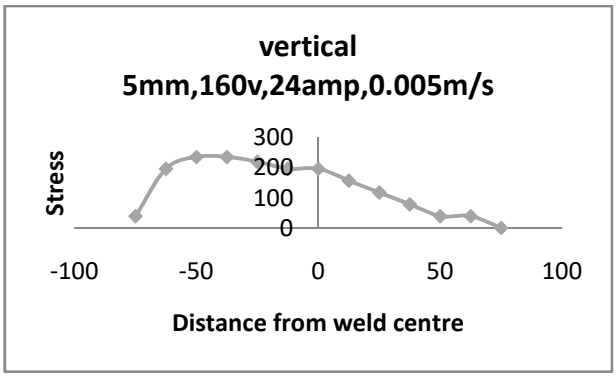

Fig-17 Vertically varying stresses at 160Volts

So from the above graphs it is clear that the horizontally the stresses decreases moving forward towards the centre it reaches the maximum stress and again it drops to the minimum position and for the vertical position also the same effect will repeats.

By taking 150V voltage we get the maximum stress as 245.05 N/mm^2 and effective stress as 223.24 N/mm^2.

Horizontal direction

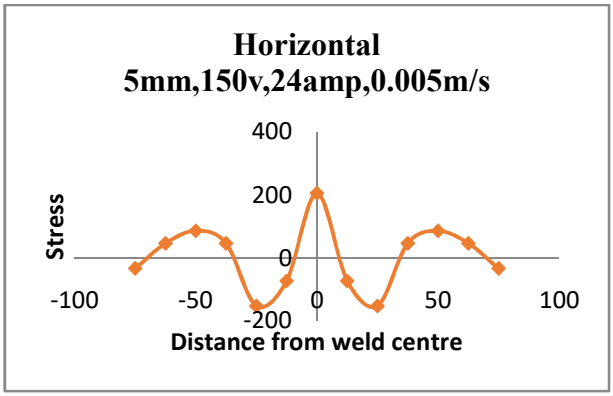

Fig-18 Horizontally varying stresses at 150Volts

Vertical direction

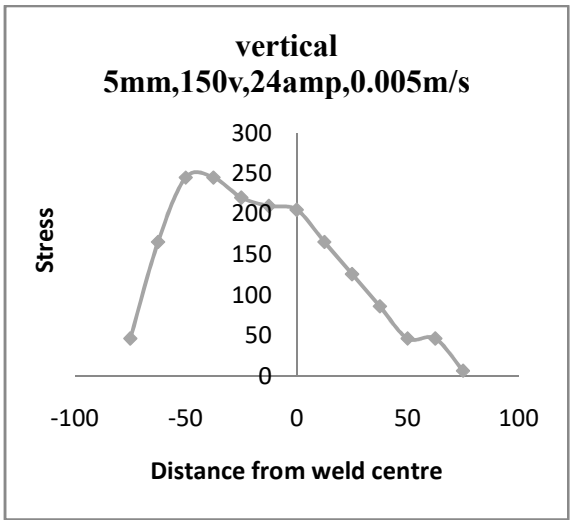

Fig-19 Vertically varying stresses at 150Volts

So from the above graphs it is clear that the horizontally the stresses decreases moving forward towards the center it reaches the maximum stress and again it drops to the minimum position and for the vertical position also the same effect will repeats.

Varying Current

By varying current and keeping other three parameters i.e., voltage, thickness and velocity the same analysis is made.

By taking 22Amps current we get the maximum stress as 245.20 N/mm^2 and effective stress as 225.70 N/mm^2.

The distribution of stress over the weld bead is represented below

Horizontal direction

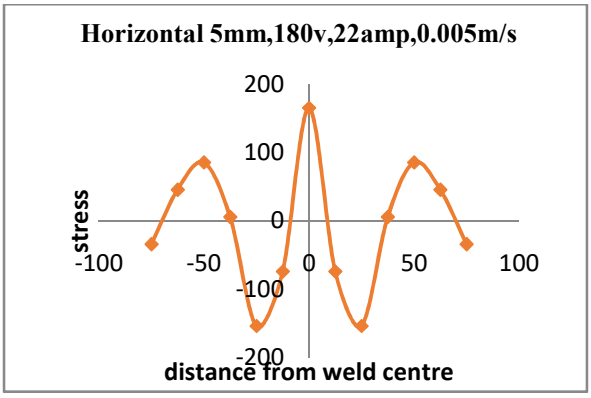

Fig-20 Horizontally varying stresses at 22 Amps

Vertical direction

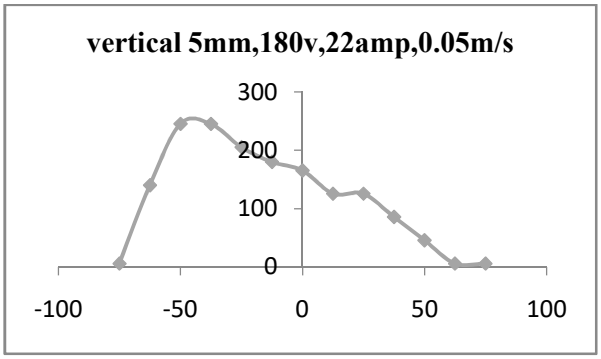

Fig-21 Vertically varying stresses at 22Amps

So from the above graphs it is clear that the horizontally the stresses decreases moving forward towards the centre it reaches the maximum stress and again it drops to the minimum position and for the vertical position also the same effect will repeats.

By taking 21Amps current we get the maximum stress as 238.7 N/mm^2 and effective stress as 219.89N/mm^2.

Horizontal direction

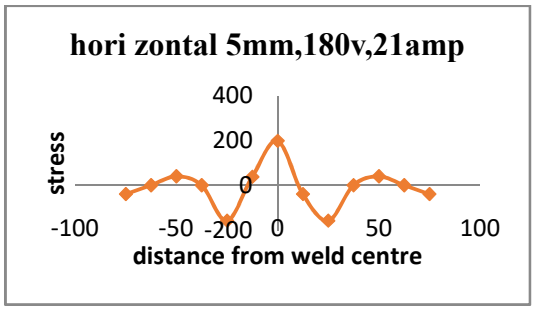

Fig-22 Horizontally varying stresses at 21 Amps

Vertical direction

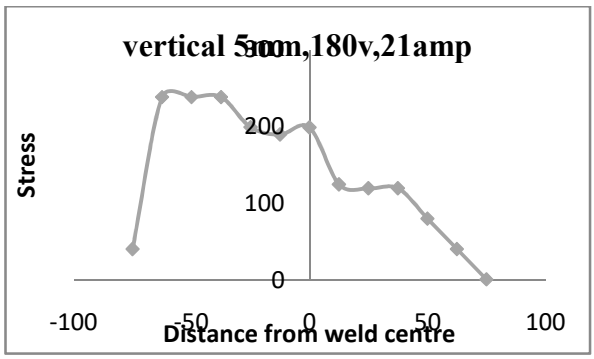

Fig-23 Vertically varying stresses at 21Amps

So from the above graphs it is clear that the horizontally the stresses decreases moving forward towards the centre it reaches the maximum stress and again it drops to the minimum position and for the vertical position also the same effect will repeats.

By taking 20Amps current we get the maximum stress as 245.05 N/mm^2 and effective stress as 223.24 N/mm^2.

Horizontal direction

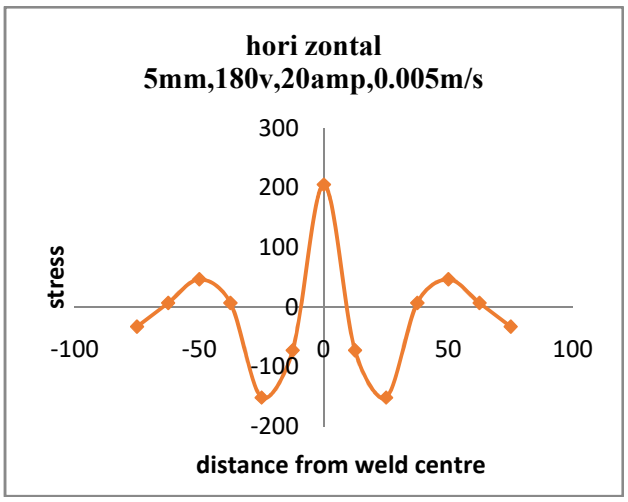

Fig-24 Horizontally varying stresses at 20 Amps

Vertical direction

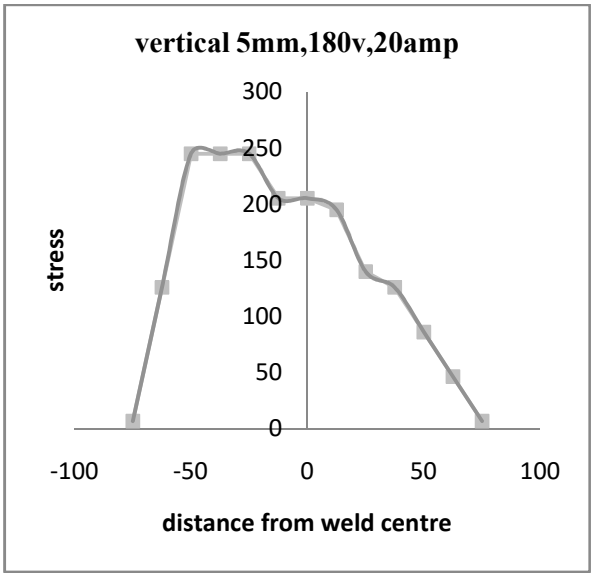

Fig-25 Vertically varying stresses at 20Amps

So from the above graphs it is clear that the horizontally the stresses decreases moving forward towards the Centre it reaches the maximum stress and again it drops to the minimum position and for the vertical position also the same effect will repeats.

When the voltage is varied then the residual stresses are initially dropped at a point and again increased another point.

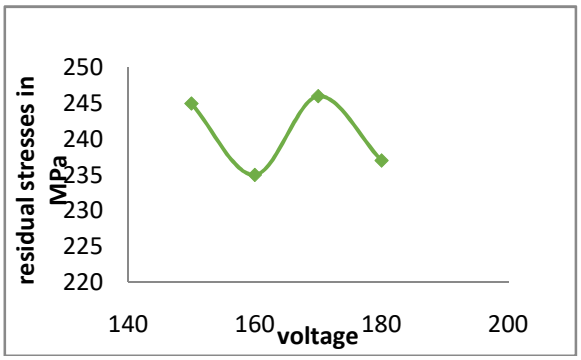

Fig-26 Varying voltage

When the voltage is varied then the residual stresses are initially dropped by the increase of voltage and again increased and then decreased.

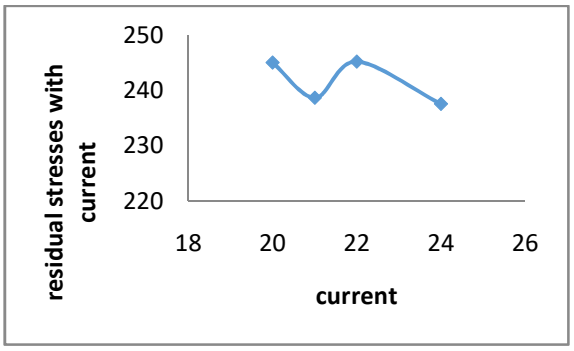

Fig-27 Varying current

From optimization from tuguchi method in minitab

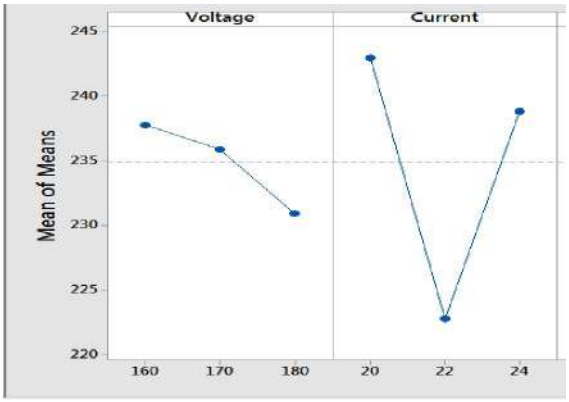

Fig-28 Optimized graphs in minitab

By the above fig it is clear that the minimum points where the residual stresses are at optimum level are voltage 180V, current 22Amps.

Conclusion

The above work displays the fact that residual stresses can be found with simulation of 3d models in SIMUFACT welding for analysis taking CATIA and ANSYS in geometrical simulations, the residual stress values for varying current are higher than in varying voltage condition. Stress analysis of steel butt weld joint had been studied. The stress from the comparison shoes that the stress at 180v is 235 M.pa. is the lowest value and best for durability of the specimen after welding. The stress from the varying current gives a brief that at 24A current the values of residual stresses are low compared that is 237.59 M.pa. But the optimization from taguchi method showed 180v and 22A is the best working conditions as per the graphs for less residual stress. The residual stresses exhibited values are around 245M.pa. and below that could be in design limit are acceptable above the values shows low grade welding and does not have a long run. The graphs of horizontal values shows high values at centre zero position where as for vertical the graph is simultaneous as seen.

Futurescope

Similar analysis irrespective of welding method and material can be done. Analysis before the fabrication helps to take proper working conditions. Further residual stresses can be controlled along with other parameter in further approaches.

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AERODYNAMIC DESIGN EVALUATION OF DELTA MODEL RC UNMANNED AERIAL VEHICLE

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ABSTRACT

Unmanned aerial vehicles have become a common trend in both defence, military and commercial purposes. Though UAVs overcame many drawbacks of historical aircrafts they have certain barriers such as requirement of initial pull to take off the vehicle, moving in only forward direction without any hover, steady pictorial data could not be achieved, etc., These barriers can be defeated by introducing the new concept of amphibian delta UAV that owns a unique property compared to present UAVs. Amphibian delta UAV is developed to operate on both land and water that works on the principle of bi-copter which improves the operational stability of the aircraft. This RC (radio-controlled) UAV is equipped with STOVL (short take-off and vertical landing) mechanism which allows landing on both water and land with minimum space required. The ideal payload consists of a cargo dropping mechanism which is fed at the center of gravity (CG) point of the plane. The complete process involves the selection of Eppler 625 airfoil from NACA which is proven to have better performance when equipped with delta UAVs. Calculations are made to predict the center of gravity (CG) point, flight time and weight characteristics of the aircraft. The preliminary design of the aircraft is done using NX CAD. Simulation is done using ANSYS FLUENT. It can be concluded that the aircraft is highly stable, can be controlled easily though it is complex in construction, possess high agility and the cost is optimized.

Keywords: *Amphibian delta model, unmanned aerial vehicle (UAV), National Advisory Committee for Aeronautics (NACA), Eppler 625 Airfoil, Short take-off and vertical landing (STVOL), CFD analysis.*

Introduction

Aeronautics is the art involved with study, design, manufacturing, and analysis of air-flight capable machines. To achieve the capability of designing, manufacture and to analyze an RC- UAV (Radio controlled-unmanned aerial vehicle) with STVOL mechanism, the delta configuration yields greater performance at a high angle of attack and produce lower drag than conventional aircraft [1] and Various experimental tests performed on flying wing prototype showed successful flights when compared with commercial models resulted in rigidity characteristics, underweight and to be more economic [2]. There can be some cases where full scale blended wing configuration is proposed for a long-range mission which allows us to utilize the maximum of the aerodynamic potential for designing a blended-wing-body configuration [3] with a twin-stabilizer design for effective stability [4]. Apart from that, the effects of stability margin and thrust specific fuel consumption had a significant role in optimizing the Blended Wing Body in both aerodynamic shapes and weight distribution [5]. The tiltrotor mechanism successfully yielded better results in driving the plane with less drag with minor vibrations on the model experimentally. The aerodynamic analysis was proven to result in the minimization of drag [6].

The dynamic characteristics and motion stability of the unmanned seaplane are analyzed based on a nonlinear mathematical model, results in good performances for the autonomous takeoff of the unmanned seaplane [7]. To study the porpoising motion under real conditions, complex effects are fully considered such as the hydrodynamic forces, aerodynamic forces, ground effect, and slipstream. The result shows that slipstream offers a nose-down pitching moment, which increases the aerodynamic lift significantly, and the center of hydrodynamic force moves to the front of the gravity center, leading to the continuous amplification of the unstable oscillation in porpoising [8].

The initiative on the design and building of a convertible aircraft for fault-tolerant control is that they can take-off and land vertically, by eliminating the need for a long runway. At the same time, fixed wings allow improving energy efficiency for multi-copters [9]. Comparing the preliminary design about structure, aerodynamics, power effect, flying qualities, dynamics, and statics on water over the conventional general aircraft, had greater stability in all the parameters [10] but the propulsion effects on a low stability aircraft can be dangerous and need to be considered during the design to avoid possible accidents and proven to be unstable [11]. In wind tunnel experimental study, the BWB model is used. The model has been scaled down to 71.5% from the actual size. Based on the results, the maximum lift coefficient is found to be 0.763 when the angle is at27.5° after which the model starts to stall. The least amount of drag coefficient is 0.014, measured at zero angles of attack. The optimum lift-to-drag ratio (L/D) is 15.9 at an angle of 7.8°. The scaled model has a big flat surface that surely gives incorrect data but the data obtained shall give some insights for future perspective towards the BWB model being tested[12].In the same way, the (BWB) airplane concept represents a potential breakthrough in subsonic transport efficiency which results in remarkable performance improvements of the Blended wing body over the conventional baseline, which includes a 15% reduction in takeoff weight and a 27% reduction in fuel burn per seat mile. Studies have also demonstrated that the blended wing body is readily adaptable to cruise Mach numbers as high as 0.95[13]. On Par with this, the development of a subscale flying demonstrator facility that should provide the capability to reduce risk in major advanced configurations studies in a highly cost-effective manner [14]. The UAVs offer more advantages when compared to manned vehicles, have been extensively used for military operations that include tracking, surveillance, and active engagement with weapons and airborne data acquisition. It also includes taking off and landing on short runway space, while traversing the operation region in considerable speed for mobile tracking applications [15]. This paper is an existing baseline geometry for the present work which is designed using CATIAV5 and analyzed using Computational Fluid Dynamics (CFD) packages. This model is then optimized using a conventional optimizing technique for better performances. The optimized model is then converted to a ducted fan configuration, for the VTOL characteristics. [16] This relates to improvements with regards to the control of VTOL aircraft that use two propellers or fans as the primary lifting devices in hover [17].In this case, the blended wing body cargo aircraft is disclosed which defines a cargo volume, where the outer surface of the plane section is shaped to provide an aerodynamic lifting surface. [18], According to them currently four BWB designs have been tested in the LST-1 wind tunnel at Flight Technology and Test Centre (FTTC), UiTM since 2005 to analyze their flight performance of these four BWB UAVs in terms of the airspeed flight envelope, endurance, range, and rate of climb as a function of the number of batteries to be carried for 1-hour endurance mission and 3-hour endurance mission[19]. The UAV (Unmanned Aerial Vehicle) is designed, which is used for surveillance, monitoring, reconnaissance, data relay, and data collection or to enter the area which is not safe for human i.e. flood affected or virus affected area which captures the real image as well as videos that used for surveillance purposes[20].

For the Present work, a unique airfoil design known as Eppler 625 has been chosen as the UAV should possess better laminar airflow and reduce the drag. When compared to several designs, blended wing configuration gives better aerodynamic efficiency and performance than others. This research mainly focuses on the design, structure, payload capacity, and stability of this current UAV. Many concepts that were mentioned had a positive response on this blended wing which has great scope in the future.

Various parameters such as aerodynamic shapes, weight distribution, and fuel consumption rate have been simulated on these BWB structures which gave the optimum results. The simulated results showed that the proposed controller had a good performance for the autonomous takeoff of the unmanned seaplane.

The complete flight mission profile is controlled by using a flight controller and the transmitter which allows the UAV to Hover and make the forward transition. The working of control surfaces and the methodology and materials were also mentioned. This conceptual model can be made into a large scale where payload capacity, avionics, and flight time of the UAV is increased by using better control systems.

Analysis

The main objective is to design a model with blended wing configuration which has a very high aerodynamic stability as there is no central fuselage. The tilt rotor setup at the centre of gravity of the UAV helps the plane to lift vertically occupying less space for take-off and landing. This combination of both blended body and tilt rotor setup enables the plane (UAV) to land on water without sliding.

At cruise condition, lift will be equal to the weight of the plane. So the aircraft should produce a Lift of 1745gms (17.45N) and the obtained theoretical coefficient of lift value is 0.392.

Table 1: Plane Design Specification Table

Specification	**Value**
Total surface area	0.314557m^2
AR(aspect ratio)	4.2
Wing span	171.1 cm
Root chord	58.1 cm
Mean chord	32.1 cm
Tip chord	18.5 cm
Total surface area	0.314557m^2

The modelling and design of AMPHIBIAN UAV is done using NX12.0. The CFD Solver chosen to carry out the Simulation work is ANSYS FLUENT. CFD Analysis is widely preferred to carry out the simulation works involving fluid flows. This makes use of algorithms and numerical techniques to solve various aerodynamic, marine and fluid flow problems

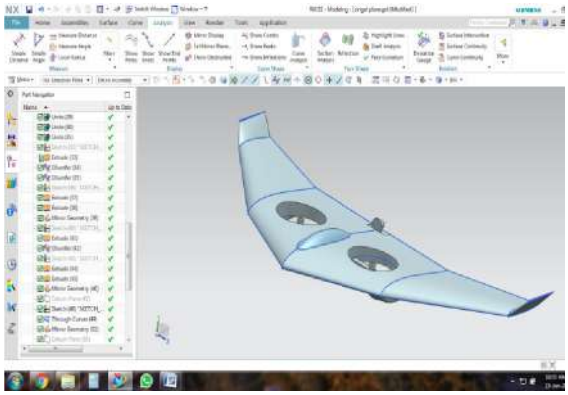

Figure 1: UAV Design

They carried out the simulation and results were noticed from the velocity magnitude distribution that, the velocity of air flowing past an aircraft wing is higher at the upper surface than at the lower surface. This would provide the necessary lift force to the wing.

Free stream Velocity of Air for horizontal mode = 5m/s-30m/s.

For vertical mode the velocity has to be far less than the horizontal mode, which ranges between 2 to 7m/s. As the vertical takeoff has to be done slowly otherwise there may be chances of plane to go out of control.

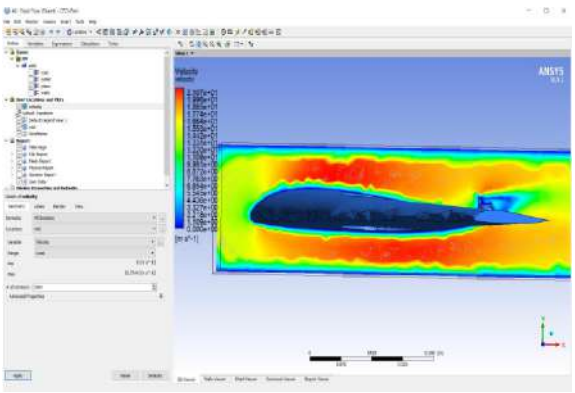

Figure 2: Velocity contour in Ansys for mid plane

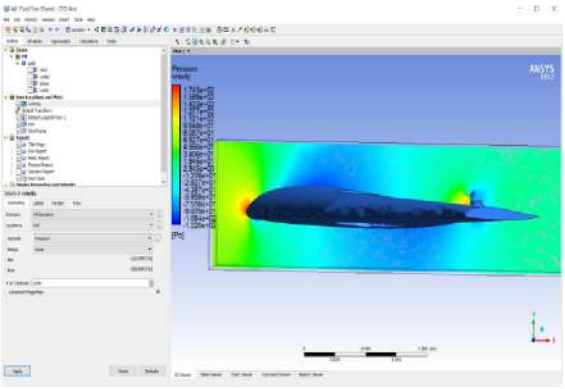

Figure 3: Pressure contour in Ansys for mid plane

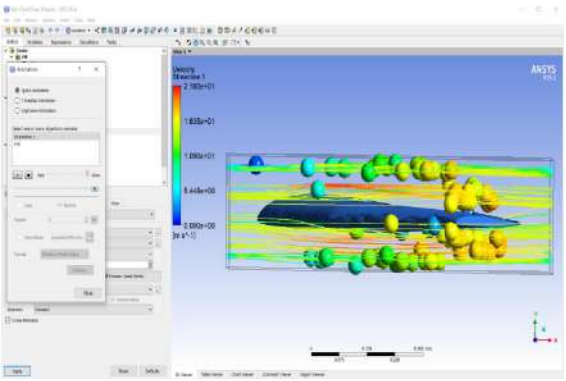

Figure 4: Stream lines flow for an aircraft in Ansys

As shown above, the analysis is carried out on the AMPHIBIAN UAV at different velocities by changing it from 1m/s-7m/s for vertical mode and 10m/s-40m/s for horizontal mode.The same procedure is repeated at different angles of attack of 5°, $10^{\circ}$and 15°. The obtained Pressure, Velocity contours are validated using aerodynamics and aircraft theory.

Results

CFD Analysis has been done to study the aerodynamic characteristics of the amphibian plane and also to know the amount of lift and drag force which is being generated by the designed model. The major forces which decide the flying capability of an aircraft are Lift and Drag forces. The performance deciding factor is the ratio of Lift to drag ratio (C_L/C_D). The Analysis is done at 4 different velocities they are 5 m/s, 10 m/s, 15 m/s, 20 m/s and at 3 various angle of attacks which are 5^0, 10^0, 15^0 on two different UAV's.

The aerodynamic theory says that the coefficient of lift increases with increase in velocity of aircraft. When the angle of attack increases the lift decreases and drag increases as the plane starts to stall in vertical direction and the air resistance increase there by increasing the drag force. This also causes instability due to which drag force dominates the lift component. The changes in Lift and Drag Coefficients with increase in velocities are shown in figures below.

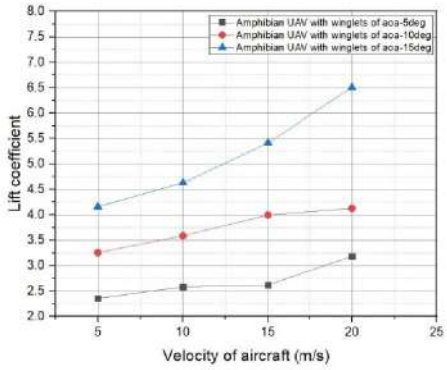

Figure 5: Lift Coefficient vs. velocity of the Amphibian UAV with winglets an floats.

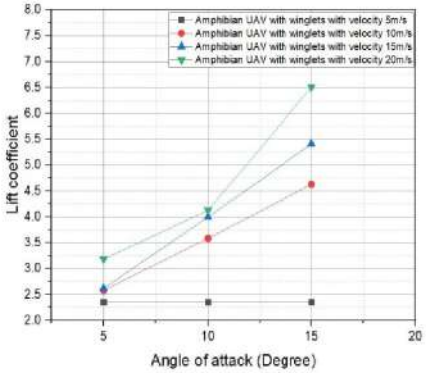

Figure 6: Lift Coefficient vs. angle of attack of the amphibian UAV with winglets an floats.

Usually the average velocity of the UAV will be around 5 to 20 m/s, so the flow analysis is made in the range of velocities. The behavior of the plane is recorded in terms of lift and drag coefficients and the values are plotted in the form of graphs shown above.

From the Figure 5 & 6, it can be observed that the lift coefficient and the drag coefficient are directly proportional to the velocity which means if the velocity increases then the lift coefficient and the drag coefficient also increases.

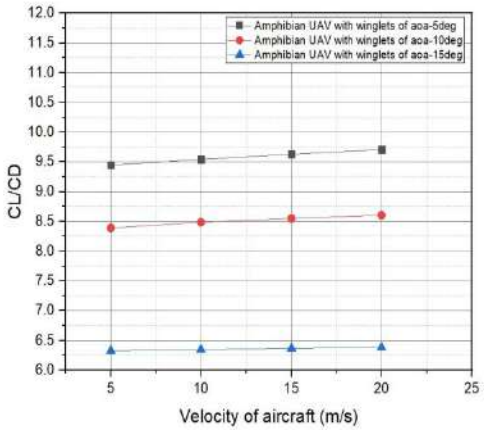

Figure 7: Ratio of Lift to drag Coefficient vs. velocity of the UAV with winglets an floats

The main factor responsible for the plane to fly smoothly is angle of attack. With gradual increase in angle of attack the drag force and the drag coefficient increases. The behavior of the plane changes with increase in angle of attack. The planes have to be maintained at a low or at optimum angle of attack at which the plane flies smoothly without any stalling effect. Such angle of attacks can be found directly from the selected airfoil itself.

The airfoil analysis gives the best angle to be maintained and the model deigned based on such airfoil has to be maintained at the same angle of attacks. From the analysis we came to know that coefficient of lift only increases till 45^0, after 45^0 the planes bottom surface will be exposed to the frontal air streams so that the drag forces will rapidly increase leading to the stalling of the plane. Heavy stalling of plane will decrease the speed of the plane, there by consuming large amounts of fuel. So the planes or UAVs fight have to be maintained at a constant or optimum angle of attack.

For this amphibian UAV any angle of attack between 5^0 and 20^0 is suitable for stable flight. But 10^0 is best according to the below graph as the C_L/C_D value is high in that case. However due to the hole in the mid-section of the plane a small amount of turbulence is created which reduces the flight performances by small amount. Analysis is done on the plane without bi-copter to know the values which the amphibian plane is lagging in.

The same analysis has been carried out on a fixed wing UAV to compare the results for best optimum design that can be used, and also to modify any irregular geometry.

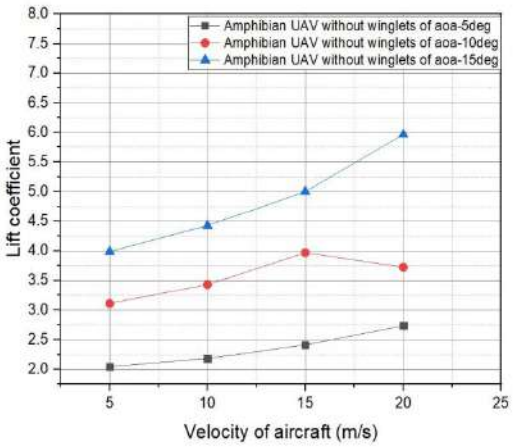

Figure 8: Lift coefficient vs. velocity of the amphibian UAV without winglets and floats

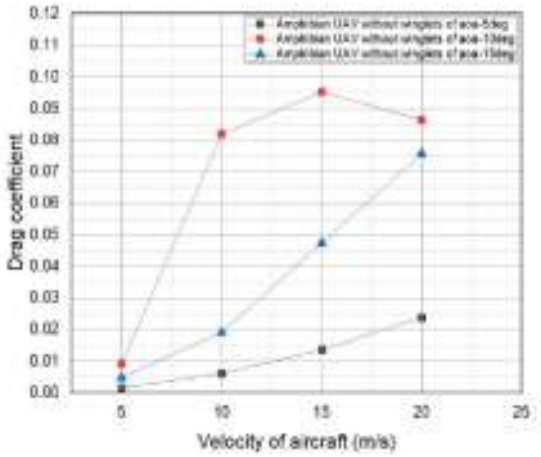

Figure 9: Drag coefficient vs. velocity of the amphibian UAV without winglets and floats

From the graphs 6.4 and 6.5 we observe that the lift coefficient and the drag coefficient are directly proportional to the velocity same as the above which means if the velocity increases then the lift coefficient also increases and the drag coefficient also increases. But when compared with the amphibian UAV the fixed wing UAV does not have any holes in the mid-section of the plane, so there are no chances of turbulence production. So, the values are slightly greater than that of the amphibian UAV.

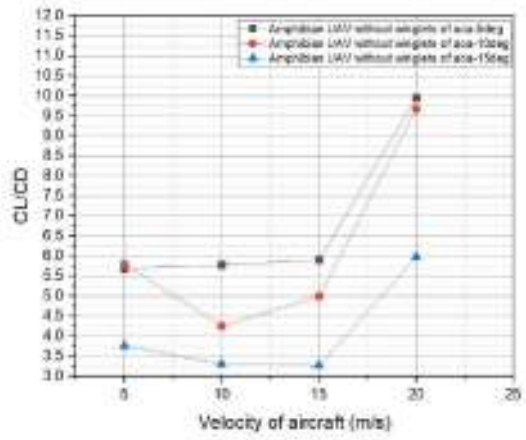

Figure 10: ratio coefficients of lift to drag of fixed wing UAV without winglets at various angles of attacks.

The aerodynamic theory also says that the coefficient of lift increases with increase in velocity of aircraft up to critical velocity beyond which its performance tends to fall due to increase in drag due to aircraft model. This causes instability due to which drag force dominates the lift component. This makes the plane to stall and fall back over. To overcome this problem the optimum suitable angle of attack has to be maintained.

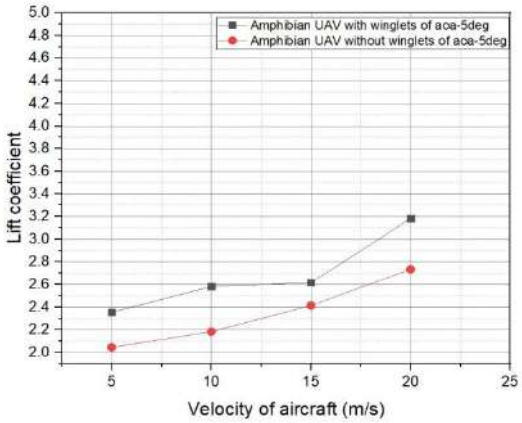

Figure 11: Comparison of lift coefficient of amphibian and fixed wing UAVs with and without winglets at 5^0 AOA

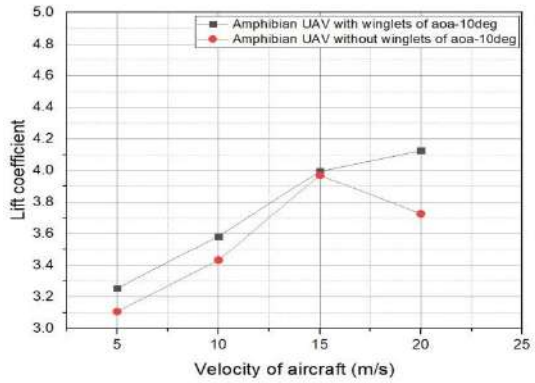

Figure 12: Comparison of lift coefficient of amphibian and fixed wing UAVs with and without winglets at 10^0 AOA.

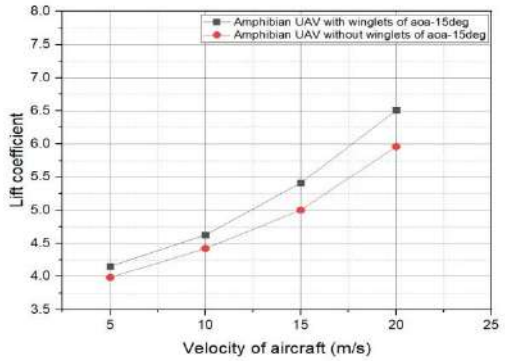

Figure 13: Comparison of lift coefficient of amphibian and fixed wing UAVs with and without winglets at 15^0 AOA

In the above figures the ratio of coefficients of lift and drag are shown, which clearly shows that the fixed wing UAV is having good flight performance but when it comes to the application purpose the amphibian UAV serves a great application as it is equipped with bi-copter which completely eliminate the initial takeoff drag.

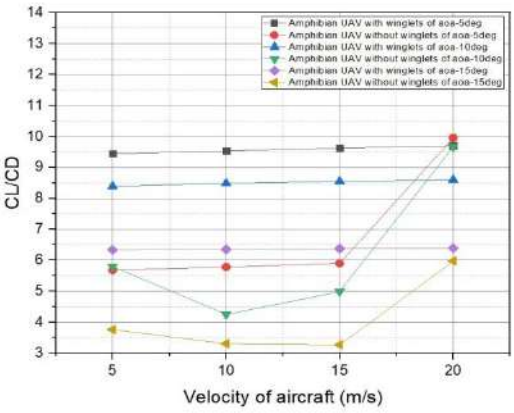

Figure 14: Comparison of ratio of coefficients of lift to drag of amphibian and fixed wing UAVs with and without winglets at various velocities.

From the figures, it is very clear that the angle of attack of 15^0 to 20^0 is best for the UAV for climbing and angle of attack of 5^0 to 10^0 is best suitable for cruise flight, as we can see the variation in C_L/C_D value among the 3 compared angle of attacks. We also know that according to aerodynamic theory, along with increase in lift coefficient there will be proportionate increase in drag also. So, in order to determine the performance of the aircraft a ratio term is introduced which is the ratio of Lift to drag coefficient (C_L/C_D). The Aerodynamic performance of any aircraft or airfoil is said to be good when the C_L/C_D ratio value of the aircraft is higher in comparison with a test case.

All the figures showed L/D ratios at different velocities and angle of attacks in which we know that, the higher the value of L/D of an aircraft, the better the aerodynamic efficiency of the aircraft. By this, it can be concluded that the suitable velocity for the present aircraft is about (5m/s-15m/s) with angle of attack of 15^0 to 20^0 is best for the UAV for climbing altitude and angle of attack of 5^0 to 10^0 is best suitable for cruise flight. These characteristics are high for the blended wing when compared with the other conventional wing types. But the same performance characteristics are high for fixed wing UAV compared with amphibian UAV. This blended wing is a laminar flow technology where the cruise flight performance is increased when compared with other type of UAV'S although a minimum turbulence occurred at the ducts of the wing, which has some effect on the flight performances but can also be reduced by introducing new technologies such as hole closing mechanism. The increase in stability at the rotation axis is carried out by giving 21° swept angle to the wings. This type of STOVL UAV's can carry out take-off and landing operations on water surfaces even at hazardous environments which is unsuitable for standard take –off, landing for conventional UAV's. It can also perform target reaching operation in remote areas like lake and rivers in a short time. The pressure and velocity contours show that the plane is less affected by the stresses during flight, and the velocity contours and stream lines flow show the behavior of air particles on the plane body.

Hence, from the above calculations and analysis we can say that aerodynamic efficiency (for example lift\drag ratio), climb rate (where excess thrust which generally increases the lift to overcome the forces such as weight and drag), cruise flight performance (When the UAV reached certain altitude) and stability (due to huge surface area) of the UAV is slightly behind the fixed wing UAV, but the amphibian UAV has a special application oriented design which has low power consumption when compared with other type of UAV'S. Hence it is proved that the AMPHIBIAN UAV is possessing better stability characteristics as conventional flying UAVs and processes properties of a flying boats and the design is expected to be suitable for multi-functional sea based operations by allowing it to operate at specific velocities at different angles of attack compare to fixed wing UAV. According to the analysis the model is fabricated accordingly with small deviations in dimensions as the model is hand crafted. The Aircraft gives a good flight time due to its light weight structure and large wingspan.

Conclusion

It is very important to note that the amphibian aircrafts have a special ability to land on water and land surfaces, this unique ability has made them useful for certain applications where other conventional planes and boats can't.

1. As the amphibian aircrafts are designed with delta and blended wing configuration that provides the planes with high stability and great manoeuvrability.
2. From the analysis we came know that the optimum angle of attack of the UAV is 15^0 to 20^0 during normal takeoff, 5^0 to 10^0 during cruise flight and the velocities of the UAV can be maintained anywhere between 10 to 30m/s.
3. The tilt rotor setup (dual copter) helps the plane to move in vertical direction occupying few places for take-off and landing which is known as STOVL (Short Take-off and Vertical Landing) mechanism.
4. Due to its design and structure it can easily slide on the water and also due to its large surface area it can be very much stable on the water currents.
5. This amphibian planes will have a bird's eye perception which will help them to cover a longer distance from a single view point where as boats have a straight line of sight which can't cover longer distance making them difficult to identify things on the plane sea surfaces.
6. This amphibian planes help us for sea and ocean surveillance.

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ARBUSCULAR MYCORRHIZAL FUNGI ASSOCIATION IN SOME ORNAMENTAL PLANTS OF PARUL UNIVERSITY CAMPUS,WAGHODIA, VADODARA.

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ABSTRACT

From different locations of Parul University, Waghodia, Vadodara, Gujarat Rhizosperic soil samples were collected. 12 ornamental plants were colonized with Arbuscular Mycorrhiza (AM) Fungi and were studied for root colonization. Between percent root colonization and spore number no correlation was found. In all the ornamental plants the diversity of AM Fungal spores were determined. Glomus spp were found predominant followed by Acaulospora, Scutellospora and Gigaspora by isolating and identifying four AMF spores up to genus level. The roots of Mycorrhiza plants with intense hyphal connection suggests the interconnecting fungal network in the Rhizosphere and appears to be the most effective method for nutrient transfer in an ecosystem. AM Fungi root colonization ranged from 12% to 99.4 % with higher value for Crinum asiaticum. Importance of AM Fungi with ornamental plants of Parul University campus garden has been discussed.

Keywords: *Ornamental plants, Arbuscular Mycorrhiza Fungi (AMF), Parul University campus garden, root colonization.*

Introduction

Innumerable microorganisms have found soil as their natural home. Participation of Soil fungi and bacteria is important for the process of agriculture which includes mineralization, pesticide decomposition, disease production, nitrogen fixation, and promotion of growth promoters, soil system process, antibiotic production, soil formation and other biological processes. In various habitats, including soil and rhizosphere, fungi are abundantly found. The portion of the soil which is specialized in ecological niche is Rhizosphere and it is under the influence of the plant roots which includes the root surface and adhering soil. The microbes are stimulated by the root exudates, sloughed off cells and decaying roots. Rhizospheres oils have abundant Mycorrhizal fungi. Since 1880's, Mycorrhizal association or fungus root is known (Frank, 1885).In most of the plants, the common Mycorrhizal association is Arbuscular type occurring in the majority of agricultural and horticultural crops. Plant roots transformation by these symbiotic fungi into unique morphological entities are called Mycorrhizae and these Endomycorrhizae produced by the non-septate fungi are generally known as "Arbuscular Mycorrhizal'' (AM).Nature's most ubiquitous constitute is AM Fungi and it occurs in varied soil. It is spread widely, interesting and is persistent example of parasitism.Non-septate Zygomycetous fungi forms the AM belonging to the genera Gigaspora, Glomus, Sclerocystis, Acaulospora, Enterophosphora, Scutellospora, Archaeospora and Paraglomus in the Glomales order. The obligate symbionts are the fungi and are not cultured on nutrient media. These endophytes are not host specific.90% of terrestrial plant roots forms a symbiotic association with these fungi and are commonly associated with pulses, cereals, fiber crops, ornamental and horticultural plants, aromatic and medicinal plants, weeds, trees, rhizoids and roots of Bryophytes, Pteridophytes, etc. In a root, energy moves primarily from plant to fungus and inorganic resources move from fungus to plant (Smith and Read, 1997) where there is a mutualistic symbiosis between plant and fungus, especially in AM Fungi. Many tropical plants including vegetables are colonized by AM Fungi.The growth of various crops including horticultural plants like Tomato and Carrot (Sasal 1991) is due to Arbuscular Mycorrhiza association. Many workers investigated improved plant growth mechanism due to Mycorrhizal inoculation. Increasing phosphate uptake by Mycorrhizal roots through greater soil exploration is well established. It also improved the uptake of limited elements like Zinc, Copper etc. Biological control of root pathogens,

hormone production, biological nitrogen fixation and better ability to withstand water stress (Bagyaraj 1984) are the other beneficial effects. In this study ornamental plants grown in different locations of Parul University campus have been surveyed for AM Fungal association. Present investigation attempts were made to study AMF colonization in 12 ornamental plants belonging to 12 different families growing in Parul University, Vadodara. There are reports on the natural colonization and importance of AM with most of the ornamental, agricultural, medicinal, horticultural and floricultural plants. The information pertaining to the occurrence of AM Fungi with ornamental plants of Parul University garden is very meagre.

Materials and Methods

The roots and Rhizospheric samples have been collected from 12 ornamental plants grown in the Parul University garden. AM Fungal propagules of the soil samples were isolated by wet-sieving and decanting method (Gerdemann and Nicolson, 1963) and identified up to genus level following Morton(1988), Schenk and Perez (1990), Morton and Redecker (2001).Plants were screened in Rabi season during the month of March and April 2021.For each species five plants were sampled. Plant roots were brought to the laboratory by digging out, which were then washed in tap water,free of soil and cut into the segments of 1cm length. Cleaning and staining of the roots were done with 0.05 percent Tryphan blue in Lactophenol as per the technique of Phillips and Hayman (1970). Root colonization of AM was observed under microscope (fig 1). Root slide technique (Read et al., 1976) was used to estimate the percentage of AM infection. The following formula was used to determine the Mycorrhizal colonization.

$$\text{Percent colonization} = \frac{\text{Total number of root segments colonized}}{\text{Total number of root segments examined}} \times 100$$

Fifty grams of Rhizospheric soil samples of individual plants within the species were mixed with one part which is used for AM Fungal sporee numeration. Wet sieving and decanting method (Gerdemann and Nicolson, 1963) was used to recover the AM Fungal spores. AM-Fungal spores (Fig.1) were mounted in polyvinyl alcohol Lacto phenol and identified using Schenk and Perez's manual (1990).

Results and Discussion The list of twelve ornamental plants associated with AM Fungi in Parul University garden showing percentage of root colonization(fig.1), spore number and AM fungal genera are represented in Table 1, Fig 2.The soil investigated in this study is sandy loamy soil and they formed good habitats for AM Fungal colonization. Four genus of AM Fungi were isolated, identified and were found associated with12 ornamental plants soil samples belongs to 12 different families(Table 1, Fig 2) were collected from different localities of Parul university garden. This shows that all the 12 ornamental plants are found to be colonized by AMF. In the present work, the association of VAM in ornamental plants, the percent of colonization and number of spores showed no correlation (Fig 2). Lower percentage of colonization was recorded among members of Amaranthaceae that is in little Ruby (Alternanthera *dentata*- 12%). Moderately colonized plants possess 65%-67% among members of Portulacaceae(*Portulaca grandiflora*) and Asparagaceae (*Chlorophytum comosum*). However,highest colonization was recorded among members of Amaryllidaceae (*Crinum asiaticum*- 99.4 %) (Table 1, Fig 2).The colonization found in roots of different plants are of Hypha and vesicular type. In all the tested plants Hyphae were found common.

Physiologically and morphologically all the fungi are not the same. These Fungi are not specific in their effect on host species in spite of having wide host range. On cultivars, their effect can vary within a single plant species and also on plants in different eco system, similar soils and soil type's change in their physico-chemical constituents. In soil, Arbuscular Mycorrhizal fungal spores are physiologically inactive. The spores germinate, grows and multiply in the presence of actively growing plant roots (Tommerup and Briggs, 1988).

Similarly, more number of spores (92/50gms of soil) was recorded in rhizosphere soil of *petunia*

atkinsiana. Glomus species predominated in the Rhizosphere soil supporting ornamental plants followed by Acaulospora, Scutellospora and Gigaspora were considered to be the least spore genera among the isolated spore genera (Table 1).AMF genera with high number is associated with *ixora coccinea*while AM Fungal genera with low number is recorded in other remaining plant species.

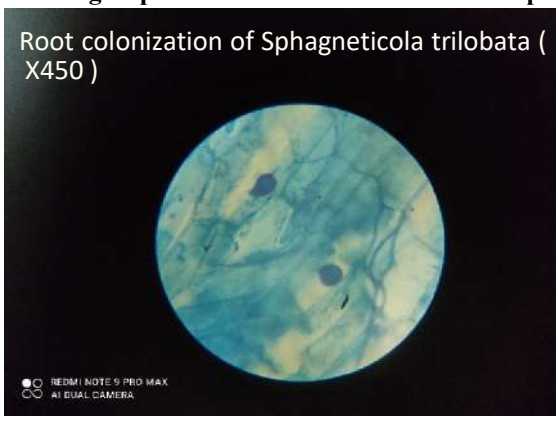
Increased growth of seedlings of plantation crops like Cashew was observed when inoculated with AM Fungi (Lakshmipathy et al., 2000). It's observed that in AM inoculated plants there is increased number of flowers and cut flowers' vaselife of Chrysanthemum and China Asters (Bagyaraj and Mallesh 2000).More rootings in Tamarindus and Cashew plants propagated through air layering was reported (Bagyaraj and Mallesh 2000).AM inoculated Avocado and Cashew plants withstood transplant shock better than uninoculated stock (Menge et al 1980, Laksmipathy et al 2004).The result obtained from the investigation for the present study suggests that the number of AM fungal spores and colonization percentage vary with different ornamental plants. Glomus spp genera is frequently found more than other four genera. More number of Mycorrhizal spores in rhizospheric soil and AM fungal infection is found in the roots of *Petunia atkinsiana* and *Crinum asiaticum*, shows that under natural conditions these plant species are considered as a good host for AMF. Hence it can be concluded that distribution or occurrence of Arbuscular Mycorrhizal Fungi differ with host ranges. However population, size, shape of spores and percentage of root colonization differs from plant to plant.Thisstudy provides an AM fungi association with ornamental plants and it is an indication of Mycorrhizal dependency of these plants.

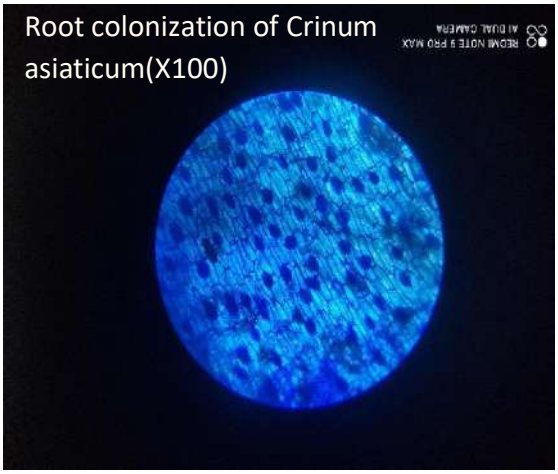
Table1. list of ornamental plants associated with am fungi in parul university garden showing percentage of root colonization,spore number and am fungal genera.

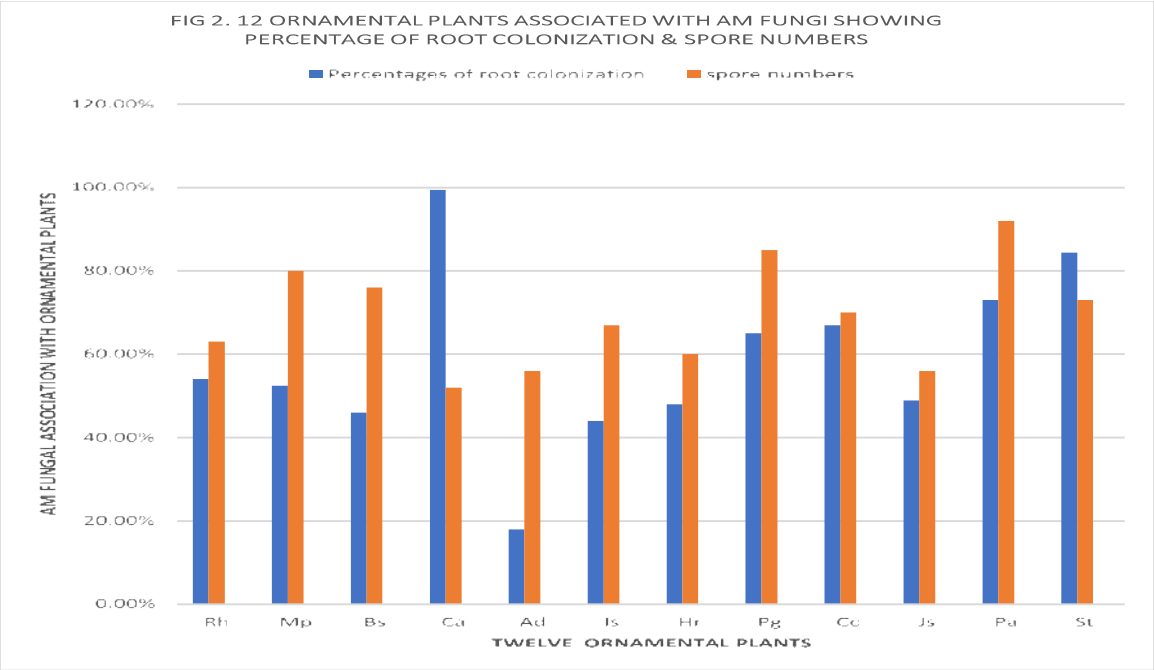
Sl no	Name of the plants	Common name	Family	Percentage of root colonization (%)	Spore number/50gm of soil	AM fungal genera.
1	Rosa hybrid L	Tea rose	Rosacea	54.1 %	63	Gl, Ac spp
2	Madagascar periwinkle (L.)Rchb.ex Spach	Vinca	Apocynaceae	52.4 %	80	Gl, Sc spp
3	Bougainvillea spectabilis Wild	Paper flower	Nyctaginaceae	46 %	76	Gl, Ac spp
4	Crinum asiaticumL.	Poison bulb	Amaryllidaceae	99.4 %	52	Gl, Gi spp
5	Alternanthera dentate (Moench) Stuchlikex R. E. Fr.	Little ruby	Amaranthaceae	12 %	56	Gl, Ac spp
6	Ixora coccineaL.	Westindian jasmine	Rubiaceae	44 %	67	Gl,Ac,Sc spp
7	Hibiscus rosa-sinensis L.	Chinese hibiscus	Malvaceae	45.8 %	60	Gl,Sc spp
8	Portulaca grandifloraHook.	China rose	Portulacaceae	65 %	85	Gl, Ac spp
9	Chlorophytum comosum(Thunb.) Jacques.	Spider plant	Asparagaceae	67%	70	Gl, Sc spp
10	Jasminum sambac(L.) Aiton	Mogra	Oleaceae	48.9 %	56	Gl, Gi spp
11	Petunia atkinsiana (Sweet) D.Don ex W.H. Baxter	Garden petunia	Solanaceae	75 %	92	Gl, Ac spp
12	Sphagneticola trilobata(L.)Pruski	Trailing daisy	Asteraceae	84.4 %	73	Gl, SC spp

- Names of four AM fungal genera - Gl- Glomus spp, Ac- Acaulospora, Sc- Scutellospora and Gi- Gigaspora spp.

Fig 1. The Root colonization and Some AM fungal spores associated with ornamental plants.







Key:

Rh - *Rosa hybrid*
Mp - Madagascar periwinkle
Bs - Bougainvillea spectabilis
Ca - Crinum asiaticum
Ad - Alternanthera dentate
Ic - Ixora coccinea
Hr - Hibiscus rosasinensis
Pg - Portulaca grandiflora
Cc - Chlorophytum comosum
Js - Jasminum sambac
Pa - Petunia atkinsiana
St - Sphagneticola trilobata

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PRIVACY PROTECTION AND INTRUSION DETECTION BY USING RPL IN THE INTERNET OF THINGS

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ABSTRACT

The Internet has progressed rapidly in the past couple of many years introducing limitless applications in various fields including industry, transport, tutoring, entertainment, etcDuring these years, various devices, organizations, and shows were made and the Internet created is still significant. The best in class age of this general association is the IoT, where a huge number of 'Things' is needed to be significant for the Internet introducing new opportunities and troubles. Data uplink and downlink guarantee to perceiving the information by using RPMA (Random Phase Multiple Access). It incorporates the hyper-accessibility correspondence to the common by using the LTE 5G (Long Term Evolution in 5G) territory used to assemble the usefulness and execution appeared differently concerning existing. It helps with growing the security without block to MUX/DEMUX has acknowledged in the LP (Low Power) in frameworks organization and the cautious field added to the correspondence of the hyper-network with the help of IoT in the RPL structure. By detecting the intrusion in DT (Decision Trees), KNN (K-Means Nearest Neighborhood), and EMANN (Ensemble Methods of Artificial Neural Networks). These are all the three methods involve to detect the intrusion and increase the efficiency by using LTE-5 in the IoT processing. It helps to reduce the RPL (Routing Protocol with Low-Power) to enhance the detection and prediction processing so well in the IPV6. By using the EMANN to increase the predictive performance on the constituent methods.

Keywords:*LTE 5G (Long Term Evolution in 5G), RPMA (Random Phase Multiple Access), DT (Decision Trees), KNN (K-Means Nearest Neighborhood), EMANN (Ensemble Methods of Artificial Neural Networks).*

Introduction

the importance of RPL asthe standard routing protocol of IoT and provide for the firsttime, a systematic review of RPL and RPL-based protocolswithin the context of IoT along with technical insights andrecommendations for these implementations. The approach ofthis review uses Google scholar to search for (”allintitle: rpl-pregnancy”) in the title of a paper while removing unwantedsimilar abbreviation for example (”RPL” as recurrent pregnancy loss). This search comes up with more than 700 papersand patents, to make sure nothing is missed, another widersearch is conducted using the phrase (IoT ”RPL” routing)to search anywhere in the article and use the years filter tocategorize results according to the publication year and scrollthrough them to find possible candidates. This search returnsmore than 2900 results including papers and patents, duplicatearticles are removed and then several papers are selectedfor each year where improvements were made to RPL in anyaspect. Papers that mentions RPL but do not discuss its usageor do not propose an enhancement are also removed from this review. The main contributions of this paper are

(i) Providingan extensive and systematic review of RPL.
(ii) Discussing theefficiency of each approach in terms of applicability, energyconsumption, flexibility, throughput, and end-to-end delay.
(iii) Providing a technical guide to assess the RPL enhancementsavailable in the literature.

Internet of Things presented by Kevin Aston is one of the advances that has changed multiplied pretty much every space of human existence. Internet of Things is another model which gives a bunch of new administrations to the general public that assists with diminishing the time and cost of gathering precise information about the actual climate, which thus could be dissected to infer valuable data. Since IoT is as yet in its beginning stage, there is no standard design to be utilized while building an IoT application. Contingent upon the application, the models that might be utilized are grouped into three-layer, four-layer, five-layer, and seven-layer engineering. The three-layer design comprises an application layer, network layer, and insight layer. The four-layer design comprises an

application layer, network layer, information preparing or supporting layer, and insight layer. The business layer, application layer, handling layer, transport layer, and insight layer are the layers present in the five-layer engineering. In the three-layer design, the application layer investigates information got from the detecting layer. Exemplification and directing are the elements of the organization layer. Sensors associated with the actual climate gather the information and send them for further preparation. This information is prepared by the conventions comparing to each layer.

These conventions utilize various methodologies and sets of decisions that must be followed to set up the correspondence between the gadgets. The standards characterize how to construct the correspondence, move information over the organization, and how to get the information. The primary focal point of this paper is on the network layer. In the network layer, directing and embodiment are the two fundamental cycles that happen. The information to be moved is isolated and pressed into various parcels, and this cycle is known as the epitome. Directing is the way toward discovering appropriate ways to move the bundle from the gadget toward one side to the gadget at another end. Steering Protocol for Low force and lossy organization (RPL) is a well-known directing convention planned and normalized by IETF to help to steer in an IoT climate. It is a distance-vector steering convention dependent on the development of RPL charts. RPL diagrams are Directed Acyclic Graphs. Steering happens vertical way (end hub to root hub). In RPL, the steering starts after the development of the Destination Oriented Directed Acyclic Graph (DODAG). DODAG depends on position esteem. Rank worth is utilized to distinguish the situation of the hub. The rank worth of hubs expansion the descending way and reduction vertical way. Rank worth is determined utilizing the OF (Objective capacity). RPL utilizes three kinds of target capacities, specifically, HOP, ETX, and ENERGY. Each DODAG is shaped with a goal work. The default target capacity of the DODAG is HOP. Each DODAG is built by utilizing solitary item work. The target work is utilized to develop the DODAG, and it is distinguished by the target code point.

Henceforth the RPL is utilized to foresee the handling as security-based. The DMS will assist with devouring the mistake resistance through the correspondence between the organization layers which implies a shared framework. For the most part, the KNN has given the reality of the result. It is perceived to the presentation higher with getting to the low force. 5G is used to convey anyplace without the prevention of the organization's hindrance. Also, it gives steadiness of security and protection in the given handling. EMANN is utilized to anticipate the weaknesses and afterward move towards security steadiness. It gets to the numerous methods lastly, it perceived the better answer for the execution of RPL Security issues. Alongside ANN and IoT give the best answer for keep away from the obstructions and assemble solid protection and better in Low force utilization.

Related Works

Iova et al (2015) has proclaimed that the Web of Things is the new space of frameworks organization and canny correspondence. Progressing investigates treat a couple of issues and troubles of IoT. QoS coordinating shows for IoT has been a rising assessment topic for a seriously long time. To present another system called E-RPL; Itis an improvement of the Routing Protocol for Low power and lossy associations (RPL). Standing out from RPL, E-RPL decreases the number of control messages. The new show proposes moreover another versatile multi-constrained objective work (OF) that can arrange a couple of estimations including energy, deferral, and information transmission to describe the beginning to end way between the sink and a given center [1].

Koutsiamanis et al (2019) have uncovered that the Routing Protocol for Low Power and Lossy Networks (RPL) transformed into the standard for controlling in the Internet of Things (IoT) associations, various researchers had investigated the security parts of this show. Regardless, no work (evidently) has investigated the use of the security components associated with RPL's standard, chiefly because there was no execution for these

features in any IoT working systems yet [2]. A fragmentary execution of RPL's security segments was presented actually for the Contiki working system (by Perazzo et al.), which outfitted us with an opportunity to dissect RPL's security instruments.

Mayzaud et al (2017) have point by point that the two or three years, the Internet of Things (IoT) has wound up being a captivating and promising perspective that way to add to boundless applications by partner more physical "things" to the Internet. Even though it emerged as a critical enabling specialist for some state-of-the-art applications, it similarly familiar new troubles with adequately doused associations. The IoT is as of now awakening especially in clinical consideration and sharp environment applications adding a huge number of low-energized sensors and actuators to additionally foster a lifestyle and familiarize new organizations with the neighborhood. The Internet Engineering Task Force (IETF) made RPL the controlling show for low power and lossy associations (LLNs) and standardized it in RFC6550 in 2012 [3].

Yang et al (2018) have proclaimed that the Content sharing associations, like YouTube, contain traces of both express online interchanges (like inclinations, comments, or enrollments), similarly as inactive associations, (for instance, referring to, or remixing, bits of a video). It has been proposed visual pictures, or as frequently as conceivable re-posted short video sections, for recognizing and checking such latent video coordinated efforts at scale. Visual pictures are removed by flexible revelation estimations that make, with high exactness. The further extend visual pictures with text, through a quantifiable model of inactive subjects. The model substance corresponds on YouTube with visual pictures, portraying a couple of extents of effect and building perceptive models for picture universality. Investigations are finished with multiple million video shots from more than 40,000 accounts on two perceptible news events in 2009: the political race in Iran and the pig flu pandemic [4].

Bruzgiene et al (2017) have revealed that with the extensive use of IoT applications and the growing example in the amount of related sharp devices, controlling has gotten especially testing. In such a way, the IPv6 Routing Protocol for Low-power and Lossy Networks (PRL) was standardized to be embraced in IoT associations. Taking everything into account, while compact IoT spaces have obtained immense unmistakable quality lately since RPL was planned for fixed IoT applications, it couldn't well change with the remarkable fluctuations in flexible applications. While there have been different assessments on tuning RPL for convenient IoT applications, and simultaneously, there is an interest for extra undertakings to show up at a standard variation of this show for such applications. As necessities are, in this investigation, to endeavor to lead a careful and broad preliminary to focus on the impact of various adaptability models on the introduction of a convertibility careful RPL to help this association. In such a way, an aggregate and explored investigation of the movability models has been acquainted with having the alternative to sensibly legitimize and take a gander at the outcome results [5].

Khallef et al (2017) have point by point that the importance of flexibility which en fit for inventive convenient applications and requires a viable controlling show that should meet the necessities of the fundamental applications like steady, trustworthiness, and high availability. In this paper, an incredibly vivacious and Fault-Resilient Routing Protocol with Qos and Mobile-RPL in the IoT, called QFMMRPL has been proposed. The failure center tends case to influence the association's execution. Besides, QoS need to give an authentic test for the networks partition of centers. Therefore, the flexibility and QoS upgraded organization for the transformation to non-basic disappointment address another open testing issue for the compact applications in IoT [6].

Karthik Kumar et al (2014) has proclaimed that the possibility of the Internet of Things (IoT) is growing effect in social applications, for instance, tainting checking helped course and vital perception. Tainting noticing expects a critical part of drinking water in light of the clarification that water is being dirtied for a grouping of reasons. The improvement of quantifiable methods subject to spatial and transient hydrological data fills in as the huge aide in quality checking of the surface water

[7]. The proposed structure executes the strategy for molding packs in sensor social occasions. The gatherings are taken apart using models subject to hydrological space-time series of variables and help to recognize the nature of drinking water.

Kim et al (2017) have revealed that the IPv6 Routing Protocol for Low Power and Lossy Networks (RPL) was recognized as the standard guiding show for Internet of Things (IoT) by IETF in March 2012. Starting now and into the foreseeable future, it has been used in different IoT applications. Anyway RPL altogether oversees IoT network necessities, there are still some open issues to settle since it was not from the outset planned for IoT applications. To addresses the issue of package incidents and impact utilization in an RPL-based association under the weighty and especially incredible weight. To address this issue in three phases: First, it has present a Context-Aware Objective Function (CAOF), which enlists the position, pondering the setting of the center point. CAOF in like manner swears off Thundering Herd Phenomenon by ceaselessly moving from elevated place regard toward the certifiable position regard [8].

Sanmartin et al (2018) have point by point that the Directing Protocol for Low-Power and Lossy Networks (RPL) is an IPv6 controlling show that is standardized for the Internet of Things (IoT) by the Internet-Engineering Task Force (IETF). RPL structures tree-like geology which relies upon different smoothing out measures called Objective Function (OF). Generally speaking, IoT needs to oversee low-power devices and lossy associations. Subsequently, the critical objectives of the RPL are limited power source, network lifetime, and constancy of the association. OFs depend upon different estimations like Expected Transmission Count (ETX), Energy, Received Signal Strength Indicator (RSSI) for course upgrade. In this work, the ETX and Energy-based OF have been evaluated similarly to energy adequacy and unfaltering quality [9].

Diro et al (2020) has announced that With the colossal extent old enough and exchange of data between IoT devices and obliged IoT security to guarantee data correspondence, it ends up being straightforward for aggressors to mull over courses. In IoT associations, IPv6 Routing Protocol is the acknowledged guiding show for Low Power and Lossy Networks (RPL). RPL offers limited assurance from a couple of RPL-express and WSN-gained attacks in IoT applications. Moreover, IoT devices are limited in memory, planning, and capacity to work fittingly using the standard Internet and guiding security courses of action. A couple of control plans for the security of IoT associations and guiding have been proposed including Machine Learning-based, IDS-based, and Trust-based techniques. In existing trust-based procedures, the flexibility of centers isn't considered in any way, or it's insufficient for compact sink center points, unequivocally for assurance from RPL attacks [10].

Falomir et al (2019) have revealed that with the broad usage of IoT applications and the growing example in the amount of related splendid devices, coordinating has gotten especially testing. In such a way, the IPv6 Routing Protocol for Low-power and LossyNetworks (PRL) was standardized to be gotten in IoT associations. Coincidentally, while convenient IoT regions have gained immense distinction lately since RPL was expected for fixed IoT applications, it couldn't well change with the incredible fluctuations in adaptable applications. While there have been different examinations on tuning RPL for flexible IoT applications, yet there is a prevalence for extra undertakings to show up at a standard transformation of this show for such applications. As requirements are, in this outline, toendeavor to lead a careful and comprehensive preliminary to focus on the impact of various flexibility models on the introduction of a convertibility careful RPL to help this communication [11].

Tajima et al (2016) call attention to that the current novel waveguide packaging for sub-millimeter and terahertz-wave contraptions is sensible for colossal chip-width MMICs and needn't bother with any additional creation measure [12]. With full electromagnetic reenactment, and look at possible wave modes in a rectangular waveguide with slight E-plane cuts formed for embeddings gigantic width MMICs into the split waveguide square and

show that parasitic modes can be throughout covered by lossy and high-dielectric material. For a 1.1-mm-wide test IC in the 260–320 GHz band, the assessed change incident is around 1 dB with more than 60 dB between port disengagement.

Paek et al (2017) have proclaimed that the RPL, an IPv6 guiding show for Low power Lossy Networks (LLNs), is the acknowledged coordinating standard for the Internet of Things (IoT). In any case, progressively more test outcomes show that RPL performs insufficiently in throughput and flexibility to mastermind components [13]. This essentially limits the use of RPL in various useful IoT circumstances, for instance, LLN with fast sensor data streams and versatile distinguishing devices. To determine this issue, make, BRPL, an expansion of RPL, by accepting the principles of backpressure-based progression to the standard RPL exercises. BRPL gives a conventional philosophy that grants customers to shrewdly merge any RPL Object Function (OF) with backpressure coordinating. BRPL uses two novel estimations, QuickTheta and QuickBeta, to help dynamic data traffic weight and center point versatility independently.

Quang et al (2014) have revealed that the RPL, an IPv6 coordinating show for Low power Lossy Networks (LLNs), is the genuine directing norm for the Internet of Things (IoT). In any case, progressively more test outcomes display that RPL performs ineffectually in throughput and adaptability to mastermind components. This essentially limits the use of RPL in various conventional IoT circumstances, for instance, LLN with fast sensor data streams and versatile distinguishing devices [15]. To determine this issue, make, BRPL, a development of RPL, by getting the principles of backpressure-based smoothing out to the standard RPL exercises. BRPL gives a judicious strategy that grants customers to keenly join any RPL Object Function (OF) with backpressure directing. BRPL uses two novel computations, QuickTheta and QuickBeta, to help dynamic data traffic weight and center point flexibility independently. To execute BRPL on the Contiki working system and foster expansive appraisal using both genuine examinations reliant upon the FIT IoT-LAB testbed and gigantic degree propagations using Cooja over 18 virtual laborers on the Cloud [14].

Methodology

As of late, Wireless Power Transfer (WPT) offers a promising answer for working with proficient and reasonable correspondence networks serving energy-restricted specialized gadgets. The current WPT advancements can be sorted as inductive coupling, attractive resounding coupling, and RF-based WPT. RF-based energy-collecting innovation empowers the chance of synchronous remote data and force move, Wireless Power correspondence (WPC), and Wireless Power backscatter correspondence (WPBC).

The SWIPT system catches RF radiation from the climate and supports the collecting of energy and unravels data from a similar RF signal got in equal using an energy and data division instrument. In the writing, two reasonable methodologies are proposed, specifically "time exchanging" (TS) and "force parting" (PS). In TS, two unique periods are utilized to change from unraveling data to energy-collecting while in PS the RF signal is separated into two sections with various forces, one for data deciphering and the other one for EH.

The first is less complex to execute than PS which, nonetheless, gives better energy proficiency. As far as we could know, energy-collecting instruments dependent on SWIPT have not been created as of recently for RPL. In this way, the paper proposes an ideal OF for the steering tree development to save the lifetime of the whole organization. In the organization, a set number of hubs with adequate ability to re-energize the neighbor hubs (kid) at the greatest degree of battery are available, and afterward, by utilizing SWIPT, one moderate hub (parent) can re-energize its battery with a small amount of RF signal force got from its kid hub. As a result, the best course determination is impacted by the decision of middle hubs sending information messages to the root hub. For instance, if a halfway hub has minimal lingering energy (RE), a traditional energy-based directing article capacity could determine an imperative to such an extent that anyway with this hub and different hubs with RE under a specific edge ought to stay away from. By expecting that a

halfway hub can be re-energized with the force moved by a youngster hub, the course choice can rather incorporate this hub to re-energize it for permitting a compelling equilibrium of the worldwide energy in the organization.

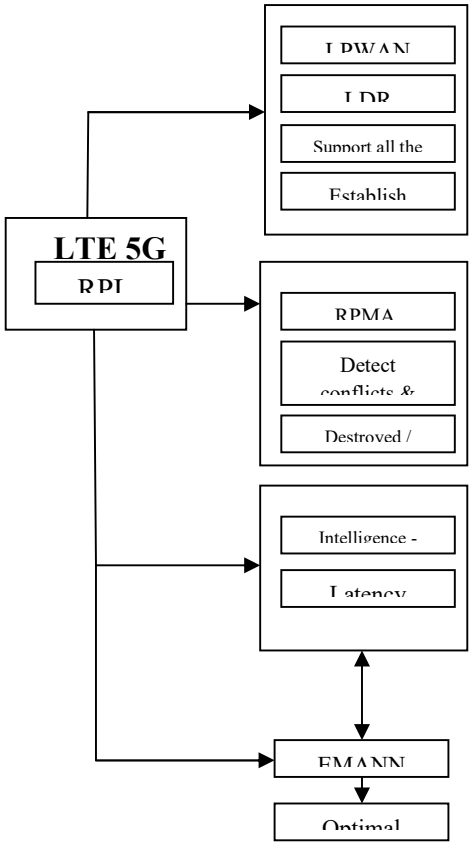

Fig: EMANN Framework

LPWAN is utilized to set up the organization association between the distributed framework. LPWAN access by the RPL partner with the LTE – 5G. TCP/IP has been giving the most grounded correspondence either moving or support a delay in the security issues. LTE-5G was given a high recurrence however RPL perceiving the low force move bypassing the association and execution. Then, at that point, RPMA is utilized to decide the identification of impact and produce the diligence of safety and exactness of the organization using time effectively. IoT is a solid base to get to the organization to keep away from the significant effect factor of safety issues. It is behind MUX/DEMUX preparing while at the same time utilizing the IoT partner with the calculations.

$$Err_j = o_j(+o_j) \sum Err_k wj_k \quad \text{..... (1)}$$

The collision detection (Equ 1) helps to prevent the vulnerabilities and the persistence about the accuracy of the data transformation in the networking. once the connection establishment is done then move on to the detection processing for the collision. Because the collision may occur anywhere with or without knowing the knowledge of expertise. in this RPMA access in the MAC layer and securely doing the process with the time spanning method. It avoids redundancy and duplication.

$$\Delta wij = (I)\ Err_j O_i \quad \text{..... (2)}$$

$$\Delta O j = (L)\ Err_j \quad \text{..... (3)}$$

The Bias addition once distinguishes the blunders check to continue on the protected moving. It is pertinent for the mistake identification according to the (Equ 2) referenced recovering the data while executing the RPL. The impact location happens to eliminate the blunder and apply the addition or decrement handling according to the inclination change (Equ 3).

$$O j = O j + \Delta O j \quad \text{..... (4)}$$

The bias is categorized in several ways. The details about the processing of bias execution depict the optimal solution. And the characteristics are given below.

Rank The position esteem is utilized to recognize the situation of the hub. In RPL, the position esteem is determined dependent on the goal work. When the solicitation is started on the sink hub, the DIO message is created. From the sink hub, DIO messages are communicated to the neighbor hubs. The position esteem is determined dependent on the goal work. The determined position esteem is sent by the hub through the DAO message to the sink hub. At times, a noxious hub sends the phony position worth to the root hub. On the off chance that this noxious hub is chosen as a parent, issues like the misusing of bundles, supplanting unique packets, and conveying counterfeit parcels will emerge. This might prompt an expansion in bundle misfortune and an abatement in the parcel conveyance proportion. The steering cycle will be started all along. The position assault is one of the significant disadvantages of the RPL directing convention.

Path Selection and parent selection In RPL, way choice is a significant interaction in moving the parcel. Way choice is the way toward figuring out how to move the parcel from the end hub to the sink hub. During the directing interaction, the hub follows certain conditions to convey the parcel in the base period, with a high bundle conveyance proportion, low parcel misfortune, etc. The way toward recreating the way by picking the substitute parent is known as parent determination. A hub will choose the parent hub dependent on the position esteem. While moving the bundle, a few interferences might happen; and assuming this is the case, it makes the way shaky.

R_C (C_j, Cj) ..... (5)

Thus the (Equ 5) decides the interaction for identifying the general closeness of the impact recognition by utilizing the DSS. The choice interaction is recognized and pick relies on the heaviness of the information transmission and time, support delay. These are every one of the three classes that include identifying the process characterization.

Mobility The hub present in the DODAG might be dynamic or static. The root hub will be static in all the organization conditions. The halfway hub chose for moving the parcel might be static or dynamic. Hub versatility is the principal justification way disappointments. This quality of the hub influences the ordinary interaction in DODAG. RPL standard doesn't uphold versatility. All the more exactly, there is no component in the RPL standard that completely upholds versatility. When the hub has left its position, either the parent-choice or the way choice cycle is started to move the parcel. Numerous analysts have begun to resolve this issue to defeat this issue and to work on the presentation of the RPL.

Path failure and Path reconstruction Way disappointment prompts a way reproduction of the DODAG all along, which influences the exhibition and nature of the directing convention. Once more, the DODAG development is to be started to finish the deficient interaction. Way recreation is the interaction to track down an elective way to move the bundle. This recreation of DODAG happens when the hub has left its position. If there should be an occurrence of hub disappointments, RPL can utilize any of the two strategies to fix the course: nearby fix and worldwide fix. In the nearby fix, if a parent hub distinguishes hub disappointment, the hub attempts to fix the course by steering through the hub's parent. The worldwide fix can be started simply by the sink hub. This causes extra control messages overhead.

RI – Interconnecting (C_i, C_j) .....(6)

Henceforth the interconnecting (Equ 6) of the organization way recognize the interaction grouping execute to characterize the conceivable outcomes of execution. Peth recognizing and address area and location assists with securing or forestall the insider or outcast aggressor in the systems administration while getting to the RPL. If guesses the assailant comes from the safeguard, it assists with distinguishing the location confirmation while entering the organization it delivered the intuitive which helps the KNN along with DSS.

Energy Energy is a significant key factor for the hub. Hubs present in the DODAG have diverse energy levels. A few hubs have a limited capacity to focus on life. On the off chance that the short-spread over hubs are chosen for steering, the hub gets rotted and leaves from the DODAG. This prompts an inadequate execution measure. Allow us to consider for instance that a hub having less energy is chosen as a parent to move the parcels in the DODAG. This might prompt issues as follows: the hub might leave from the way before it finishes the interaction; inadequacy in directing may bring about the increment in bundle misfortune; or sometimes, if the hub devours more energy it might likewise prompt rotting of the hub and diminishing the lifetime of the hub.

Congestion Blockage in an organization might happen if the quantity of parcels shipped off the organization is more noteworthy than the number of bundles an organization can deal with. Clog control alludes to the procedure to control the blockage level and keep the heap beneath the limit. In blocked organizations, the bundles might set aside an excessive amount of effort to execute the steering interaction. In the organization, the parcels are executed

dependent on need. At times, after some time, the interaction is declined and another way determination or parent-choice cycle will be started to finish the interaction.

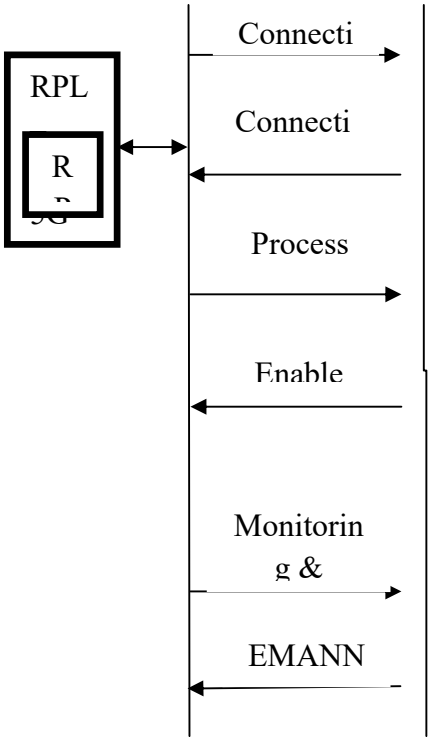

Fig: MONITORING AND EVALUATION

These are largely the qualities required to give better proficiency while getting to the RPL. The mix of KNN, DSS alongside IoT, and EMANN access give the best answer for insider impact discovery. EMANN was controlled to track down the ideal arrangement across these strategies and distinguish the discovery and persistence to the security handling in the RPL. And it produces the QoS in the networking buffer delay by using RPL in networking.

Result and Discussion

The simulationresults and practical implementations of RPL show that itcan be efficiently used in different applications includingbut not limited to healthcare, smart environments, transport,industry and military applications. It is not easy to find asingle adaptation of RPL and declare it as the ultimate routingprotocol but many of the protocols presented in this review areinteroperable and backward compatible with the native RPL.This also proves that the original design of RPL was successful in creating a flexible and scalable basis. Having said that, it

is also worth mentioning that some of the design features that are documented in the original standard RFC 6550 and RFC 6551 including multiple instances and version numbers were rarely investigated in the literature, while some of the potentially. The simulation results and practical implementations of RPL show that it can be efficiently used in different applications including but not limited to healthcare, smart environments, transport, industry and military applications. It is not easy to find a single adaptation of RPL and declare it as the ultimate routing protocol but many of the protocols presented in this review are interoperable and backward compatible with the native RPL.

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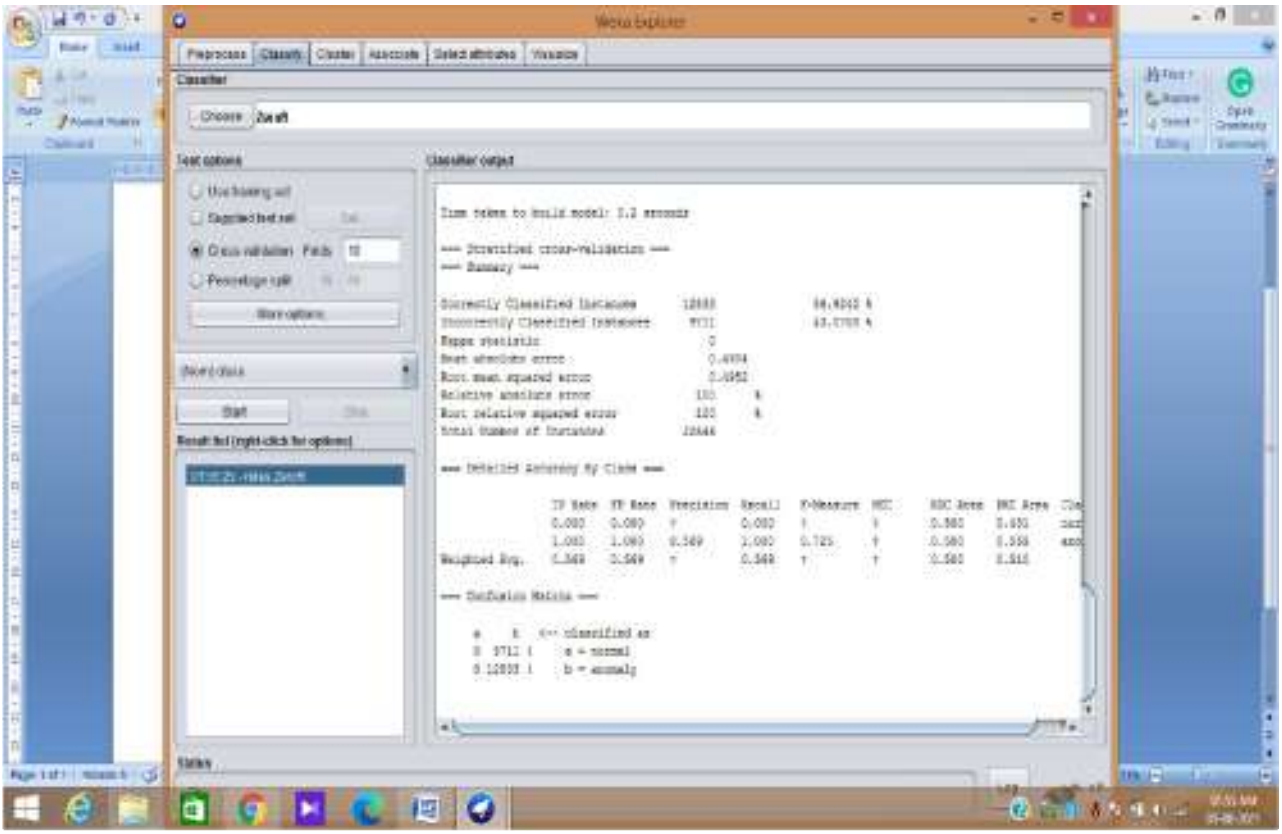
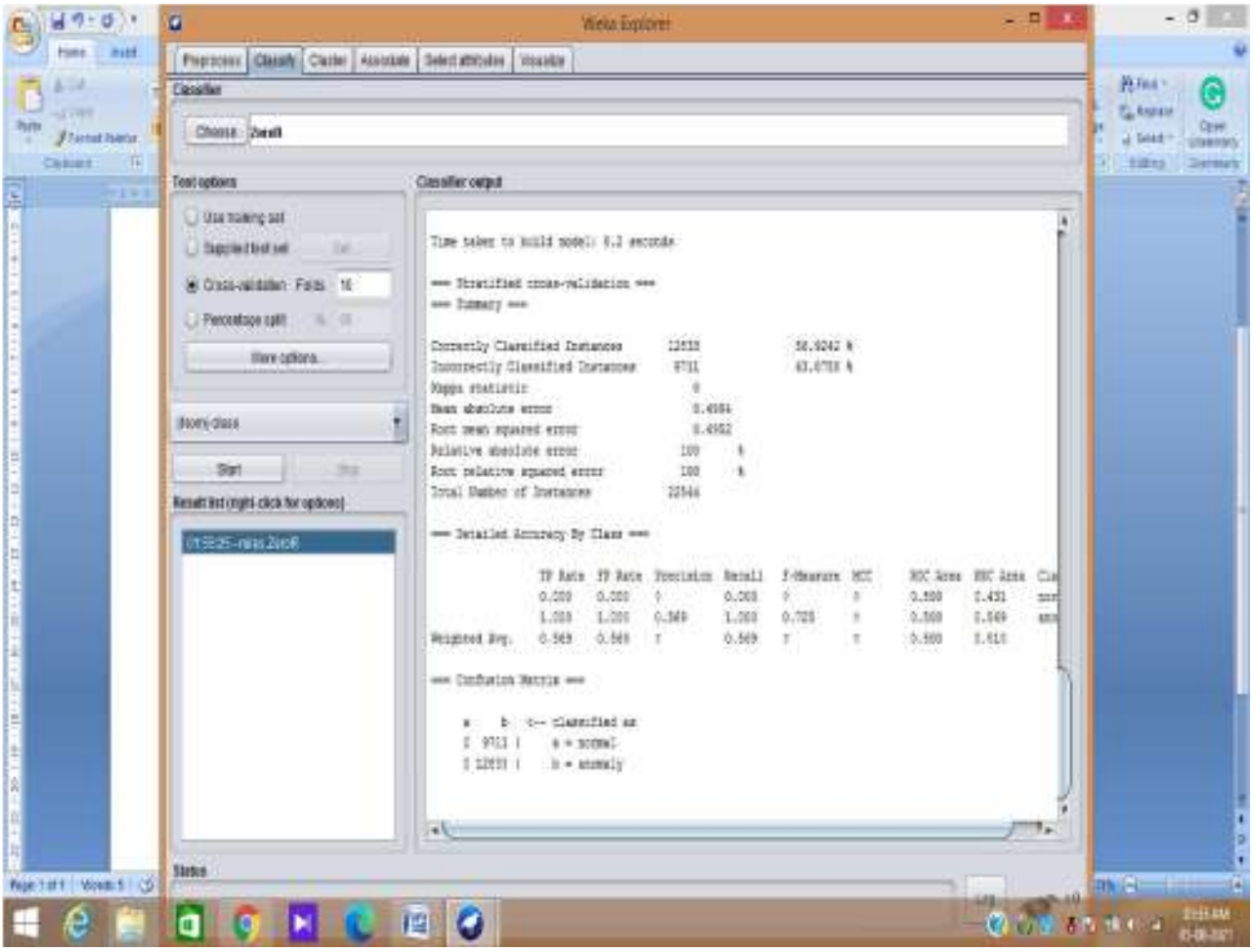
The distinction increments as the quantity of hubs increments, and as there are more choices to choose from for a favored parent. That implies, fewer jumps to the sink hub don't mean a superior way.



Classifier – 10 fold-Validation



Anomaly vs Normal in the network protection performance

The reproduction tests done in this paper infers that:

- OF0 is superior to MRHOF as far as Energy Consumption, Convergence Time in the Static-Grid Topology, Listen to Duty Cycle, and Transmit Duty Cycle.
- There is no large contrast between both Objective Functions in Mobile-Random Topology except that OF0 is superior to MRHOF in Power Consumption.
- The RPL Routing Protocol and Its Objective Functions need more improvements to manage Mobile-Random Based Networks.

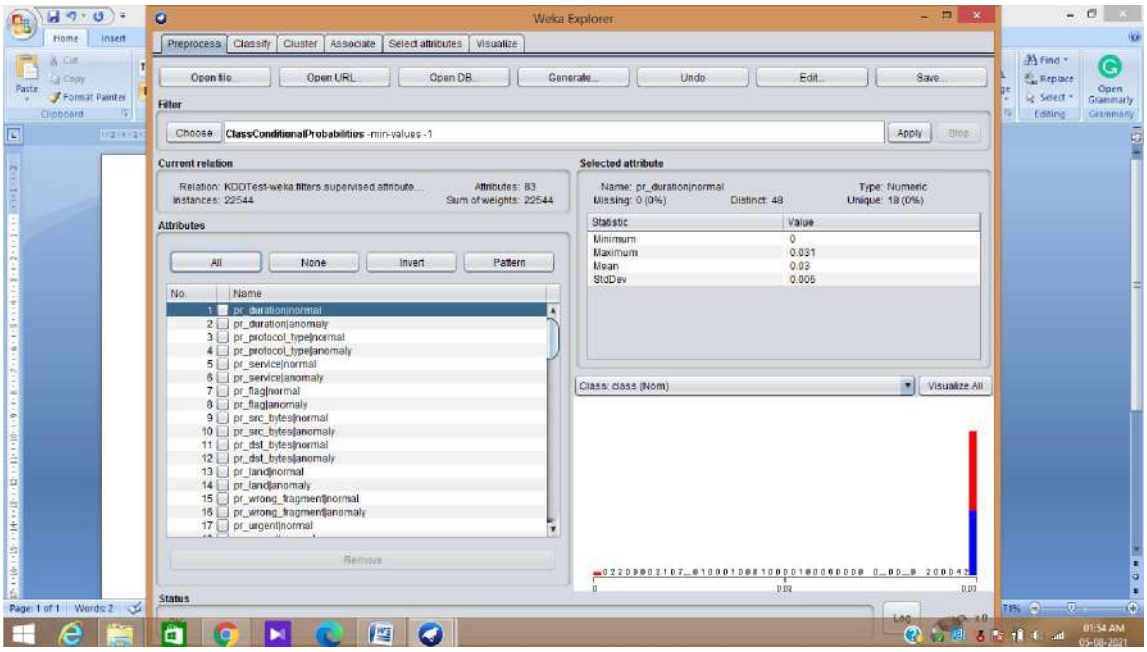
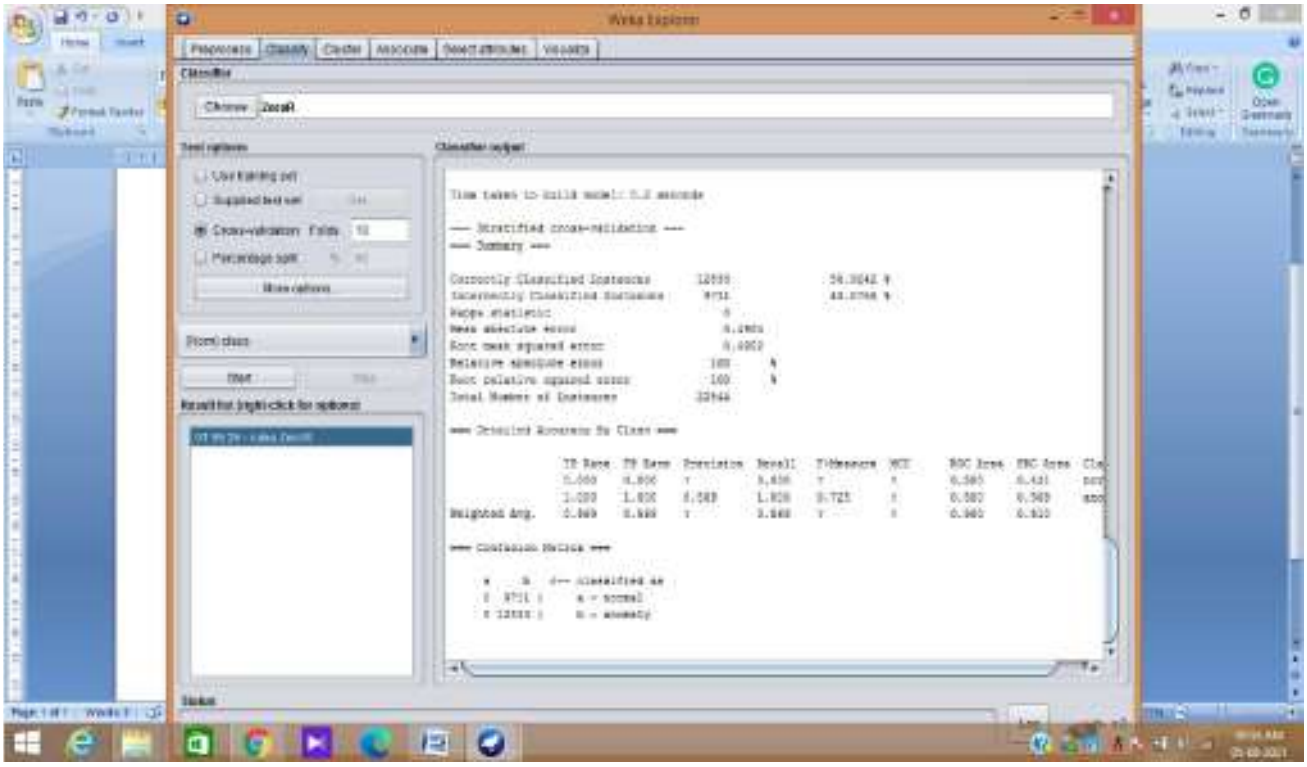
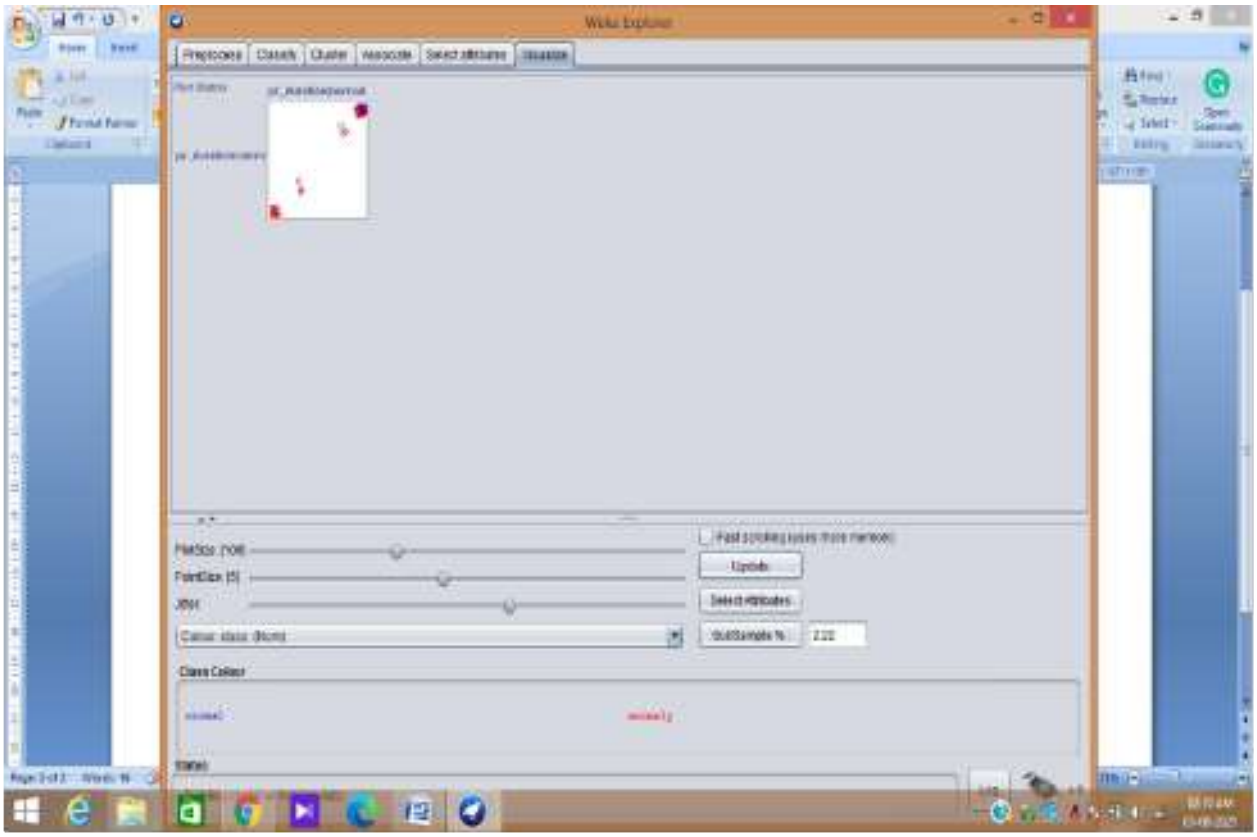


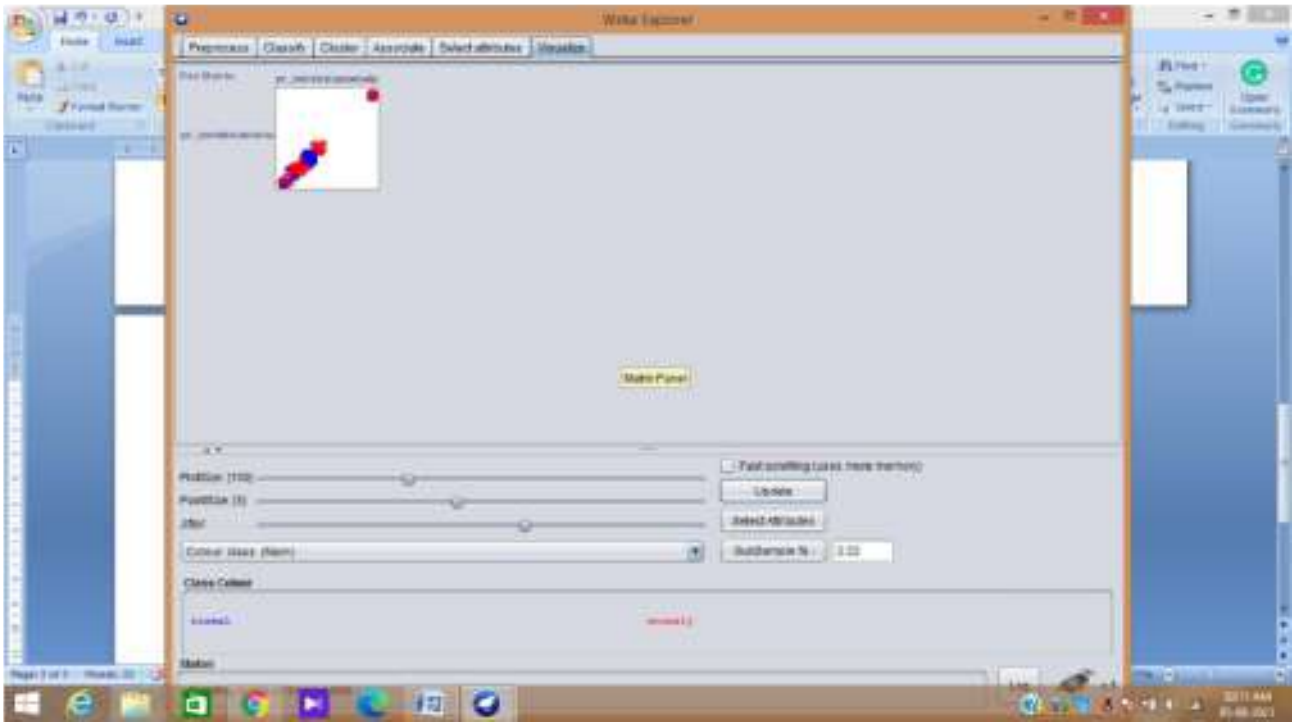
Fig: Collision *Detectionand*Class Condition Probabilities by using *RPL*



Anomaly vs Normal in the network protection performance



Normal for instance training datasets NSL-KDD



Anomaly for instance training datasets NSL

KDD

Plan to examine the impact of the Success Rate of transmission or gathering in the organization, as well as adjusting the interior parent choice techniques for the Objective Functions that might upgrade the Convergence Time of the Mobile-Random Based Networks.

To consider the security impacts of carrying out different target capacities in a similar organization. That is significant because heterogeneous organizations will in general be more powerless against security assaults. That is because it is hard to execute bound together security rules and techniques to diversely organized organizations.

Conclusion and Future Enhancement

Internet of things (IoT) is an imaginative and creative innovation. IoT gadgets have been designed and added to society for the utilization of different applications. RPL is one of the well-known directing conventions utilized in IoT. The primary focal point of this convention is directing. Gadgets are created are utilized to help in moving information gathered from gadgets in the organization. In any case, an ever-increasing number of gadgets are being developed to diminish crafted by individuals. The primary focal point of this article is to feature the issues and difficulties of steering convention for low force and lossy organization (RPL) with the conviction that the exhibition of RPL can be improved by resolving these issues. The nature of administration is a significant factor that assumes a significant part in the fruitful working of any organization even on account of IoT too. QoS is controlled by the exhibition of assistance. A few issues should be addressed to work on the exhibition of RPL. For future consideration for associate with high performance embedded with neural network technique to increase the security level.

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SOCIAL IMPACT OF CREATIVE DESIGN THROUGH GRAFFITI

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ABSTRACT

The paper presents creative design in a social environment with the help of images, icons, expressions, symbols, knowledge and typography. Creation of a design rich in aesthetics, having some useful motive to create social awareness in the context of culture is appreciated. It helps to cater to the mass communication of a group of people. In today's digital world, with the rise in technology and the Internet, it introduces people to certain significant issues and events. It also paves the way for a social responsibility of the designers. The scale of the design created may be small or a full wide wall, an effective communication always works on the needs of their audience, the socio-cultural trends as well as the sustainability and its impact on the environment of the society. The paper explores the impact of the design on social values. The pivot of the creative design is always human-centered in the social context. How graffiti uses imagery to speak for the messages and communication is to be conveyed through this paper. To search how graffiti design focuses on changing the ideology of the masses. To judge the success of artwork, Survey and Observation at different locations and e-resources are taken as tools of methodology. Vernacular language, the colors and even the folk art is expressed by the Graffiti writers and artists give meaning. Both graffiti and creative design help in bringing about a social change. Social designs are flexible, innovative and good for a social environment. It solves the everyday needs and problems of the locals for social upliftment and a changed mind set. The research provides an opportunity to further work on the dynamic nature of the ever-changing global society and creativity.

Keywords: *Communication, Aesthetics, Social Change, Digital-Era, Sustainability.*

Introduction

A **creative design** helps in social well-being. It rejuvenates the mind of the beholder, brings identity with community and its surroundings in the neighbourhood. It also enriches and enlivens the environment. A ***creative design*** is an aesthetic concern of an artist to fulfill his vision to create something novel. So creative design has to be experience based, interactive, narrative, scriptive or any architectural scenario which galvanises the activities of a society in the context of culture. It should create a numerous innovations in communication, reflection of a message, information or aesthetical concern. It could be in the form of hand-painting, or computer based digital content also." Innovations here are social innovations which mean community development and also organising community for public participation to bring about a social change to curb the stereotypes for the betterment of humanity and a better worldliness.

A Creative Designer works for a **positive impact on the lives of people** through his designs. Such Social Designs are called **Social Innovations, Social Impact Design or Social Design or Design for Social Impact.**A ***Social Change*** is said to be when an artist is always inspired to create joy and empower the audience viewers identity which rekindles hope and re-imagines a better future as feels *Jones (Oct. 29, 2020).*The culture renews itself with the passage of Time, Art and Creativity. **Social Impact design** is applying to **human centred Designs** which works as tool to change the mindsets and the complex social problems that surround us such as Poverty, Homelessness, Child Abuse, Hunger, Racism, Global climate change, Gender Equality, Disease and health sanitation etc. It is considering deeply about the human challenges that people face.

So, Designing for Social Impact gives designers a lot of power. It is like working on a group of people who have traditionally influenced and controlled the people in that community. This way the viewer is regenerated to upgrade a society-socially, economically, culturally and environmentally. Such creative energies of local people attract more and more people to participate in the development of the community. This social impact of art can be very interestingly utilised and felt through graffiti.

Graffiti is a diverse form of art. It gives expression with creativity. And this art is freedom to express a note of protest, revolt, love, affection, and to question the stereotypes and even help in beautification. Ordinary man gets influenced by Graffiti writings or art on the walls. It is inspired by the creativity of an

artist and a number of cultures and lifestyles. Graffiti is seen in urban as well as the rural spaces throughout the world in the form of a unique culture of the young generation now a days. The examples of graffiti are beneficial to the communities. What so ever, it is a medium of social change and expression of a society with reference to the culture. It is no longer dubbed as vandalism or illegal as people have accepted its existence as eco-friendly and beautifications of their neighbourhood. The governments and the administration has started hiring the artists to make the cities clean and green and smartly beautifying. It is the power of imagination that fights against the useless or unacceptable principles of society. It questions the unacceptable customs that are not required in contemporary times. It helps in enlightening people regarding the sustainability to preserve values, environment and the planet earth regarding an array of issues. It acts as a tool to present transformation of a new society that is always human centred. The visuals not only adds to beauty but establish that mirror of life which has a dynamic nature and to this graffiti -scape there are a number of commuters around trains, the important places and the back of the Govt. Offices and these portraits are impossible to ignore.

Hence the public and visible nature of Graffiti is an important factor to bring a bend in social thought. It is a globally accepted voice and opinion, that transforms the thinking of the entire community and brings about a social change.

Though Graffiti, is a tool of visual communication, it is dated back to ancient caves. It is a spray painting of the subway trains or murals on the public or private spaces in the form of typography, illustrations, images, symbols or icons. It gives expression to the words, and the imageries in a unique manner by bringing art away to open spaces from the art- galleries. An aesthetic purpose with some important meaning from the theme of the content, has its deep impact on human centered society. Such designs are Social Impact Designs. Graffiti involved individuals, gangs, or a group to spread awareness and cater to a wide variety of public.

In the digital era, graffiti designs are in paint or plaster as an expressive form of art. Graffiti is not only to write slogans, protests, but a technical skill that is well planned for a definite and specific purpose which is helpful in changing the mindset of people through aesthetically chosen images, icons, symbols or typographic expressions. In the time of staying home, Pandemic COVID-19 times, the lock down has restricted the people to stay indoors. They have to be educated to be aware of the virus and take precautions to save lives.

It becomes easier for a creative designer to support social causes such as education, health equality and upliftment of the underprivileged creativity through design and graffiti communicates and helps in creating various opportunities to solve such social problems, build relationships and this rebuild and reshape a society.

The role of the media in awakening is not less. Electronic media provides transmission of cultural products and forms a communicative network which is a fast transportation and contributes to a globalised market. But outdoor media has one mode named Graffiti which can take help of media too.

Designers have to rethink traditional modes and methods of creating social change.

Sustainable design eliminates negative environmental impacts through thoughtful designs in terms of environment, economy and society. According to the UN's our designs need to meet “The economic needs of the present without compromising the ability of the planet to provide for the needs of future generations.”

Objectives

To work as a creative artist is like an organiser working for the socio-cultural change for the next generation. The depleting natural resources, the global warming, and health issues are raising concerns with influential organizations. How the creative process and graffiti artists bring about a blend in the ideology has to be probed. Hence the objectives of this study are:-

1. To explore the social impact of design on social values.
2. To study the role of a creative design as a social responsibility.
3. To deal with the necessity to cater to mass-communication for a social change.

Methodology

Creative process involves innovations, aesthetics and goods for society and socially responsible design is the outcome of the attitude and emphasis on the needs and expressions of the public interests, issues and day to day problems. From the rise of civilizations the needs are getting changed and hence the change in traditions, and culture. In the latest advertising the messages are bombard for the utility of the products, and communicative ability in Graffiti.

It is not that only creative design through digital media help and highlight particular properties of art and social issues but rather any medium of art could invoke viewers to negotiate practices.

It provides us with an insight to reflect the dynamic ways of the life and the universe, for a civilization. The people, start redefining their concepts and ideas. They perceive differently and make meaning differently in a special way. Thus the same object- become special and more valuable for their practical use.

The sole focus is on **message** rather than the style of **typography and imagery.** Images and language could be the component and is useful in projecting a reflective practice which is an important and pleasurable diversion in ever-changing socio-cultural conditions of a society.

The study of research is quantitative along with deductive approach. The survey of the graffiti and their observation are the tools used for the research. The pictures of the graffiti pieces are taken from e-sources and are self-clicked also. As the limitation due to lock-down in the pandemic era 2021, one has to restrict to nearby places and the secondary Research and review of the secondary material collected from news papers, blogs, instagram and social media also.

Data collection is done after the interpretation of the pictures on the bases of different variables called **Cultural aspect, Images, Imagery / object Design and multicultural relation Conventional meaning, Impact (on social behaviour)**

Discussion

Graffiti has been established as an aesthetic tradition. It has found its place in contemporary society. Many techniques have been evolved. The motive and its attitude has not been referred properly. It is no longer a moral decay and negative expression of society. It is considered as a talent and has made a positive impact on society.

Picture 1. Self Clicked (2021) Knowledge and Education, Life Skills on the walls of Govt School, Ladowali Road, Jalandhar.

Interpretation: Graffiti on the life-skills on the walls of Govt. Model Smart School, *Ladowali Road, Jalandhar* is self-explanatory. It shows a tree, a thick banyan tree that resembles a society. The big fruit crop on it is the ripe fruit of respect for elders, self discipline, kindness, regard for elders, honesty and equality uniformity. The painted graffiti is not very attractive there may not be uniformity and proportion but the content, the text, the concept is very attractive. Symbolically too a tree represents transformation, growth, representation of life, wisdom and prosperity. In our culture it represents life. Apple reminds us of temptation, knowledge, luxury, joy too, fall of man from the Garden of Eden And It reflects the virtues and Life-skills a new generation should have. As it is on the wall of a busy road and school, it attracts a huge audience and this narrative hints at adopting these skills for the new generations. The Vernacular language has been used which means ways to live a life!

Picture 2. Self Clicked (2021) Women Empowerment, on the walls of Govt. School, Model Town, Jalandhar

Interpretation: There is the imagery only, no text. The outline of a lady with flowers only (multi-colored Simple) and a butterfly in her hand is a really creative design. This presents scenic imagery which is beautiful. No typography but it conveys a wonderful message one looks at it twice. The butterfly can be equated as an ability to float upon a breeze. It is freedom and change, joy, good luck. It awakens a sense of lightness and joy. So, the lady or a woman has a right to dream. Symbol of hope, yearning to transform, She cannot stay with confining walls any more breaks the limitations, creativity of a garden with wings is Women Empowerment from home to office to space and what not!!!

Picture 3. Self Clicked (2021) Safety of Children, Shun Child Labour, Save Lives of children on the walls of Govt. School, Ladowali Road, Jalandhar.

Interpretation: No to **Child Labour**. A girl cleaning and washing utensils has a vision of a school a good education. She wants to go to school to enjoy a new life- life full of knowledge. So, both the message in vernacular language help in reflecting the purpose of the graffiti and the social issues of child Abuse.

Picture 4. Human Qualities and virtues, Delhi Police headquarters building in New DelhiPhoto Courtesy: https://www.ndtv.com/delhi-news/delhi-huge-mural-of-mahatma-gandhi-unveiled-on-police-headquarters-wall-549330

Interpretation: Mural at Delhi Police headquarters building in New Delhi depicts our Father of Nation called Mahatma Gandhi. It is an icon in itself. It is associated with the Swachh Bharat Abhiyan. It is a symbol of Ahimsa, Peace, to Hate the sin not sinner and so he is remembered for his philosophy of life when scanned through semiotics. He is loved and regarded. He is the guardian of our culture and makes an impact on our society.

Picture 5. Acceptance of Post COVID-19 era ,Banksy Game Changer (2020) | Picture Boy playing with nurse toy
Picture courtesy:

https://christies.shorthandstories.com/CKS19586-Lot-0006/index.html

Interpretation: Banksy's child playing with a nurse toy has thrown all the toys like Spiderman and others to the garbage bin as he gets inspired by the new normals bombarded to him three media in different mediums.

Picture 6.Wisdom and knowledge, (MAY 19, 2021). Hindustan Times, New Delhi

Interpretation: Owl with Mask depicts Newnormals NO MASK, NO ENTRY. Owl is a symbol of wisdom and knowledge for safety,An owl with a mask. Owl symbolizes the inner voice. To keep away one has to learn to listen to the inner voice of his soul to save himself and not to listen to what other people say. It is a sort of awakening and attentive attitude. Owl mythological symbolises death also and is considered that brings bad luck. The message is in bold English Language so that different multi-cultured societies could understand the concept and idea.

Picture7. Stereotype Women are Inferior (2020) | Let Her Speak
Picture courtesy: Self Clicked

Interpretation: The Abstract design is reflective. No proper image but symbolic representation of a Girl, or women who is considered physically as well as mentally inferior to men folk. The loud and bold message in English asks to give her the right to speak for the sake of gender equality.

Picture 8. Nature Nurturing
Photo Courtesy:
https://www.facebook.com/KitchenFunWithMy3Sons/photos/a.371333696230783/3925049490859168/?type=3

Interpretation:A beautiful mural from Lodhi Colony, Delhi is self explanatory to teach children since childhood to put efforts for a green clean environment and global environmental changes that are aiding natural calamities.

It is against deforestation. It is a pledge to grow and tender trees for shelter, oxygen and fruit and protection against soil erosion.

There is no Text but the image itself speaks of a million words.

Picture 9. Women Empowerment (2020), St+art India brings St+art Chennai 'Harbouring Hope' https://timesofindia.indiatimes.com/city/chennai/start-festival-supported-by-asian-paints-creates-chennais-first-art-district-at-kannagi-nagar/articleshow/74712929.cms

Interpretation: The Tsunami is associated with man's interference with nature. In this mural at Chennai, the women and the Girl child show hope. Hope against the devastation of Tsunami as the sky is clear now and the mother teaches the girl-child to look forward and the positive always better future. It reflects women empowerment also.

Times of India [23 March 2021] describes **Post Covid Times and explains** Business is the sustainability of economical help picking up in an article at Kochi.

Graffiti Artists are charging Rs 500/- a day for one wall of 6 meter long. They work around its borders in eco-friendly alternatives, says *Steve Brown.* Minimum walls could be 25 -30 per artist.

Table 1. Analysis of Data

Picture	Cultural Aspect	Images	Type of Design	Conventional meaning	Impact
1	Knowledge and Education	Narrative Sketch	Interactive Design	These virtues one should have	Human Centered, Social Awareness Essential Life Style
2	Women Empowerment	Abstract Exploratory Message	Beliefs of Society	Beauty and Aesthetics	Educate Girl Child, Save Girl Child
3	Safety Of Children	Visionary Sketch	Psychological Design	Educate Girls No discrimination Of Sex	No to Child Abuse
4	Human Qualities and virtues	National Figure	Perspective Design	Bapu Gandhi	Symbolises Quality of life
5	Acceptance of Post COVID-19 era	Human Centric	Psychological Design	Child Adopted new normal	Acceptance of Life with Corona virus.
6	Wisdom and knowledge	Bird Symbolism	Motivational Mythical Character	Symbol of Bad Luck	Acceptance of Life with Corona virus.
7	Stereotype Women are inferior	Only Typography Message	Experience Design	Text explains itself	Gender Equality
8	Nature Nurturing	A Girl child	Reflective Design	Water Plants	Grow and adopt trees.
9	Women Empowerment	Human Centric	Narrative Design	A mother and daughter looking at sky	Reflects at Hope

None of them is computer technological based with a long creative process. It is simple Graffiti with Spray, watercolours paints made in a very less time.

The role of art in bringing the social change in the mainstream and popular mode of visual art which is committed to the masses is Graffiti and the creativity.

The table shows that the creative design used by the graffiti artists is enormously supporting cause for adapting to something new. It brings about a far reaching effect that is providing an essential support System to the changing times and is building a vision for sophisticated skills and lifestyle suiting to the new environment. This freedom of expression on the deserted walls of the buildings or torn plastered spaces is giving a new look to the surroundings.

When creative design is supporting these exceptional graffiti pieces, the artists home definitely a potential to bring about a difference and change mindset. New narratives, experiences and sustainability in the form economy, ideology and of course time saving devices and modes. There is always a challenge for the artists to capture an imagination that could motivate to change the traditions and customs and values of a Society. So that an acceptable ideology could help in bringing about a social change for this media has to access the utility of the Graffiti advertising as a unique resource in re-defining society and people and that planet Earth in a better way with a diverse experience and narratives through graffiti also.

Conclusion

Messages are loud and clear. Messages mostly communicate with typography also. Images bring energy to design only in a limited time as designs are not crazy or minimal uses of loud colours are there in Graffiti. Non-traditional fonts and texts are used. Regional and tribal influence can be seen. Ethics of design show empathy and commerce is intertwined with creative principles. Stereotypes are also showcased to change the mindset of the society.

Thus, Art is communication that binds people from different cultures and different places to reflect, collaborate and build a community having a profound impact on society. Future study can be done.

Creative Design through Graffiti is an influential factor in society for changes like opinions, instilling values and translating experiences of the community in that particular time when it is written and displayed.

Research in this study shows that the creative aesthetical designs in paintings, sculptures and all other applied forms of art are repositories of a society's collective memory. It preserves what fact- based historical records cannot; how it exists in a particular place at a particular time.

Further study can be done on dynamics of styles and methods of Graffiti as Social Impact Design.

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ANALYTICAL MODELING OF ADDITIVE LAYER MANUFACTURING PROCESSES FOR METAL TOOLS COMPONENTS PRODUCTION

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ABSTRACT

Current research into the development of additive layer costs shows that this technology is economical in producing small batches with ongoing centralized manufacture; however improved automation may contribute to cost efficiency in distributed manufacturing. Due to the difficulty of which additive production costs are calculated, the reach of the current studies is small. Many of today's studies analyze single-part development. Many that look at assemblies prefer not to look at the impact of the supply chain, such as inventory and shipping prices and lower probability of interruption. Analysis currently also shows that the expense of content is a significant part of the cost of a commodity made using additive layer. Technologies may, therefore, also be compatible, with two technologies being implemented side by side and advantages larger than if independently adopted. Growing usage of additive processing may contribute to a decrease in raw material costs through saving in scale. This could result in further implementation of additive layer processing through the decreased cost of the raw material. The expense of raw materials will often save on a scale if specific materials are more popular than a host of other materials. The production method for additive layers is still a significant cost driver, but this cost has decreased continuously. The average price dropped 51% between 2001 and 2011 after inflation changes.

Keywords: *Layer manufacturing, metal tools, 3D printing, modelling, rapid, fabricated metal.*

Introduction

AM has increased energy in India over the last few years in manufacturing technologies for India. AM is making strides in the usage of additive layer technology and its success is growing with 3D printers beginning to decline in rates owing to strong rivalry on the Indian market. Additive layer development from the removal of human organs to the printing of footwear and chocolates and much else on the market. Additive layer processing goods join all unexplored markets more and more. The output boundary of additive layers is infinite and is able to manufacture goods correctly in all industries [1]. The medical applications are introduced, lightweight goods are broad-scale commercial applications and the cost of development decreases. The Additive Layer Manufacturing Society of India (AMSI) is an organization that functions as a technical organization within society and seeks to facilitate additive layer processing technology and 3D printing. India's additive-layer manufacturing business also funds researchers, suppliers, institutes and association of scientific production, 3D designers and additive-layer technology. The additive layer manufacturing society of India's 2020 vision is to place a 3D printer in every India educational institution[2].

Data Analysis and Validation

Latest studies on the production costs of additive layers shows that this technology is economically cost productive for manufacturing small batches with continued centralized produce. Because of the complexity of calculating the processing costs for external layers, the reach of ongoing studies is limited. Many of the existing studies look at single-piece output, and the assembly studies do not discuss supply chain consequences, such as inventory and transport costs along with reduced supply interruption threats. Analysis also indicates at present that manufacturing prices reflect a large proportion of the expense of a commodity manufactured with additives. Technology may also be compatible when two innovations are implemented side by side, with better advantages than independently adopted. Growing implementation of the output of additive layer may result in reduced cost of raw materials by saving scale [3]. A further adoption of additive technology could then result in reduced cost to the raw material. Scale-saving costs for raw materials can often arise as unique materials become more popular rather than a vast variety of different materials. A variety of dynamic variables minimize the

expense of manufacturing additives, such as construction orientation, the usage of envelopes, build time, consumption of resources, product design and work. The basic orientation of the component in the construction room will contribute to an improvement in energy consumption of up to 160%. Furthermore, the complete usage of the building chamber greatly decreases per unit expense [3,4].

Result Formulation and Discussion

A.Production and cost effectiveness of additive layer manufacturing

1)Additive layer manufacturing Costs and Benefits

The cost of output can be classified in two distinct forms, as stated in Young (1991)14. The first concerns certain "well-structured" costs such as labour, supplies and equipment costs. The second is "unstructured costs," including those linked to building collapse, system installation and inventory. The emphasis in the literature appears to be more placed on well-structured additive layer manufacturing costs than on unstructured expense; nevertheless, the badly structured costs which mask some of the major benefits and cost savings in additive layer manufacturing. It may also be helpful to recognize the output of additive layer in lean production.

2) Product Enhancements and Quality

While the expense of additive manufacturing is the subject of the study, it is necessary to remember that the utilization of this technology results in product changes and quality disparities. There is more geometric independence in the manufacture of additive layers and it allows more flexibility; nevertheless, there are restrictions that some designs need support systems and means to dissipate heating into output 45. Each commodity produced may be personalized at little to no expense, with the exception of design costs. Customized implant repair devices, dental work and hearing aids are still importantly required in the medical sector.46 There is still the option for consumers to develop or customize their goods. However, quality safety is one of the issues with additive development. Standard methods are currently required to measure and maintain precision, surface finishing and detail to achieve the desired quality of the part [5].

B.Cost Models and Comparisons

1)Two Major Contributions to Additive layer manufacturing Cost Modeling

Two expense models attract substantial focus in the manufacture of additives: 1) Hopkinson and Dickens (2003) and 2) Ruffo et al (2006a). Hopkinson and Dickens measure the cost of chemicals generated in the production sector based on the average cost for each component and three other assumptions: 1) one form of piece is made by the device over a one-year period; 2) overall quantities are used; and 3) machinery functions for 90% of the time. The study comprises of labor expenses, material costs and equipment. Additional considerations such as electricity usage and leasing of room were included but added less than 1% of the costs. By dividing the overall cost by the total number of pieces generated over the year, average partial cost is determined [6]. The expense of the equipment, labour costs and material costs can be broken down. These costs are measured using stereolithography, fused deposition simulation and laser sintering, for two sections, a lever and a cover. Show a cost overview for the heel that indicates that laser friction was the cheapest method for the manufacture of additive coating for this component in this study. The process costs played a crucial role in the expense of stereo and fused deposition models while the material costs added greatly to laser sintering.The annual cost of machines per part, which depress the entire system after eight years, is determined by Hopkinson and Dickens, and applies to the depreciation costs per year (divided by machines and auxiliary equipment 8) and machine repair costs per year divided by output volumes [7,8]. The effect is a cost per variable, as seen in Figure 3, which is constant over time. A contrast with injection molding is also shown in the figure.Ruffo et al. measure the expense of processed additives using a cost-based operation model where each cost is related to a real activity. They generate the same level as the selective laser without Hopkinson and Dickens. In

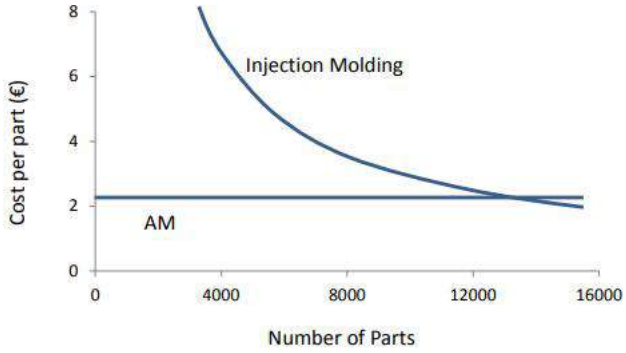

Fig 1: Cost Model Compared to Injection Molding [7].

Their model is the amount of raw material costs and indirect costs for a construction, the net costs of it (C). Prices ($P_{material}$), calculated in euros per kilogram, compounded by mass of kilograms, are the raw material prices (M). The indirect costs are determined by multiplyingthe cumulative construction period (T) by the cost rate ($P_{indirect}$). The actual cost of a building is then seen as:

$$C = P_{material} * M + P_{indirect} * T$$

The cost of a construction (C), separated by the amount of parts concerned, is measured as the overall costs of the construction. In comparison, Ruffo et al. show that the key factors in the costing model are time and materials. The computer was expected to operate for 50 weeks/year 100 hours a week (57 percent utilization). Indicates the average indirect costs per hour. Figure 4 displays the expense model and the net cost.There are three separate times determined by Ruffo et al. model: I 'time to scan the segment and its edge for sintering;' (iii)' time to add powder layers;" (iv) time to heat the bed prior to scanning and test it steadily, add the powder or simply wait for the correct temperature.' The model Ruffo et al. has the dental form of a jagged saw, because of the influence of a new line, sheet or structure. Every time one is introduced, average costs irregularly rise due to raw material and process time usage

Table 1: Indirect Cost Activities [8].

Activity	Cost/hr (€)
Production Labor/Machine hour	7.99
Machine Costs	14.78
Production Overhead	5.90
Administrative Overhead	0.41

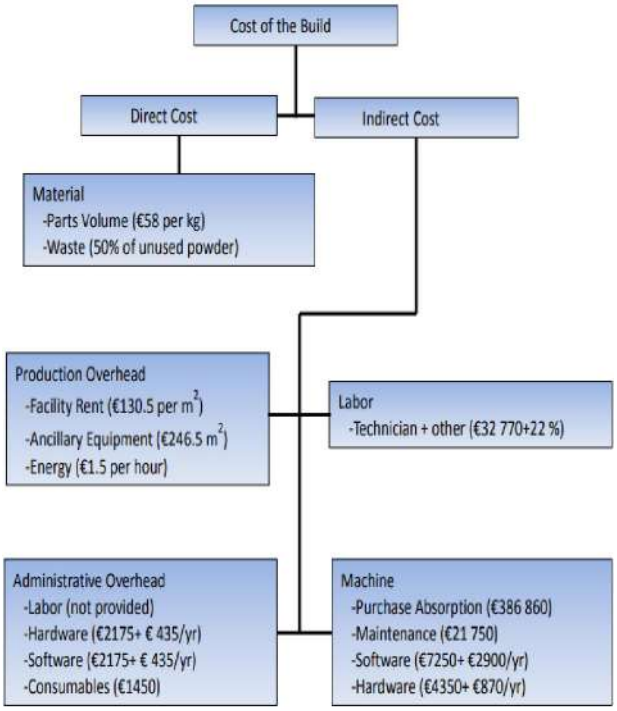

Fig2: Cost Model for Additive Manufacturing [8].

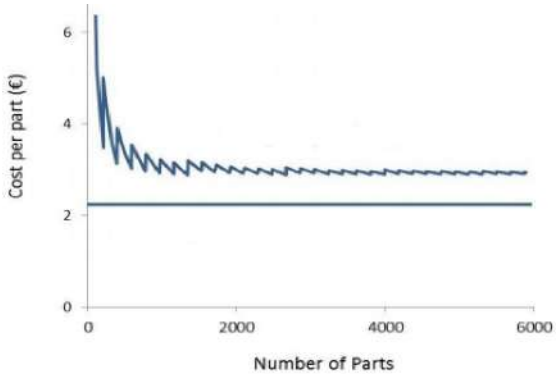

Fig3: Cost Model Comparison [8].

The lever cost is measured at 1600 pieces at €2,76 per piece compared with €2,20 for laser sintering in Hopkinson and Dickens. The discarded content has also been recycled by Ruffo et al. The cost per unit was EUR 1.86 in this study.

Many costs analyses presume that one element is repeatedly produced; nevertheless, the capacity to manufacture multiple components simultaneous is one of the advantages of the additive layer production. Thus, a "intelligent mix" of components may result in lower costs. In a single component output, the overall cost for a construction is divided by the amount of materials, but at the same time the cost of the various components being constructed is more complex. Three costing methods for costing estimation are contrasted by Ruffo and Hague

(2007). The first step is focused on the volume of components

$$Cost_{P_i} = \left(\frac{V_{P_i}}{V_B}\right) * Cost_B$$

Where $CostPi$ = cost of part i
VPi = volume of part i
VB = volume of the entire build

$$Cost_B = \sum \frac{indirect\_costs}{working\_time}\left(t_{xy} + t_z + t_{HC}\right) + \frac{direct\_cost}{mass\_u\ nit} m_B$$

mB = mass of the planned production proportional to the object volumes, and the time to manufacturing the entire build
txy = time to search the segment with the sintering powder boundary
tz = Period for inserting powder layers
tHC = During the scanning and refreshing of the bed after scanning and inserting powder layers
i = an index from one to the amount of components
$CostB$ The C from above is still the same, which is a build's overall expense. The second approach is based on the construction expense of a single item as seen as follows:

$$Cost_{P_i} = \frac{\gamma_i * Cost_B}{n_i}$$

Where

$$\gamma_i = \frac{\mathrm{Cost}^*_{P_i} + n_i}{\sum_j \left(\mathrm{Cost}^*_{P_j} * n_j\right)}$$

I is also the index of the component measured, j is the index of all components produced on the same bed and neither is the number of components defined by I and Cost Pi € TM s is the cost of one component I determined using the earlier equation of C. The third solution is focused on the expense of a big component. This is identical to the second process, with just a high number of parts rather than a single component, the cost variables in Ţi estimated. The following are represented:

$$\mathrm{Cost}_{P_i} = \frac{\gamma_i^{\infty} * \mathrm{Cost}_B}{n_i}$$

Where

$$\gamma_i^{\infty} = \frac{\mathrm{Cost}^{\infty}_{P_i} + n_i}{\sum_j \left(\mathrm{Cost}^{\infty}_{P_j} * n_j\right)}$$

Where $CostPi\ \infty$ is an imaginary number of the fabricated components I that reaches infinity.
For the feasibility of the estimation of the cost per component, Ruffo and Hague use a case study. The findings show that the only "fair assignment method" is the third type. The two others are shown to be ineffectual, since the expected cost of larger components is decreased dramatically at the expense of smaller components.

C.Additive layer manufacturing

Complete advantage the aim at the business level is to increase benefit, but several stakeholders must recognize the costs and advantages at social level. At this step, the goal may be to mitigate the usage of resources and increase usefulness. Dollar prices are affected by several factors like scarcity, regulations and costs of education which affect the efficiency of allocation of resources [9]. The allocation of resources is an important concern, but recognizing the social effect of additive layer output involves distinguishing problems of the allocation of resources from the problems of resource usage.Development considerations are usually known as land (i.e. natural resources), labour, capital and entrepreneurship; but capital does require machines and equipment produced of land and labour themselves. In addition, the time, as seen in many business strategies debates, is a major factor in the development of all products and services. Thus, property, labour, human resources, entrepreneurship and time may be called the most fundamental elements of development. Human capital and entrepreneurship in the development of additives are significant, but these are complicated problems that are not at the heart of the study [10]. The remainder of the article's property, labour and time are the major manufacturing costs. It is necessary to remember that there is a time-work balance, as seen in Figure 6. It is calculated in working hours per hour. For eg, constructing a house takes hundreds of individuals fewer than building a house takes. It can also be remembered that there is also a time/work/land trade-off (i.e. natural resources), as seen in Figure 4. A system will, for example, minimize time and time.

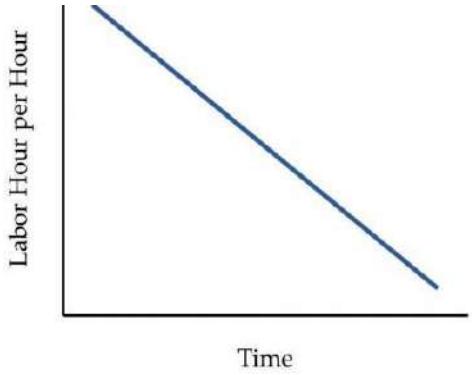

Fig 4: Time and Labour Needed to Produce a Manufactured Product [10].

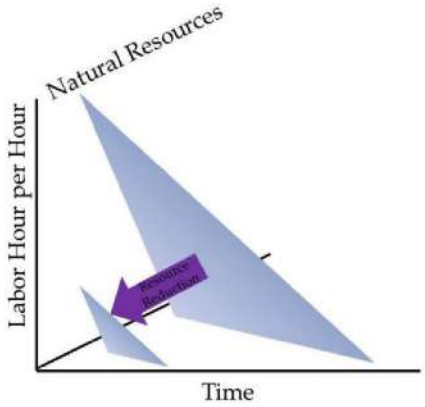

Fig 5: Time, Labour, and Natural Resources Needed to Produce a Manufactured Product [10].

Number of people available for production however more energy is used. In the diagram, the triangular plane is possible to generate a finished commodity with a combination of ground, labour and time. It is just a shift in resource usage to drive about this aeroplane. By either shifting resources or reducing output resources, a business may increase benefit. Movement through the aviation plants as shown in Figure 4 may contribute to more successful resourced allocation for a business and for society. If you also analyze the costs and advantages of a commodity or method from a social point of view, it is clear that property, labour and processing time must be calculated to see if the mix of energy necessary for manufacturing a product has been minimized [11]. If additive layer output contributes to a decline in production capital, the aircraft is pushed towards the origin, as seen in Figure 5.

D.Implementation and Adoption of Additive Manufacturing

Additive layer processing is radically different from conventional processes; it is also a task in and of itself to decide how and when to profit from the advantages of additive layer production. Furthermore, development is optimized utilizing the conventional approaches by manufacturing sector. It is complicated and challenging to classify items that profit from enhanced uncertainty or are rendered near to customers or understand their effect on inventory since it influences variables that are difficult to quantify [12].

E.Adoption of Additive layer manufacturing

Some of the factors influencing the implementation of additive layer processing technologies may be identified by the use of current papers and texts, but through the compilation of additional evidence such questions cannot be substantiated. Surveys can also be used to test a modern technology's views of a manufacturer or consumer, but this is also an intense capital operation. In order to predict potential adoptions in the additive sector, Thomas (2013) utilizes domestic unit sales [13]. The increase of revenue can be generalized to an exponential curve with the least squares criterion reflecting conventional logistic S-curve of technology diffusion by utilizing the amount of domestic unit sales. Mansfield introduced the most commonly known model of technical diffusion:

$$P \quad (t) \quad = \quad f(x) = \sum_{n=1}^{\infty} \left(a_n \cos \alpha \frac{n\pi x}{L} + b_n \sin \beta \frac{n\pi x}{L} \right)$$

Where

(t) = the number of possible consumers adopting the latest technologies on time t;

α = location parameter; and

β = Shape parameter ($\beta > 0$).

The proportion of potential units sold by time t is expected to be close to the proportion of possible consumers who have embraced the new technologies by time t in order to analyze additive manufacturing. When looking at exports in the market, it is thought a production product additive layer constitutes a set amount of gross profits. Comparable to unit purchases,

the revenue would rise. Based on 2011 results, the proportion used was determined. α and β parameters are determined using the average annual revenue regression between 1988 and 2011 on additive layer development systems in the U.S. Device revenues in the US are calculated as a percentage of global sales. This approach gives some knowledge regarding the latest development in the usage of processing technologies for additives. Regrettably, the potential market saturation amount for additive manufacturing is poorly known, i.e. it is not obvious which percent of the related manufacturing sectors can manufacture parts utilizing additive layer manufacturing technology as compared to traditional technologies [14,15]. A changed model of Mansfield is adopted by Chapman to deal with this problem:

$p\ (t) = \eta\ /\ 1+e^{\alpha-\beta t}$

Where, η = Business level in percent saturation.

Since μg is unclear, the range of the related production shipments as seen in Table 2 ranges between 0.15% and 100%. 0.15 percent is based on an expected Wohlers revenue turnover of 8 years, equal to $3.1 billion in business openings and 0.15 percent saturation of the market in 2011. The table indicates the additive layer output at this stage is projected to hit 50% in 2018 and 100% in 2045. A more plausible scenario appears to suggest that the output of additive layers will have a market saturation of between 5 and 35%. At these stages, the output of additive layers will exceed 50% of the demand capacity between 2031 and 2038 whereas between 2058 and 2065 touching 100%, as seen in Table 2. Between 2029 and 2031 the market will hit 500 billion dollars and between 2031 and 2044 100 billion dollars. As seen in Figure 8, it is possible that the manufacturing of the additive layer is on the extreme left side of the diffusion curve and it is impossible to foresee future patterns. The figure indicates the diffusion for each stage of concentration on the sector, except for the 0.50% and 0.15%, presented in table 2 as these are too limited to include in this map [16,17].

Table 2: Forecasts of U.S. Additive layer manufacturing Shipments by Varying Market Potential [16].

Market Potential Relevant manufacturing (% of shipments)	Market Potential Shipments ($billions 2011)	Approximate Year 100% of Market Potential Reached	Approximate Year 50% market Potential Reached	R^2
100.00	$2058.9	2069	2042	0.948
75.00	$1544.2	2068	2041	0.948
50.00	$1029.5	2067	2039	0.948
45.00	$926.5	2066	2039	0.948
40.00	$823.6	2066	2038	0.948
35.00	$720.6	2065	2038	0.948
30.00	$617.7	2065	2037	0.948
25.00	$514.7	2064	2037	0.948
20.00	$414.8	2063	2036	0.948
15.00	$308.8	2062	2035	0.948
10.00	$205.9	2061	2033	0.948
5.00	$102.9	2058	2031	0.948
1.00	$20.6	2052	2025	0.949
0.50	$10.3	2050	2023	0.949
0.15	$3.1	2048	2018	0.950

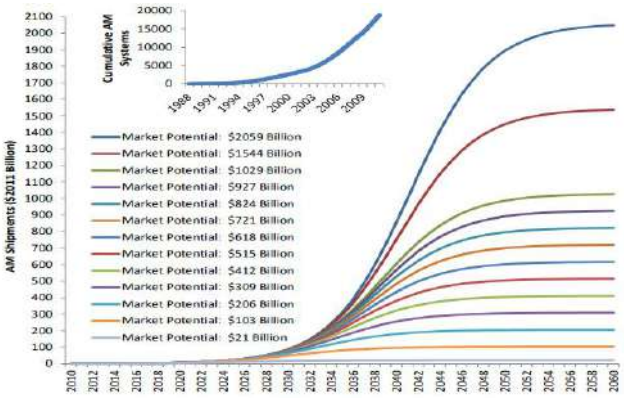

Fig 6: Forecasts of U.S. Additive layer manufacturing Shipments, by Varying Market Saturation Levels [16].

F.Responsible Innovation and Ethical value in AM

Manufacturing is mainly concerned with risk control and accountability for shareholders with various management backgrounds, compliance with both laws and regulation of financial risks in the interests of shareholders. The quest, collection and implementation of ethical judgments are less important, but are focused on lower funding risks and on finding optimum marketing achievements. Due to ethical decision-making, the consequences on the world and community are beneficial and detrimental. Responsible innovation is an interactive, open process, with ethical consideration, in which multiple players and innovators collectively assume responsibility each other [18].In specific, the controversy indicates that the development context influences moral judgement and personal beliefs, personal honesty and variables influencing any stage and taking into consideration their integrity. Thus, debate now contributes to a more proficient manufacturer's recognition of the legal, ethical issues, an appraisal of cost-benefit companies and the implementation of responsible interventions with an effect on personal and corporate decision-making method. This next issue explains how to communicate with all the parties participating in the production process to an appreciation of their roles, desires and responsibilities and responsible ethics issues at the various levels of manufacturers' organizations [19, 20].

Conclusion

This paper concluded with a special reference to the RRI system, proposing some guidelines for the potential strategy for the additive development sector in India. The study's aim is to explore the reasons that inspire entrepreneurs to implement additive manufacturing and how it functions as a responsible innovation. The research often looks at particular opportunities and obstacles in the phase of adaptation, and identifies some market models that lead to sustainable innovation. The explanations why responsible creativity is established are the growth of the organization's common interest and its lack of arrangements. The visionaries and the corporation now and then play an important role in the national improvement. In this case, interact with key players in Responsible Innovation in the innovation mechanism throughout the fieldwork. It is necessary to talk to players because Faulkner (2009) argued that regulatory and socio-political forces are influenced and developed by technological developments which render it a joint dependence. That's it. Responsible innovation and the discursive and political trends surrounding it may also be the product of commentary on previous regulatory and management problems posed by technology, as well as emerging technical transition and innovation conditions and technology's position in society.

Recommendation for Further Research

The legislative system and the infrastructure that allow ethics considerable in additive manufacturing can be generated by policymakers. If new innovations are to be implemented wisely, so that the social and ethical issues mentioned above can be recognized and solved, an accountability creation framework and infrastructure needs to be built. The policymaker’s proposal focuses on the need to standardize critical discussions and enable current society and different partners to engage in a community approach and also a group with expertise at the substance level. Such a conference is essential to ensure that careful change covers unique special preferences and viewpoints as well as representing broader public

interests.The identification of other intersections of the liable Indian invention requires or defines a certain feature of technical characteristics.

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METHODS FOR ORGANIZING SECURE AUTHORIZATION AND AUTHENTICATION MECHANISMS

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ANNOTATION

This article is devoted to the development of an autonomous system that implements secure authorization and authentication. The system described in this article provides secure mechanisms for authorization and authentication, storage and processing of account data. The implementation was carried out in the Python 3.7 programming language.
The paper considers software methods that can be used in the processes of authorization and authentication of users in software for any purpose. Attention is also paid to the issues of secure storage of data provided by users in the database, interaction with this data: sampling, presentation and processing. The main task was to implement and compare modern implementations of these processes using ready-made library products. The project considered and implemented approaches to the technical implementation of authorization and authentication using the two most popular and significant libraries at the moment, Django and Flask. The paper implements the possibility of using the second Google authentication factor 2FA, which provides a high degree of reliability and security of the data of users
who use this service. Python 3.7.4 was chosen as the development language, with a set of Djang web frameworks, Flask, a library for working with SQLAlchemy databases, a library for routing, debugging and the Werkzeug interface, a Jinja template library for creating an interface user interaction, OneTimePass and PyQRCode to implement the possibility of using two-factor authentication based on Google Authenticator. The software product implements a secure method of authorization and authentication, based on the data obtained during the review and comparison of modern solutions.

Keywords: *autonomous system, authorization, authentication, 2FA, relational database, security.*

Introduction

The issue of the security of information and personal data is raised in all areas of activity, while authorization and authentication are among the main processes for ensuring the protection and safety of data. These processes are implemented and used in all aspects of our life. An example that has a great influence in our life is the use of authorization and authentication by banking systems, for authentication which use a password and a code sent to the mobile number associated with the account. Consideration of modern implementation options and the capabilities provided by ready-made solutions and frameworks is an urgent issue.
This paper discusses the methods that are used in the authorization and authentication processes, as well as the secure storage of data provided by users in a database, and interaction with them. The main task was to implement and compare modern implementations of these processes.

In the project, these processes were considered and implemented using the two most popular and significant web libraries Django and Flask, the possibility of using the second authentication factor Google 2FA was implemented. The presence of several authentication factors in the security mechanisms of the systems provides maximum reliability and security of the data of users who use this service.
Python 3.7.4 was chosen as the development language, with a set of web frameworks Djang, Flask, a library for working with SQLAlchemy databases, a routing, debugging and interface library Werkzeug, a Jinja template library for creating a user interface, OneTimePass and PyQRCode to implement the possibility of using two-factor authentication based on Google Authenticator. The program implements a secure method of authorization and authentication, based on the data obtained when considering and comparing modern solutions.
The result is a secure authentication and authorization mechanism with multiple

authentication factors using an identifier with a password and a device with an authentication application.

Authentication

Authentication is a procedure for verifying the identity of a subject, which reliably verifies that the person who presented his identifier is in fact the person whose identifier he is using. To do this, he confirms the fact of possessing some information (identifier) that can only be available to him (password, key, etc.) [10, 11].

To confirm his authenticity, a person must provide some secret information, which should be available only to him alone. It can present various types of information to the system.

Authentication factor is a certain type of information provided by the subject during his authentication [5].

There are three authentication factors used in various combinations: based on knowledge of something, possession of something, based on biometric characteristics [2].

The first factor of authentication (based on knowledge of something) is, for example, a password or PIN. The second factor of authentication (based on possession) is, for example, a physical key, a magnetic stripe card, an OTP token that generates a one-time password. The third authentication factor (based on biometric characteristics) is, for example, a fingerprint, a drawing of the retina, a voice.

Authentication can be implemented using one of three authentication factors. For example, during the authentication process, the user may be denied a password, or a fingerprint may be required. Authentication that uses only one factor of authentication is called one-factor authentication.

Authentication that uses multiple authentication factors is called multifactor authentication. The concepts of two-factor and three-factor authentication are also used when using a combination of two and three-factor authentication, respectively.

NCSG-TG-017 introduces terms for different types of multifactor authentication: Type 12, Type 23, and Type 123. Type 12 authentication uses two authentication factors: the first (based on knowing something) and the second (based on having something) [eleven].

If only one authentication factor is used for authentication, it is vulnerable. Multi-factor authentication uses multiple authentication factors to provide greater security. The most common use case for multi-factor authentication is using an ATM machine. It is required to use the magnetic stripe card and PIN at the same time. Some types of authentication are discussed below.

Password Authentication

To verify users in information systems, password authentication is most widely used - authentication based on the possession of some secret knowledge.

Systems of varying degrees of security use permanent, conditionally permanent and temporary passwords.

The longer the password, the more secure it is (it is more difficult to guess and other types of attacks). Equally important are the password alphabet, the maximum number of attempts to enter it, the minimum time that must elapse between attempts, and other authentication parameters.

The oldest and simplest password authentication method is open password authentication. The user enters his username and password, which are then transmitted over the network in clear text. The authentication server finds the user account and compares the entered data with its contents. If there is a match, the authentication is considered successful. Most of the software used does not use passwords in their pure form, but their hash values obtained by calculating a cryptographic hash function.

One-way hash functions are functions that take a variable-length string as input and convert it to a fixed-length output string. The differences in working with the hash value are that the workstation first calculates the hash value of the password entered by the user, then the data is sent over the network and compared with the hash value of the password stored in the user account [3].

The main property of unidirectional hash functions is the impossibility of recovering the

original information if the hash value obtained from it is available. It is almost impossible to recover the open value of a password from a password file where it is stored as a hash value.

Due to the fact that password authentication is based on storing some information, many users of information systems with password authentication choose not arbitrary and hard-to-guess information as a secret, but easy-to-remember expressions or their personal data.

To increase the resistance of password protection to brute force, many information systems implement password verification for compliance with certain requirements and blocking the selection of simple passwords [7].

Password attacks and protection against them are:

- Stealing a password file. An attacker could read a user's passwords from a password file. To prevent this, all passwords are hashed.
- Dictionary attack. The attacker, sorting through passwords, searches the file using words from a large dictionary prepared by him in advance. Protection against this is limited read access to the password file, generating a hash value in a different way for each user (noisy hashing), adding password format rules.
- Password guessing. Password format rules help to combat this, as well as automatic blocking of a user account after several unsuccessful login attempts.

Authentication using biometric characteristics.

Typically, this authentication is one of the easiest methods for users to authenticate with. In most cases, a well-designed biometric system simply takes readings from the person and authenticates correctly.

The user provides a sample; it is an identifiable, raw image or record of a physiological or behavioral characteristic. This biometric sample is processed by a recording device to obtain information about the distinguishing features, resulting in a control template. Patterns are large numeric sequences, and the pattern cannot be recovered from the pattern. The control pattern is the user's "password".

The control template is compared with a reference template created on the basis of several samples of a certain physiological or behavioral characteristic of the user, taken during his registration in the biometric system. Since the reference and reference templates never completely match, the biometric system has to decide whether they “match enough”. The match rate must exceed a certain configurable threshold.

Biometric systems can be wrong, the control pattern can be wrongly recognized:

- matching another person's reference template;
- Inappropriate to the reference template of this user, despite the fact that this user is registered in the biometric system.

The accuracy of a biometric system is measured by two parameters [9]:

- The Bad Match Rate (FMR), also known as the false admission rate (FAR);
- The False Mismatch Rate (FNMR), also known as the False Reject Rate in Available (FRR).

Attacks on and protection against biometric systems:

- A fake of a distinctive feature. Protection against this can only be the hanging of the level of detail. When the reference template is made, additional biometrics are removed from the legitimate user, so that a simple copy of the legitimate user's physical identity would not reflect all of its parameters.
- Reproducing user behavior. Modifiable behavior is a defense against this threat.
- Interception of biometric indicators. To prevent this, biometric data must be encrypted.

One-Time Passwords authentication.

Switching to this authentication method is one of the options for protecting against various password-based authentication attacks.

One-Time Passwords (OTP) are dynamic authentication information generated for a single use using authentication devices [6]. One-Time Password is invulnerable to network traffic analysis attacks, which is a significant advantage over remembered passwords. Despite the fact that an attacker can intercept a password by analyzing network traffic, since a password is valid only once and for the entire limited period

of time, an attacker at best has a very limited opportunity to introduce himself as a user using the intercepted information.

OTP tokens are usually used as possible devices for generating one-time passwords, that is, mobile personal devices that belong to a specific user and generate one-time passwords used to authenticate this user. Thus, one-time password authentication, as compared to password-based authentication, is a second factor authentication.

To generate one-time passwords, OTP tokens use hash functions or cryptographic algorithms:

- Symmetric cryptography (one-key cryptography) - in this case, the user and the authentication server use the same secret key;
- Asymmetric cryptography (public key cryptography) - in this case, the device stores the private key and the authentication server uses the corresponding public key.

Symmetric cryptography is usually used in OTP tokens. Each user has a unique personal key that is used to encrypt data to generate OTP. The same key is stored on the authentication server. The server encrypts the same data, and then the result is compared with the one sent from the client. If there is a match, the authentication is considered successful.

There are two modes in which OTP tokens can operate: asynchronous ("request-response") and synchronous ("response only", "time synchronization" or "event synchronization").

In the challenge-response method, a random challenge is generated by the authentication server, which is sent to the user, and then encrypted with an OTP token using the user's secret key. The same happens on the authentication server, and then the results are compared. If they match, authentication is considered successful. With a username, the random request and the encryption result are transmitted over the network in cleartext.

In synchronous methods, the authentication process differs in that the authentication server does not have to generate a request for its subsequent encryption, but uses different values. The response-only method generates a "hidden" request that uses the values of the previous request. Upon initial initialization of this method, a unique random seed is generated. In the "time synchronization" method, the OTP is generated based on the value of the internal clock. The event-based synchronization method quantifies how the user is authenticated and then generates an OTP based on this value.

It is also possible to use a combination of several different OTP authentication methods. The most common examples are a combination of time sync and event sync.

Public Key Authentication

An authentication method based on the use of public key cryptography. A key pair is generated for each user of the system, which consists of a public and private key. The public key is available to everyone and is stored on the authentication server, the private key is known only to the user for whom it was generated. These keys are needed to encrypt and decrypt information, because information encrypted with one key can only be decrypted with another key from this pair. This technology is at the heart of electronic digital signatures. Thus, the authentication server stores a file of public keys of all users, with the help of which the data that is generated by the server is decrypted and then sent to the user for encryption using his private key. This option is considered to be well protected, because if an attacker intercepts messages exchanged between the user and the authentication server, he cannot obtain any information about the user's private key.

Authorization

Authorization is a procedure for granting a subject certain rights of access to system resources after passing the authentication procedure. For each person, a set of rights is determined that he can use when accessing the resources of this system [4].

Authorization deals only with identified and authenticated users. In addition to granting access rights to users, authorization tools can also grant rights to perform various system functions.

To solve the authorization problem, the following access control models were developed [9]:

- Selective Access Control (DAC). When using this approach, each user or group of users is allowed or denied certain actions in the system by explicitly indicating their identifiers.
- Mandatory Access Control (MAC) Model. With this approach to determining access rights, all data is classified into information of different access levels (official, secret, top secret), all users of the system also receive a certain status, depending on which they have a different access level. The mandate approach is stricter than the selective approach, because users do not have the ability to change the level of accessibility of information. A user with a higher access level cannot grant read rights to his file to another user with a lower access level.
- Role-Based Access Control (RBAC). In this approach, roles are distinguished that carry access to certain system services. Users receive a role that contains the authority to access system objects.
- Attribute Access Control Model (ABAC). When using this approach, the user's access to the system objects is determined dynamically based on the analysis of the attributes available to the user and the requested object. This model introduces the concept of policies, which are expressed through a set of logical rules, which in turn take into account the attributes of the subject, object and environment.

Authorization and authentication procedures are very closely related and are implemented with the same software, which can then be integrated into third-party systems or applications, and also delivered as separate products. At the same time, there are two schemes on the basis of which software systems of authentication and authorization are built [9].

Server-based centralized schema. In this scheme, the server is engaged in providing network resources to the user. The main task of such systems is to implement the “single sign-on principle”. In this centralized scheme, the user goes through the authentication procedure once and after that receives a certain set of permissions for access to network resources for the entire time of his work. The most common system of this type is Kerberos, which was discussed earlier.

Decentralized scheme based on workstations. In this case, the authorization tools work separately on each machine. At the same time, the administrator has to monitor the operation of the security mechanisms of each individual application.

Authorization and authentication systems are closely interconnected, while authorization works only with identified and authenticated users, without ensuring access control, the existence of developed and complex systems would be impossible. Both systems need to have the same level of requirements. The reliability of the entire system is determined by the level of reliability of the most unreliable link. No link in this system can compensate for the other.

Overview of libraries that implement authorization and authentication methods

To implement authorization and authentication mechanisms, the following libraries were used, written for the Python language [8]:

- Flask
- Django
- SQLAlchemy
- Werkzeug, Jinja, OneTimePass, PyQRCode

Flask.

Flask is a small framework, which is why it is often referred to as a "microframework" [15]. It was designed as an extensible framework - it has a monolithic core that implements all the main services, and everything else is supported through extensions. Since the developer selects only the required packages, the result is a limited set of software tools that fully meet the requirements.

Flask has two main dependencies: WSGI (Web Server Gateway Interface) and templates from the Jinja2 project. The routing, debugging and interface subsystems are borrowed from the Werkzeug library. These libraries are described below.

Flask does not provide support for database access, web form validation, user authentication, or other high-level tasks, so the developer can

choose the extensions that are most suitable for the project. This is the main difference between Flask and other large frameworks, which provides ready-made implementations that are difficult to replace with your own, if at all possible.

Django.

Django is a high-level Python framework that allows you to create secure and maintainable projects [14]. Django encourages rapid development and clean, pragmatic design, and offers a quick and easy start. This makes it suitable for both beginners and experienced programmers.

Django provides a lot of functionality and a huge number of high-level implementations that developers might want to implement. This framework can be used for almost any type of site.Besides the extensive standard implementations included in the project packages, it can be extended with third-party components if needed. Django helps developers avoid common and common security mistakes, examples of which are a secure way to manage user accounts and passwords, prevent session information from being placed in cookies where it is vulnerable, or using passwords themselves instead of their hashes. Django is scalable as every part of the framework can be changed or replaced.

Unlike Flask, Django has ready-made authorization and authentication implementations that are standard and meet the latest security requirements, so only these will be used in this Django project.

SQLAlchemy.

SQLAlchemy is a Python software library for working with relational DBMSs using ORM technology [19]. Object-Relational Mapping is a programming technology that connects databases with the objects of the programming language used, creating a "virtual database".

This library synchronizes Python objects and relational database records, makes it possible to describe database structures and interact with them using the Python language, without using SQL. SQLAlchemy supports various databases, including PostgreSQL, which is used in these projects.

By using SQLAlchemy, applications are secure because query parameters are escaped, making it unlikely to use SQL injection. Also, the code written in Python is compatible with several DBMS, which makes it portable.

Werkzeug, Jinja, OneTimePass, PyQRCode.

Werkzeug is a comprehensive web library that is responsible for routing, debugging, and interface [20]. This library is the most advanced and voluminous library for providing WSGI utilities.

Werkzeug does not have any dependencies, it provides the developer with the ability to choose a library for using templates, a library that connects program code and databases, as well as a way to handle requests.

Also, this library is used in the project for hashing and password checking. Since this process is one of the main ones in protecting passwords from intruders, it is better to use ready-made and secure solutions than trying to write your own hashing function.

Jinja is a modern and developer-friendly templating language [12] for Python that has been modeled on Django templates [16]. It is widely used, efficient and safe.

This library provides many features, including:

- Template inheritance
- Fast compilation to optimal Python code
- The ability to compile the template in advance
- Easy debugging due to the readability and comprehensibility of exceptions
- Customizable syntax

OneTimePass is a module for creating and using one-time passwords, namely HOTP (HMAC-

based one-time passwords) and TOTP (time-based one-time passwords). They are used in Google Authenticator apps. Thanks to this library, it is possible to use the second authentication factor in the made project.

PyQRCode is a module that generates QR codes [18]. This module is written in pure Python. The advantage of this module is manual control of automation, which sets some or all of the properties of the QR code. This module is used to display OTP tokens, to synchronize them with devices of account holders.

Results of project implementation using different libraries

Django has the concept of "project" and "application". A project is Django code with some settings. An application is a set of modules that describe models, process requests, and store URL templates and configurations. One such application is the account application, as well as the authentication application, which is basic.

```
INSTALLED_APPS =
[
    'account.apps.AccountConfig',
    'django.contrib.admin',
    'django.contrib.auth',
    'django.contrib.contenttypes',
    'django.contrib.sessions',
    'django.contrib.messages',
    'django.contrib.staticfiles',
]
```

Listing 2.1. List of connected applications.

In the configuration file of our project, we must specify the applications connected to it in Listing 2.1, account.apps. AccountConfig is an account application that provides a set of basic models for working with users, groups, and permissions. With these models, we can immediately create tables in our database. This project uses PostgreSQL [17]. The database, user and password are also specified in the project settings file in the DATABASES dictionary Listing 2.2.

```
DATABASES = {
    'default': {
        'ENGINE': 'django.db.backends.postgresql',
        'NAME': 'django-diploma',
        'USER': 'ilya',
        'PASSWORD': '*******',
    }
}
```

Listing 2.2. Setting up a connection to the database

The authentication system is implemented in the django.contrib.auth package and is used by other packages. This system automatically detects the following models:

- User is a user model with username, password, email, first_name, last_name, is_active fields;
- Group is a model for a group of users;
- Permission is permission for a user or group of users to perform certain actions.

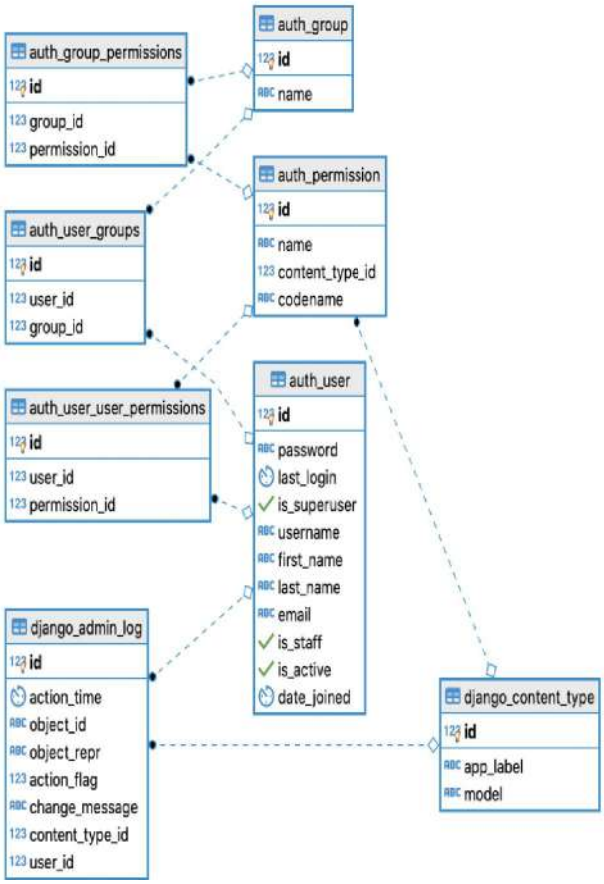

Figure 2.1. Database schema

After creating migrations, tables will appear in the specified database (Fig. 2.1). Since they are generated automatically, and their implementation cannot be changed, in order to expand information about users, roles and access rights, it will be necessary to create separate tables and build a one-to-one relationship with the data in them.

Django provides forms and handlers in the authentication subsystem. The authentication application contains a class that contains handlers. In our project, we connected the class handlers LoginView - the user login handler, LogoutView - the exit handler (Listing 2.3)

```
from django.contrib.auth import views as auth_views
urlpatterns = [
    path('login/', auth_views.LoginView.as_view(), name='login'),
    path('logout/', auth_views.LogoutView.as_view(), name='logout'),
    path('', views.dashboard, name='dashboard'),
]
```

Listing 2.3. Authentication processing connection

With the help of ready-made implementations and high-level functions, the main handlers, necessary models, tables in the database are created and used automatically. The written project has a page for entering user account data (Fig. 2.2), a page for successful authentication (Fig. 2.3) and a notification about unsuccessful authentication (Fig. 2.4).

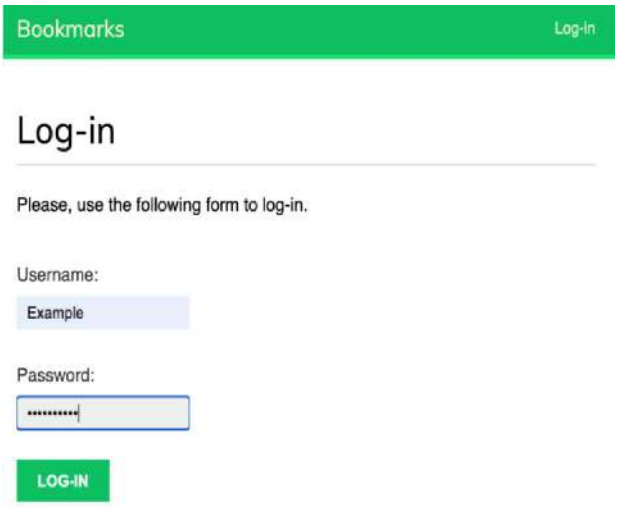

Figure 2.2. User account data entry page for identification and authentication

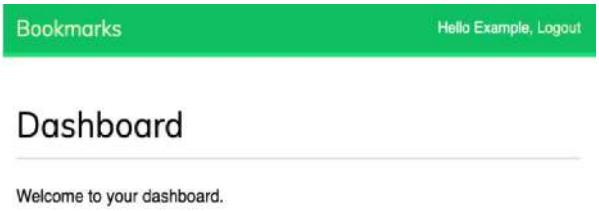

Figure 2.3. Page of successful passage of the identification and authentication procedure

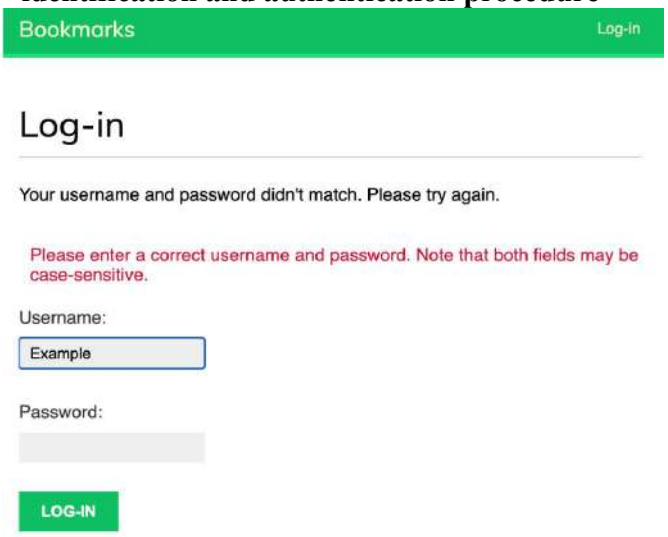

Figure 2.4. Notification of unsuccessful identification and authentication procedure

Project implementation using flask.

Flask differs from Django in that it gives the developer full control; the developer can choose the necessary components or write their own. This framework is very flexible and suits almost all requests.

Before creating and initializing the project, it is necessary to initialize the variables responsible for the settings, interaction with the database, the variables used in the project Listing 2.4.

```
class Config:
    SECRET_KEY = os.environ.get('SECRET_KEY')
    SQLALCHEMY_COMMIT_ON_TEARDOWN = True
    SQLALCHEMY_TRACK_MODIFICATIONS = False
    FLASKY_ADMIN = os.environ.get('FLASKY_ADMIN')
class DevelopmentConfig(Config):
    DEBUG = True
    SQLALCHEMY_DATABASE_URI = os.environ.get('DEV_DATABASE_URL')
config = {
    'development': DevelopmentConfig,
    'default': DevelopmentConfig
}
```

Listing 2.4. Initializing project settings

To set variables, the os.environ.get () function is used, with its help values are taken from environment variables, and not stored in the source code itself. This greatly increases the security of the project, since to access the database it is necessary to provide the login and password of the database administrator, and if this data is open and accessible from the source code, then the safety and reliability of the data of user accounts will be violated.

When starting our project, the first step is to create the application itself, in which the necessary mechanisms and components are initialized and connected. Listing 2.5. Create_app is a factory function that returns the created application instance. The settings described above are used, and the components required for the project are initialized. In the created project, db is an object of the SQLAlchemy class from the flask_sqlalchemy library, it is necessary to link the project with the database, specific classes with the database tables, login_manager is an object of the LoginManager class from the flask_login library, which manages the sessions of authenticated users. After initializing the necessary components, it is necessary to register the pre-created layouts that store the route definitions of our project.

```
def create_app(config_name):
    app = Flask(__name__)
app.config.from_object(config[config_name])
config[config_name].init_app(app)
bootstrap.init_app(app)
moment.init_app(app)
db.init_app(app)
login_manager.init_app(app)
from .main import main as main_blueprint
from .auth import auth as auth_blueprint
app.register_blueprint(auth_blueprint,
url_prefix='/auth')
app.register_blueprint(main_blueprint)
return app
```

Listing 2.5. Application creation

To create an authentication and authorization system, we need to declare the User and Role models, user and role, respectively. Thanks to the previously created db instance (Listing 2.5.) From the flask-sqlachemy extension, it is possible to define models, since it contains a base class for inheritance, as well as a number of helper classes and functions that are used to define data structures.

The role model is the Role class Listing 2.6, inherited from db.model, where __tablename__ is the name of the table in the database, and all other class variables declared as instances of the db.Column class are model attributes.

```
class Role(db.Model):
  __tablename__ = 'roles'
id = db.Column(db.Integer, primary_key=True)
  name = db.Column(db.String(64), unique=True)
  default = db.Column(db.Boolean, default=False, index=True)
  permissions = db.Column(db.Integer)
  users = db.relationship('User', backref='role', lazy='dynamic')
```

Listing 2.6. User Role Class

The id field is a unique identifier for the role, which is the primary key.

The name field is a unique string that stores the name of the role.

The default field is a boolean field that is responsible for the default role. There are 3 roles in this project: User, Moderator, and Administrator. The User role is considered standard for all users, thanks to the default field, this role is automatically assigned to all new users.

The permissions field is an integer number that is responsible for access rights, respectively, for the user authorization process. This number is interpreted as a bit mask of privileges, each bit corresponds to a specific privilege, and each role has its own set of privileges (Table 2.1).

Table 2.1

Privilege	Bit values
Access to the page for the user of the User role	0b00000001 (0x01)
Access to the page for the user of the Moderator role	0b00001000 (0x08)
Access to the page for the user of the Administrator role	0b10000000 (0x80)

The users field is an object-oriented representation of the relationship between the Role and User models; when accessing this attribute, a list of users who are assigned this role will be returned.

```
class User(UserMixin, db.Model):
  __tablename__ = 'users'
  id = db.Column(db.Integer, primary_key=True)
  email = db.Column(db.String(64), unique=True, index=True)
  username = db.Column(db.String(64), unique=True, index=True)
password_hash = db.Column(db.String(128))
role_id = db.Column(db.Integer, db.ForeignKey('roles.id'))
otp_secret = db.Column(db.String(16))
```

Listing 2.7. User account class

Also, the role_id field in the User model (Listing 2.7) is a foreign key that establishes the relationship. The call to the db.ForeignKey ('roles.id') function sets the value of this attribute to be interpreted as the value of the row id column from the roles table.

The id field is a unique identifier that is the primary key.

The email field is a unique string that is responsible for the user's email address that will be used for authentication.

The username field is a unique username.

The password_hash field is an attribute that stores the hash value of the user's password. Storing the password in clear text is considered insecure. All operations that require password authentication are performed with its hash value.

The otp_secret field stores the generated 10-character binary string, thanks to which one-time passwords are generated.

After writing these classes, it is necessary to create the corresponding tables in the database [1] (Fig. 2.5) by calling the db.create_all () function.

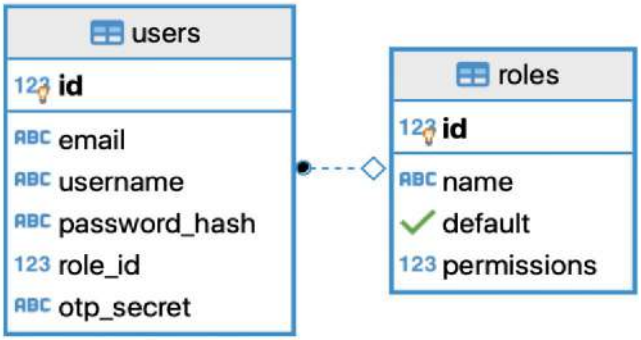

Figure 2.5. Project database using Flask

The insert_roles () function (Listing 2.8) was written to define and write user roles to the database as they are defined by the developer.

```
definsert_roles():
  roles = {
'User': (0x07, True),
'Moderator': (0x15, False),
'Administrator': (0xff, False)
  }
for r in roles:
    role = Role.query.filter_by(name=r).first()
if role is None:
      role = Role(name=r)
role.permissions = roles[r][0]
role.default = roles[r][1]
db.session.add(role)
db.session.commit()
```

Listing 2.8. Creating user roles

The User class defines functions for working with data, and also overrides the initialization of class objects (Listing 2.9). When initializing the role field, the role with the default = True attribute is automatically set, only if the email does not match the one specified in the settings. The secret key for the one-time password is generated automatically. When a password is written to the table, the hash value of this password is automatically written. The verify_password (self, password) function calculates the hash value of the argument passed to it and compares it with the existing one. The verify_totp (self, token) function works in a similar way. The can (self, permissions) function determines whether a given user has enough privileges to perform actions. When performing actions for which the user does not have sufficient privileges, a 403 'Forbidden' error is thrown.

```
def__init__(self, **kwargs):
super(User, self).__init__(**kwargs)
if self.roleis None:
if self.email ==
current_app.config['FLASKY_ADMIN']:
self.role =
Role.query.filter_by(permissions=0xff).first()
if self.roleis None:
self.role =
Role.query.filter_by(default=True).first()
if self.otp_secretis None:
self.otp_secret =
base64.b32encode(os.urandom(10)).decode('utf-
8')
@password.setter
defpassword(self, password):
self.password_hash =
generate_password_hash(password)
defverify_password(self, password):
return
check_password_hash(self.password_hash,
password)
defverify_totp(self, token):
return onetimepass.valid_totp(token,
self.otp_secret)
defcan(self, permissions):
return self.roleis not None and \
      (self.role.permissions& permissions) ==
permissions
```

Listing 2.9. User class methods

The login () function (Listing 2.10) is responsible for authenticating users. It uses the created authentication form (Fig. 2.6), which sends the entered data to this function. After identification, comparing the hash values of the password and one-time password, the user is authenticated. If one of the fields is incorrect, the user receives a notification about incorrectly entered data (Fig. 2.7).

```
@auth.route('/login', methods=['GET', 'POST'])
def login():
    form = LoginForm()
    if form.validate_on_submit():
        user = User.query.filter_by(email=form.email.data).first()
        if user is not None and user.verify_password(form.password.data) and user.verify_totp(form.token.data):
            login_user(user, form.remember_me.data)
            return redirect(request.args.get('next') or url_for('main.index'))
        else:
            flash('Invalid username, password or token')
    return render_template('auth/login.html', form=form)
```

Listing 2.10. User authentication function

Figure 2.6. Authentication form

An administrator account was used as the account. After entering the account data, as well as the one-time password from the device, the system notifies of the successful completion of the identification and authentication procedures (Fig. 2.8).

The permission_required () and admin_required () decorators are designed to check the user's privileges (Listing 2.11).

```
def permission_required(permission):
def decorator(f):
@wraps(f)
def decorated_function(*args, **kwargs):
if not current_user.can(permission):
abort(403)
return f(*args, **kwargs)
return decorated_function
return decorator
def admin_required(f):
return permission_required(Permission.ADMINISTER)(f)
```

Listing 2.11. Authorization decorators

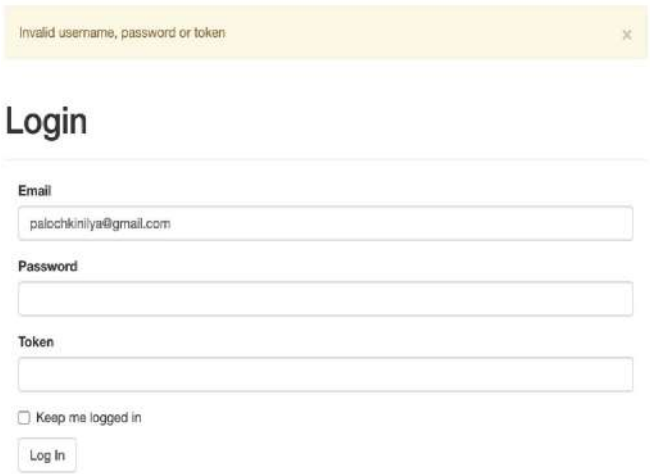

Figure 2.7. Invalid data notification

Figure 2.8. Successful Authentication Page

Pages / admin (Fig. 2.9) and / moderator (Fig. 2.10) are available for viewing only by users with the Administrator and Moderator or Administrator roles, respectively. Since each page in Flask needs its own function that processes it, using the permission_required () and admin_required () decorators, only users with the required role will be granted access (Listing 2.12).

```
@main.route('/admin')
@login_required
@admin_required
deffor_admins_only():
return "For administrators!"
@main.route('/moderator')
@login_required
@permission_required(Permission.MODERATE_COMMENTS)
deffor_moderators_only():
return "For moderators!"
```

Listing 2.12. Restricted page presentation functions

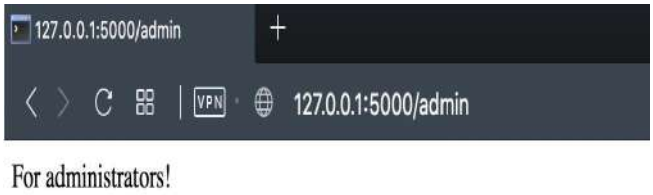

Figure 2.9. A page accessible only to a user with the Administrator role

Figure 2.10. A page available to a user with the Moderator or Administrator role

To define an authenticated user, the flask_login library has the @login_required decorator, which is used in the function of displaying the / auth / secret page (Fig. 2.11), so that any authenticated user can access it.

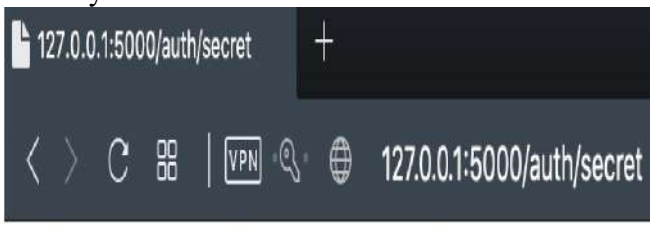

Figure 2.11. A page available to all authenticated users

When trying to get information on a page for which the user does not have sufficient rights, he receives an access error 403 (Fig. 2.12). This will happen if a regular user tries to view the / admin or / moderator pages, if a user with the Moderator role tries to view the contents of the / admin page, or an unauthenticated user navigates to the / auth / secret page.

Figure 2.12. Closed access to the moderator page for a user with the User role

Since this project uses two-factor authentication based on Google authenticator, it was necessary to create a registration form (Fig. 2.13) that will display the otp_secret attribute to the user in the form of a QR code (Fig. 2.14) in order to synchronize the account and the user's device.

Figure 2.13. User account registration page

Figure 2.14. Two-factor authentication setup page

After scanning the QR code, a cell with one-time passwords for authentication will appear on the user's device in the Google Authenticator [6] application (Fig. 2.15).

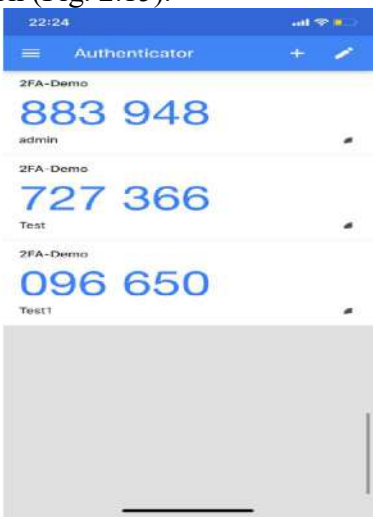

Figure 2.15. One-time codes in the Google Authenticator app on your phone

Conclusion

The paper considers the existing authorization and authentication mechanisms, developed an autonomous system that implements the correct operation of these mechanisms and secure data storage.

To demonstrate the efficiency of the considered approaches, two stand-alone model systems were developed on the Django and Flask web frameworks. For these systems, databases for storing account data were designed and implemented.

The system written on the basis of the Django framework uses the provided high-level functions and views that implement the authorization and authentication process. A system written on the basis of the Flask framework uses lower-level functions that make it possible to define and develop these mechanisms. The Werkzeug library was used for hashing, and the Jinja library was used for creating templates. It is worth noting that this system has implemented the possibility of two-factor authentication based on Google Authenticator, using the OneTimePass and PyQRCode libraries.

The data processed and used by the system is stored in a database based on the PostgreSQL RDBMS. The SQLAlchemy library was used to safely and quickly retrieve and process data.

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AUTOMATIC CLASSIFIER

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ABSTRACT

The call center is a central point from which all customer contacts are managed. These centers can be operated by either an in-house department responsible or outsourcing customer interaction to a third-party agency. These call centers interact with customers and try to facilitate and fulfill the customer needs. With such countless calls, it is vital for call Centers to comprehend the plan of these calls to give positive client encounters that guarantee consumer satisfaction, profound client commitment to help deals and income, and ideal assignment of specialists or client support agents across the business Effective Customer Lifecycle Management and Customer Relationship Management have become areas of prime focus for retaining and enhancing market share for any industry. Companies have set up call centers to interact with customers and try to facilitate and fulfill the customer needs. This can be implemented in any fields involving customer feedback or enquiry systems.

Keywords: *Customer, Call, Centers, Exchange, Management, Calls, Needs, Fulfill, Facilitate, Complain, Purchase*

Introduction

Call centers are valuable to companies because they provide a platform to customers where the company could enhance its image, resolve problems and to create a stronger customer base. The virtual queue provides callers with an alternative to waiting on hold when no agents are available to handle inbound call demand. AI, chat bots and automatedself-service technologies free up call center employees from routine tier-1 support requests so they can focus on more complex tasks. Customer questions – faster, with accuracy. Help agents get the job done smarter, all while reducing support costs.

A remote helper that answers your client's inquiries straightforwardly toward the front and furnishes your representatives with the data and assets that they need toward the back. The start to finish client supported with AI. The pathway to constant self-administration and AI help with client support presents tremendous freedoms to speculation organizations. Reasons why AI-upgraded client care is the fate of call focuses are Pre-emptive activity, the ascent of informing applications, you just need to prepare them once, Customer administration that is consistently on, Reliable assistance, any place clients need it, need for speed, Demand for self-administration choices, Personalization is critical, Scalability with speed.

Three outcomes that should guide all customer service engagements:

- **Customer Centric** - always ensure that any process or activity has the customer at the center of it.
- **Performance Driven** - continuously measure and enhance the performance.

Results Oriented - keep tracking how well you are doing in solving customer problems and howhappy the customers are.

Literature Survey

In the research [1], they are especially keen on performing text mining methods over transcribed audio to identify the speaker's emotion. This project describes the overall methodology and present the experimental results for speech-to-text transcription, text classification and text clustering. This paper describes the overall methodology and present the experimental results for speech-to-text transcription, text classification and text clustering.

In the paper[2], we characterize the issue of client call aim as a multi-class order issue originating from the enormous database of recorded call record transcripts. Experimental results show that with the thrust of our scalable data labeling method to provide sufficient training data, the CNN-based predictive model performs very well on long text classification according to the quantitative metrics of F1-Score, precision, recall, and accuracy. Ajmerain 'Audio classification using braided

convolutional neural networks. Recent publications suggest hidden Markov models and deep neural networks for audio classification. This study aims to achieve audio classification by representing audio as spectrogram images and then use a CNN-based architecture for classification. This study presents an innovative strategy for a CNN-based neural architecture that learns a sparse representation imitating the receptive neurons in the primary auditory cortex in mammals. The proposed CNN architecture, referred to as braided convolutional neural network, achieves 97.15, 95 and 91.9% average recognition accuracy on GSCv1, GSCv2 and US8 K datasets, respectively, outperforming other deep learning architectures. This paper evaluated a deep convolutional neural architecture for 2D image classification of sound events using a Mel-spectrogram representation.

In the Paper [3] Automated text classification has been considered as an essential technique to oversee and handle a tremendous measure of documents in digital forms. All in all, text classification assumes a significant part in data extraction and outline, text recovery, and question-replying. This paper outlines the content order measure utilizing Machine Learning Techniques.

Existing Systems

The job of call center agents to listen and understand customer concerns while also providing helpful information. At the end of the day, customer service call centers need to create satisfied customers with every call.

Normally in existing system, the calls from customers are picked by humans and they tend to classify them based on the conversation and this is traditionally being followed for a very long time in all call centers. This process is tedious. It makes customers to wait for long.

Fig 3.1 Managing call Queues in Call Center

PROPOSED SYSTEM

There Effective Customer Lifecycle Management and Customer Relationship Management have become areas of prime focus for retaining and enhancing market share for any industry. Companies have set up helplines to interact with customers and try to facilitate and fulfill the customer needs.

- More information can be collected if all such calls are manipulated and analyzed.
- For analyzing the data, it should be categorized. This could be a hectic task if done manually.
- The aim of this classifier is to automate the process of categorizing the conversations into one of the many categories so that it can be used for processing later.

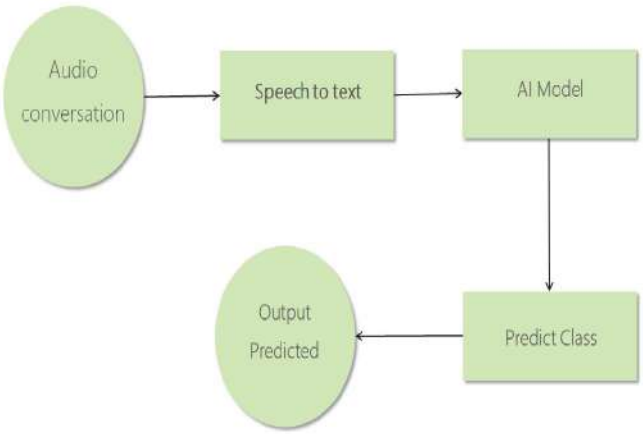
- These conversations mainly fall under the categories of

1. Purchase
2. Exchange
3. Service
4. Feedback

Technology Used:

Python Machine Learning Algorithm (SVM), Natural Language Preprocessing (NLP), Google speech Recognition API, Google Translator API.

Fig 4.1Flow Chart



DATASET COLLECTION AND PREPROCESSING

A data set (or dataset) may be an assortment of knowledge. within the case of tabular knowledge, a knowledge set corresponds to at least one or a lot of information tables, wherever each column of a table represents a selected variable, and every row corresponds to a given record of the info set in question.

Here Dataset was utterly curated by us.

Fig 4.1.1 Sample Dataset

	A	B
1	post	tags
2	I want to buy Washer	Purchase
3	I want to buy Dishwasher	Purchase
4	I need a Refrigerator	Purchase
5	I need to buy	Purchase
6	How much does it cost	Purchase
7	Great Service	Feedback
8	Happy with service and product	Feedback
9	Good	Feedback
10	Bad	Feedback
11	Can I exchange my old mixer	Exchange
12	I want to exchange grinder	Exchange
13	Can I exchange a different product from the one described b	Exchange
14	How can I get my used product back	Exchange
15	Is there a list of used products that can be exchanged	Exchange
16	Why do I see a different exchange value at different pin code	Exchange
17	How can I get my used product back	Exchange
18	No water or ice coming out of dispenser	Complaint
19	Icemaker does not make ice	Complaint
20	Buildup of ice in the fridge	Complaint
21	Water leaking	Complaint
22	Refrigerator not cooling	Complaint
23	Broken or faulty control panel or circuit board	Complaint
24	Not keeping food cold	Complaint
25	Blocked drain or outlet	Complaint

Pre-Processing Approach**:** Speech to Text API

1. Input Audio is converted to chunks.
2. Audio chunks converted to text.
3. Text is translated to English suppose it is in a different language.

Preprocessing Techniques used by Model:

- Remove Stop Words
- Remove bad Symbols
- Remove Punctuation
- Text to Lower Case

Model Training

A training model is a dataset that is used to train an ML algorithm. It consists of the sample output data and the corresponding sets of input data that have an influence on the output. The training model is used to run the input data through the algorithm to correlate the processed output against the sample output. The result from this correlation is used to modify the model.

Dataset: Custom dataset (Post-Call content, Tags-Labels)

Algorithm Used: SVM (Supervised Multi-class Text Classification)

Training Methodology: Cross Validation

Model Testing

Model testing means using models for describing test environments and test strategies, generating test cases, test execution and test design quality. MBT ensures the possibility to trace the correspondence between requirements, models,

code and test cases used for the tested system.
Testing is done with 30% of the dataset and the accuracy of testing the model is calculated using metrics such as precision recall and f1 score.

Classification

Classification is a process of categorizing a given set of data into classes, it can be performed on both structured or unstructured data. The process starts with predicting the class of given data points. The classes are often referred to as target, label or categories.
The audio is classified, and its category is displayed.

Application

Classification has been and continues to be a hot research topic in the data science arena. While text summarization algorithms have existed for a while, major advances in natural language processing and deep learning have been made in recent years. Many internet companies are actively publishing research papers on the subject.
These are some use cases where audio classification can be used across the enterprise:

Customer Relationship Management

Investment banking firms spend large amounts of money acquiring information to drive their decision-making, including automated stock trading. When you are a financial analyst looking at market reports and news every day, you will inevitably hit a wall and will not be able to read everything. Classification systems tailored to financial documents like earning reports and financial news can help analysts quickly derive market signals from content.

Customer Life Cycle Analysis

The customer lifecycle is a term that describes the different steps a customer goes through when they are considering, buying, using, and remaining loyal to a particular product or service. These conversations can be classified for further research and analysis can tell how to improve the customer life cycle.

Question Answering and Bots

The customer lifecycle is a term that describes the different steps a customer goes through when they are considering, buying, using, and remaining loyal to a particular product or service. These conversations can be classified for further research and analysis can tell how to improve the customer life cycle.

Result

Finally, the audio conversations have been classified into their appropriate categories and the results are displayed. In future we look forward to include more categories and do the needful. This would definitely help industries in increasing their customer relationship management
The (fig 6.1) is the predicted experimental results precision and weighted averages.

	precision	recall	f1-score	support
Purchase	1.00	0.62	0.77	8
Feedback	0.50	1.00	0.67	4
Exchange	0.83	0.62	0.71	8
Service	0.78	0.88	0.82	8
micro avg	0.75	0.75	0.75	28
macro avg	0.78	0.78	0.74	28
weighted avg	0.82	0.75	0.75	28

Fig 6.1 Experimental results

An audio was sent as input, the input audio falls under service category and our module predicted it correctly with 78% of accuracy (Fig 6.2).

```
C:\Users\shali\Anaconda3\lib\site-packages\sklearn\linear_model
\stochastic_gradient.py:183: FutureWarning: max_iter and tol parameters have been
added in SGDClassifier in 0.19. If max_iter is set but tol is left unset, the
default value for tol in 0.19 and 0.20 will be None (which is equivalent to -
infinity, so it has no effect) but will change in 0.21 to 1e-3. Specify tol to
silence this warning.
  FutureWarning)
Converting audio into text:
I need to fix my washing machine how much do you charge for service
The audio file belongs to the category:
['Service']
```

Fig 6.2 Predicted Category Result (Service)

An audio was sent as input, the input audio falls under purchase category and our module

predicted it correctly with 100% of accuracy (Fig 6.3).

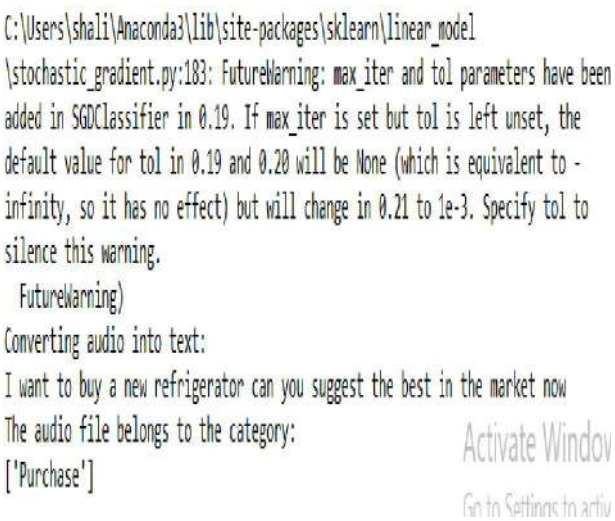


Fig 6.3 Predicted Category Result (Purchase)

An audio was sent as input, the input audio falls under Exchange category and our module predicted it correctly with 83% of accuracy (Fig 6.4).

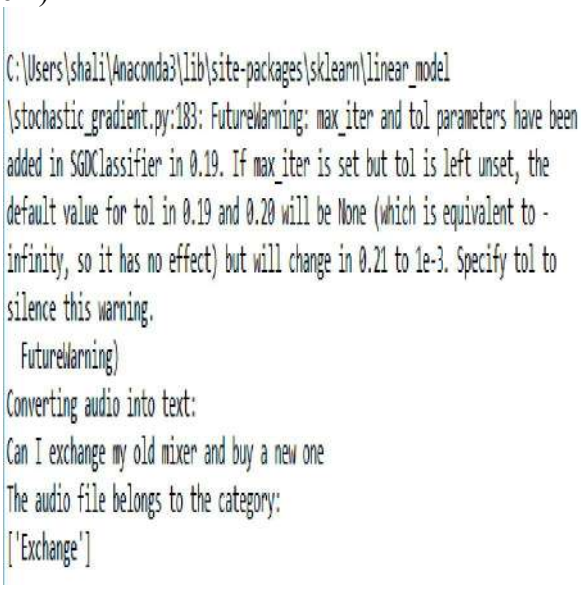


Fig 6.4 Predicted Category Result (Exchange)

An audio was sent as input, the input audio falls under Feedback category and our module predicted it correctly with 50% of accuracy (Fig 6.5).

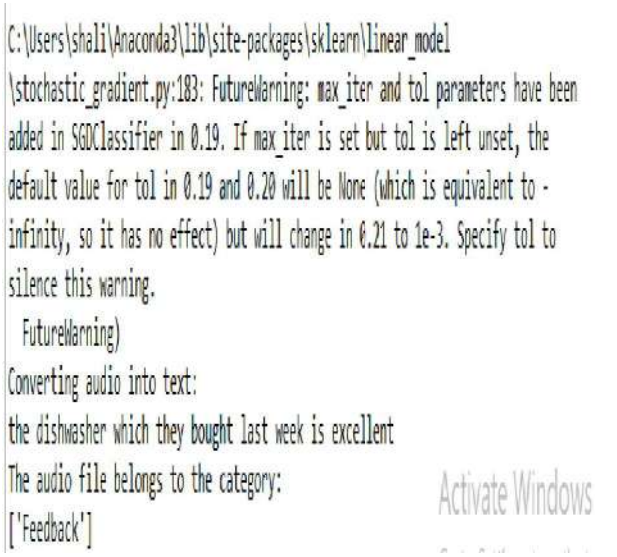


Fig 6.5 Predicted Category Result (Feedback)

Conclusion

Automatic text classification is an old challenge, but the current research direction diverts towards emerging trends in news, call centers, industries, education and blogs. This is because there is information overload in these areas, especially on the World Wide Web. It consists of automatically classifying the audios. Audio classification approaches based on Neural Network, Graph Theoretic, Fuzzy and Cluster have, to an extent, succeeded in making an effective summary of a document. Both extractive and abstractive methods have been researched. Most classification techniques are based on extractive methods. An Abstracted method is similar to summaries made by humans. Abstractive audio classification as of now requires heavy machinery for language generation and is difficult to replicate into the domain specific areas.

Future Work

This method is proposed only for English. In Future It can be done for Native languages like Hindi, Tamil, Kannada, Malayalam, Telugu, Marathi and so on and can also Identify customer issues and respond with solutions, suggest personalized offers, Process and learn from gathered information.

Acknowledgment

This method is proposed only for English. In Future It can be done for Native languages like Hindi, Tamil, Kannada, Malayalam, Telugu, Marathi and so on and can also Identify customer issues and respond with solutions, suggest personalized offers, Process and learn from gathered information.

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EFFECT OF COVID-19 ON MENTAL HEALTH OF STUDENTS AND PERCEPTION OF KNOWLEDGE ABOUT COVID-19

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ABSTRACT

Aims: *This study aimed to assess the mental health of students during the COVID-19 pandemic and to examine their perception of knowledge about COVID-19.* ***Material and methods:*** *An anonymous internet based survey was distributed to 150 students via Google forms. The survey was completed by 108 students that included their knowledge about COVID-19 through a self designed questionnaire, the General Health Questionnaire (GHQ-12) and the PTSD Checklist-Civilian Version (PCL-C). Univariate and bivariate analysis were used to evaluate the effect of COVID-19 on youth mental health.* ***Results:****The study consisted of 108 participants (23 males [19.8%] and 85 females [80.2%]). Regarding the knowledge about COVID-19, 95% CI 41.9-62.9% of the participants had full knowledge of the information about COVID-19, with 95% CI 1.9-3.8% participants reporting to have no knowledge.One-way ANOVA did not reveal any significant changes between GHQ-12 and PTSD between gender, age, marital status and socioeconomic status. However, socioeconomic status was slightly more but not statistically significant. The subcategories of the demographic variables were also not associated with GHQ-12 and PTSD on LSD post hoc comparisons.52.4% of participants reported difficulty in concentration, 59.6% participants reported a slightly higher level of stress during the pandemic, 53.9% were unhappy and depressed, almost 50.5% reported to lose confidence, 28.6% reported to be feeling cut off from other people in the pandemic and 32.7% reported difficulty in falling asleep.* ***Conclusion:****The non-significant results in this study negate the expected trend in the pandemic scenario regarding the mental health status of students and improve the reliability of the literature. As the survey was conducted almost a year after the pandemic started, the negative effects on the behavioral aspects of students might have decreased in severity. Also, there are some limitations to the study such as small sample size, biased sample selection and non-representative nature of the selected sample. Therefore no strong conclusions can be drawn from the results. Nevertheless, local governments and educational institutions should develop effective psychological interventionsfor students. Given the unpredictable duration of the pandemic and its high severity, the public health awareness and mental health concerns need to be addressed more efficiently. Further research is required in this area to evaluate the mental health status during the pandemic era.*

Keywords: *COVID-19, stress, depression, coping, questionnaire*

Introduction

SARS-Cov-2 has emerged from the seafood market in Wuhan city of China with several cases of pneumonia with unknown etiology emerging by November 2019.[1]Theinfection was named as "coronavirus disease 2019" (COVID-19) by WHO.Although known to have originated from animal origin, it is reported to have a human to human spread through coughing, sneezing and by spread of respiratory droplets and aerosols.[2]This global pandemic is being fought by the healthcare workers across the world who are taking efforts to control the disease. Also, vaccines against the SARS-CoV-2 virus are also available and mass vaccination programs have begun across the globe.[3]

This global pandemic has come with issues of uncertainties and fears associated with the pandemic, nationwide lockdown, loss of jobs and drop in the economy which have led to mental health issues such as depression, anxiety, stress and even suicide.[4]Especially in students, mental health issues are an obstacle to academic performance in their educational courses due to disturbances in motivation and concentration.[5]On 24 March 2020, the Indian government ordered a nationwide lockdown limiting the movement of the general population resulting in the closure of educational institutions. This resulted in uncertainty in the academic and professional career of students. Given this situation, this study was conducted to evaluate the psychological impact of COVID-19 on college going students and assess their knowledge about the infection.

Methods

An anonymous internet based survey was distributed to 150 students via Google forms. The survey was completed by 108 students that included their knowledge about COVID-19 through a self-designed questionnaire, the

General Health Questionnaire (GHQ-12) and the PTSD Checklist-Civilian Version (PCL-C). Univariate and bivariate analysis were used to evaluate the effect of COVID-19 on youth mental health. The response rate was 72%.

Measures Knowledge about COVID-19

Five questions were used to assess the knowledge of the students such as "Do you know that the patients infected with COVID-19 experience mild to moderate respiratory illness and that medically compromised patients are more likely to develop serious illness?". Participants could select from 1 (did not have full knowledge) to 5 (full knowledge) to judge the participants' knowledge about COVID-19.

The General Health Questionnaire Scale (GHQ-12)

The General Health Questionnaire (GHQ-12)[6] was used to evaluate the mental health status by asking whether the participant has experienced a particular symptom or behavior recently. It consists of 12 questions to assess the severity of a mental health problem over the past few weeks using a 4 point scale (from 0 to 3, less than usual, no more than usual, rather more than usual, much more than usual). The total score of the questionnaire ranges from 0 to 36 with higher scores indicating a worse mental health. The application of this questionnaire in research settings is well documented with the evidence that is consistent and reliable method when used in general population samples.

The PTSD Checklist-Civilian Version (PCL-C)

The post-traumatic stress disorder Checklist-Civilian Version (PCL-C)[7] is used in this study which is a standardized self-reporting rating scale comprising of 17 items corresponding to the key symptoms of PTSD. Respondents indicate how much they have been bothered by a symptom using a 5 point scale (1-5, 1- Not at all, 5 – extremely).

Statistical analysis

Data was coded and analyzed in a statistical software STATA, version 10.1 (2011) designed by Stata Corp, Texas (USA) with $P < 0.05$ as the level of statistical significance.For comparison of two categories, t-test for two independent samples was used and for more than two categories, one-way ANOVA (F-test) was used for comparison across the categories. Descriptive analysis included summary measures like mean and standard deviation for quantitative variables, or frequency and percentages for categorical variables. Binary multiple logistic regression (MLR) analysis was also performed to adjust observed association between outcome and response for respondent's characteristics and other variables.

Results

The demographic characteristics of the 108 patients (23 males [19.8%] and 85 females [80.2%]) are shown in Table 1. Their ages ranged from 18 to 32 years of age. Most of the study participants were above the age of 20 years (80%). All of the participants were college going students and most of them were single (98.1%). 96.3% students belonged to the middle class.

Regarding the knowledge about COVID-19, 54.6% of the participants had full knowledge of the information that COVID-19 patients experience mild to moderate respiratory illness and that medically compromised patients are more likely to develop serious illness, but 2.9% of them did not have full knowledge of the same. Also, 63-66% of the participants had full knowledge about the information presented in question 2,3 and 4 (Graph 1). Only 41.9% of the participants knew that the COVID-19 virus can survive up to 72 hours on plastic and stainless steel, less than 4 hours on copper and less than 24 hours on cardboard (Table 2).

One-way ANOVA did not reveal any significant changes between GHQ-12 and PTSD between gender, age, marital status and socioeconomic status (Table 3). However, socioeconomic status was having slightly more influence though not statistically significant. The subcategories of the demographic variables were also not associated with GHQ-12 and PTSD on LSD post hoc comparisons (Table 4). 52.4% of participants reported difficulty in concentration, 59.6% participants reported a slightly higher level of stress during the pandemic, 53.9% were unhappy and depressed, almost 50.5% reported to lose confidence, 28.6% reported to be feeling cut

off from other people in the pandemic and 32.7% reported difficulty in falling asleep (Graphs 1 to 6).

Univariate logistic regression was conducted to define the factors forecasting psychiatric symptoms. Though the results were not statistically significant for any of the parameter (Table 5)but adjusted odds ratios with magnitude >1 for gender and socio-economic status do suggest that malestudents (OR =1.82) and students with medium and high socio-economic status (OR =1.68) are likely to be more influenced by the pandemic than their counterpart.

Discussion

COVID-19 is an unprecedented infective disease with changes in the lifestyle due to lockdown, social distancing having implications in the economic and social life taking a toll on mental health in the world. In this survey, the results for assessing the mental health of students with GHQ-12 and PTSD questionnaires were not statistically significant. These non-significant results negate the expected trend in the pandemic scenario regarding the mental health status. The reasons for the non-significance could be a small sample size of 108 participants, biased sample selection of only college going students in the age group 20-35 years of age and non-representative nature of the selected sample.

52.4% of participants reported difficulty in concentration, 59.6% participants reported a slightly higher level of stress during the pandemic, 53.9% were unhappy and depressed, almost 50.5% reported to lose confidence, 28.6% reported to be feeling cut off from other people in the pandemic and 32.7% reported difficulty in falling asleep. A systematic review on COVID-19 pandemic and mental health consequences reported general public revealed lower psychological well-being and increased anxiety and depression as compared to the pre pandemic period. Female gender, poor self-related health and relatives with COVID-19 were the factors associated with the psychiatric symptoms.[4] Past pandemics have also demonstrated a wide array of neuropsychiatric symptoms such as mood changes and psychosis.[8] Another systematic review and meta-analysis on the prevalence of mental health problems during COVID-19 pandemic suggested the pooled prevalence of depression, anxiety, distress, and insomnia was 31.4%, 31.9%, 41.1% and 37.9%, respectively and that the general population and non-medical staff had a lower risk of distress than other populations.[9]

Also, it was found that most of the participants (41.9-62.9%) had knowledge and exhibited good understanding regarding COVID-19 infection signs and symptoms, self isolation, social distancing, awareness and ways to protect oneself from the infection, the procedure of wearing a face mask and information regarding the COVID-19 virus, but a few participants [1.9-3.8%] lacked the knowledge completely. This understanding plays a role in the control of this pandemic. If the public is cognizant about the disease and its modes of transmission, then only it can be expected from them to follow measures to protect themselves and prevent further spread. A single unaware person can be a potential source of infection for the entire community or region if precautionary measures are not implemented. Similar results are obtained by other studies that identified the awareness related to COVID-19 to be around 60-80% suggesting that effective awareness campaigns should be undertaken for public awareness.[10]

It was also found in the study that male students with medium and high socioeconomic status were more likely to be affected due to the pandemic. Similar results have been reported by a study evaluating the impact of COVID-19 on mental health which observed a feeling of solitude, being withdrawn and self-harm in males as compared to females.[11] Contradictory studies reporting worse effects on mental health of females are also available in the literature.[12]

The results of this study could have implications on the field of research on mental health of individuals in the COVID-19 pandemic. The findings contrast with the existing studies studying the levels of stress, anxiety and depression among students in the pandemic which improves the reliability of the literature. Further research in this area is necessary to reconcile the differences in the results. Future researchers should include a population which as a wider age group, with different levels of education, socioeconomic

status and maybe follow the results to a longer period of time to study the effect of these factors on the outcomes of the study.

Conclusion

The non-significant results are quite different from what was expected. But due to limitations of the study, no strong conclusions can be drawn. Nevertheless, local governments and educational institutions should develop effective psychological interventions for students. Given the unpredictable duration of the pandemic and its high severity, the public health awareness and mental health concerns need to be addressed more efficiently.

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Table 1 Demographic characteristics of the participants (n = 108)

Variable		**Sample (n=108)**	**Percentage**
Gender	Male	23	21.3
	Female	85	78.7
Age	Up to 20	28	25.9
	>20	80	74.07
Educational status	Primary school		
	Secondary school		
	High school		
	College/university	108	100
Marital status	Single	106	98.1
	Married	2	1.85
	Widowed		
Socioeconomic status	High	1	0.93
	Middle	104	96.3
	Low	3	2.78

Table 2: Knowledge about COVID-19

Question	Fully known (%)	Not known (%)
Do you know that the patients infected with COVID-19 experience mild to moderate respiratory illness and that medically compromised patients are more likely to develop serious illness?	56(53.3)	3(2.9)
Do you know what is the difference between self-isolation, self-quarantine and distancing?	64(59.2)	3(2.78)
Do you know that ways to protect yourself from COVID-19 and how to prevent the spread of the disease?	64(59.2)	2(1.85)
Do you know the proper procedure for wearing a face mask?	67(62.04)	3(2.78)
Do you know that COVID-19 virus can survive up to 72 hours on plastic and stainless steel, less than 4 hours on copper and less than 24 hours on cardboard?	45(41.6)	4(3.7)

Table 3: Summary of GHQ-12, PTSD scores by demographic characteristics of the respondents

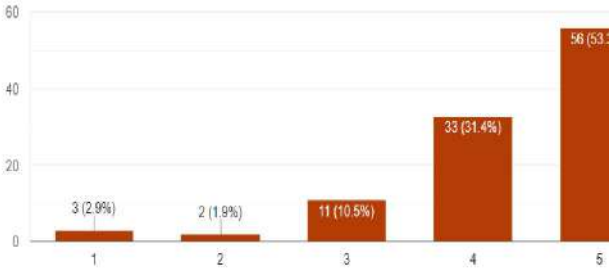
Variable		GHQ-12		PTSD	
		Mean ±SD	P	Mean ±SD	P
Gender	Male	15.34 ± 4.80	0.9896	46.60 ± 18.56	0.8884
	Female	15.33 ± 4.80		46.02 ± 17.47	
Age	Up to 20	15.32 ± 5.76	0.9845	44.03 ± 20.23	0.4638
	>20	15.34 ± 4.32		46.88 ± 16.69	
Educational status	Primary school	-	-	-	-
	Secondary school	-		-	
	High school	-		-	
	College/university	15.33 ± 4.71		46.14 ± 17.62	
Marital status	Single	15.27 ± 4.71		46.33±17.72	0.4137
	Married	18.5 ± 4.94		36 ± 7.07	
	Widowed	-		=	
Socioeconomic status	High	15 ± 0	0.7601	3 ± 0	0.1597
	Middle	15.28 ± 4.72		2.35 ±1.17	
	Low	17.33 ±5.77		3.66 ±1.52	

Table 4 Results of post-hoc analyses among the respondents with and without psychological disorder (i.e. GH 12 score >12) by their demographic characteristics

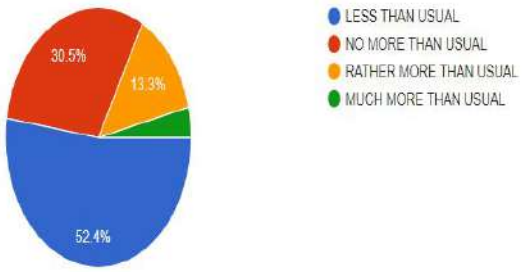
Characteristics		Psychological disorder (GH 12 score >12)				P value
		Present		Absent		
Variable	Categories	No.	%	No.	%	
Age-group	≥20 years	61	76.25	18	64.29	0.2189, NS
	< 20 years	19	23.75	10	35.71	
Gender	Male	15	65.22	8	75.29	0.3334, NS
	Female	64	34.78	21	24.71	
Marital status	Married	77	72.64	29	27.36	0.3871, NS
	Single	2	100.0	0	0.00	
Educational status	College/university	79	73.15	29	26.85	-
Socioeconomic status	High	1	100.0	0	0.00	0.4670, NS
	Middle	75	72.12	29	27.88	
	Low	3	100,0	0	0.00	

Table 5 Factors associated with psychological disorder (GHQ-12 score>12) from Crude and Adjusted (Multiple Logistic Regression) analyses

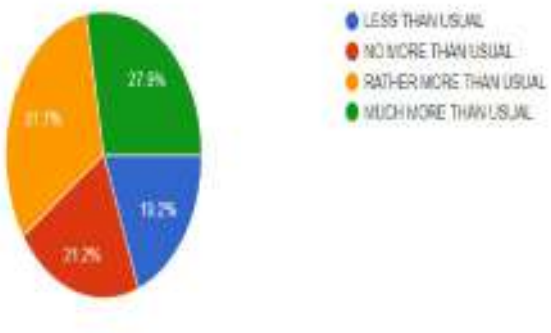
Variable		**Crude OR(95%CI), P value**	**Adjusted OR(95%CI), P value**
Age (>20)	<20 years	1 (Reference)	
	≥20 years	1.78 (0.62 -4.92). P=0.2189	1.57 (0.56 -4.38). P=0.3930
Gender (Male)	Female	1 (Reference)	
	Male	0.61 (0.21 -1.93), P=0.3314	1.82 (0.61 -5.47), P=0.2870
Marital status (Married)	Single	1 (Reference)	
	Married	0.97 (0.94 – 1.01), P=0.3871	-
Socioeconomic status (Medium & High)	Low	1 (Reference)	
	Medium & High	0.96 (0.92 – 1.01), P=0.2841	1.68 (0.64 -43.48), P=0.0756



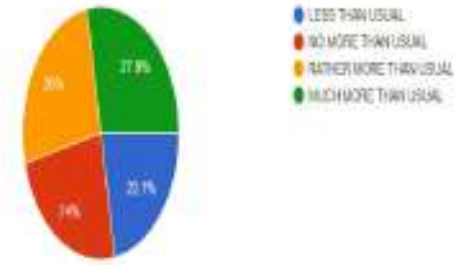
GRAPH 1: KNOWLEDGE ABOUT COVID-19: RESPONSE TO QUESTION 1



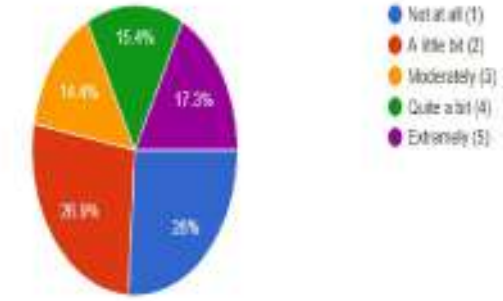
GRAPH 2: GENERAL HEALTH QUESTIONNAIRE: RESPONSE TO QUESTION 1 (ABLE TO CONCENTRATE?)



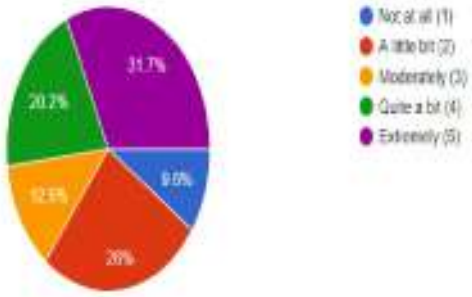
GRAPH 3: GENERAL HEALTH QUESTIONNAIRE: RESPONSE TO QUESTION 5 (UNDER STRESS?)



GRAPH 4: GENERAL HEALTH QUESTIONNAIRE: RESPONSE TO QUESTION 9 (FEELING UNHAPPY AND DEPRESSED?)



GRAPH 5: PTSD CHECKLIST- CIVILIAN VERSION (PCL-C): RESPONSE TO QUESTION 13 (TROUBLE FALLING OR STAYING ASLEEP?)



GRAPH 6: PTSD CHECKLIST- CIVILIAN VERSION (PCL-C): RESPONSE TO QUESTION 15 (HAVING DIFFICULTY CONCENTRATING?)

POTENTIAL ANALYSIS OF ADDITIVE LAYER MANUFACTURING TECHNOLOGIES USED FOR PROCESSING POLYMER COMPONENTS

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ABSTRACT

In previous years, the usage of additive layer processing grew considerably. Different companies, including motor cars, aerospace, equipment, communications and medical devices utilize additional layer production. However, at present, processed additive layer products comprise less than one percent of all items manufactured. If the prices of additive layer processing systems decline, the manner in which customers communicate with suppliers will be modified. Additional development layer innovations provide the market and culture with different possibilities. It will make the personalized development of strong lightweight goods simpler, and prototypes that with past manufacturing techniques were not feasible. However, the application of this device may be hampered and delayed by numerous obstacles. Many situations require higher costs than conventional approaches for making a component utilizing additive layer production techniques. This study reviews the cost literature for the development of additive layer and attempts to recognize situations in which additive production may be cost-effective and also to identify new methods of minimizing costs in the usage of this technology.

Keywords: *Additive layer manufacturing (ALM), metal tools, rapid prototyping, modeling, polymers, SLM.*

Introduction

In today's speeches from numerous academic experts, responsible creativity is a familiar and yet problematic term. Europe's leaders fight to announce that their country or territory in all industries is moreresponsible and creative than their neighbors. However, corporations, trade associations and industries still argue that their laws, technical, sociological, and economic problems have not been subject to the correct conditions and actions at responsible innovation, and that everyone has a voice to understand what constitutes the secret to responsible innovation [1]. It is an ever-growing field which has attracted both political and scholarly interest (Grunwald, 2011). Smart, balanced and balanced development, which is targeted by the EU 2020 plan, becomes central to responsible science innovation (European Commission, 2010). Likewise, in additive layer technology, especially in aerospace, the responsible definition was often used [1, 2]. In general, the technology undergoes the industrial revolution leading mainly to considerable improvement in the manufacture of additive layers (ALM) (popularly named 3D Printing, 3DP).

Additive Layer Manufacturing Technology: Indian Perspective

Basic development practices ranged from 5000 to 4000 BC, according to the historian. The development operations are primarily concentrated on woodwork, ironwork and metalworking. Following that, some sculptures were made in the 2500 BC with earthenware, glass beads, wax and jeweler parts. During AD 600-800, steel output, casting sand from cast iron, during AD 800-1200 has been reported [2]. The manufacturing of ancient India began 3000 BC and the example of a casting that was found at Mohenjodaro of the 11 cm old bronze dance child. In the region of Delhi in 2000 BC iron bowls, daggers, nails, arrows and haoks were discovered (Hopkinson 2006).

A.History of Manufacturing

Manufacturing is the overwhelming majority of things in which we communicate in our everyday lives. This covers extremely complicated items such as our vehicles or machines, our clothing, our chair, the roof over our head and also food. The combination of fundamental processing processes (Beitz and Küttner 1995) can be used across all production measures required to produce this broad variety of goods. Six classes also use these strategies. The first is when a section of an entity is cut off. Boiling, sifting, folding, baking, turning and chiseling are typical examples. The second is that the characteristics of the products are evolving to enhance their properties [3,4].

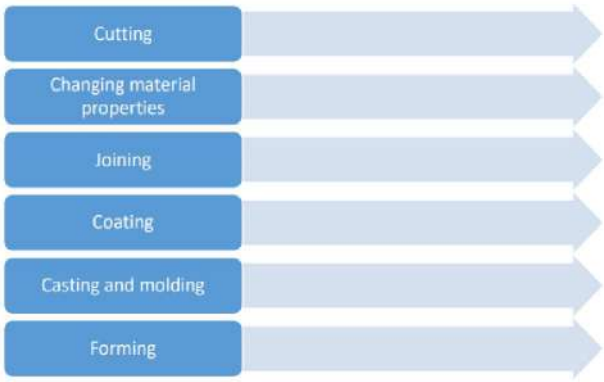

Fig 1: Fundamental manufacturing techniques [3].

B.Manufacturing with Technology

In addition, processing methods developed parallel to developments in culture and contributed to the early steps of the European industrial revolution. Because textiles were still the main part of manufacturing industry in addition to food production, spinning, weaving and knitting equipment were enhanced various [5]. These labor improvements were frequently criticized by employees and the government.

C. Additive layer Manufacturing - Market Growth

The manufacturing of additional layer applications appears virtually infinite. Early usage of 3D printing in the form of fast pre-production prototyping. But the production of additive layers is still used to produce consumer high tech (aerospace, pharmacy, automobiles, and electronics) and goods for customers (home and fashions) Nowadays not just polymers but metals and ceramics are part of our materials [6, 7].

D. Additive layer Manufacturing: Key Processes & Polymers

Seven areas are listed in additional layer production processes. The ASTM International Technical Committee F42 on the development of additive layer technology has established these classifications [7]. The Committee's function focuses on encouraging awareness, fostering research and the use of technologies through developing norms.

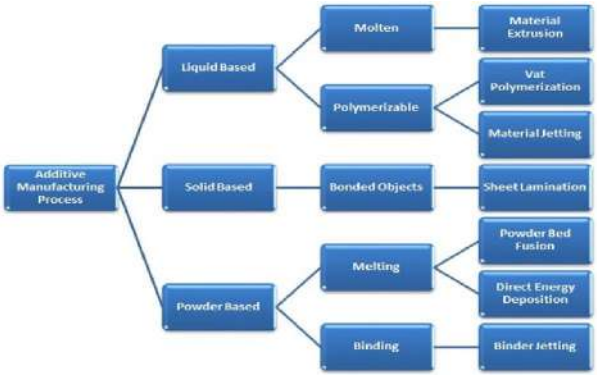

Fig 2: Consolidation approach and the applicable phase of additive layer development [7].

E. Photopolymerization Additive layer Manufacturing Process

The photopolymer's self-adhesive property lets the layers bind together and a full three-dimensional object is essentially preserved and hardened entirely. Designs will be sunk into a liquid bath to extract excess resin in an ultraviolet oven and post-cured. You may also print items "bottom up" with a vat with a slightly versatile transparent backdrop and concentrate UV upwards around the base of the vat [8].

F.Powder Bed Fusion

Powder fusion is similar to binder jetting, except for powder layers, such as a laser or a choice beam, that combine with a heat source. This method is known as SML or electron beam melting (EBM) while metal powder is used. This process is also known as SML. Sintering is an alternative way to liquefy the powder through fire [9].The method of powder bed fusion includes the commonly used printing strategies: DMLS, Electron Shaft Smoothing (EBM), Selective Hot Sintering (SHS), Selective Laser Dissolving (SLM) and Selective Laser Sintering (SLS).

G. Stereolithography (SLA) and fused deposition modeling (FDM)

Overhaul-designing systems also involve specific support structures for the creation of other processes for added layer, such as stereolithography (SLA) and fused deposition modelling (FDM) [10]. Although SHS does not need a specific support material feeder, since the building component is still surrounded by uninterred powder, this enables previously impossible geometries to be installed.

H. Properties of Polymeric Materials for Additive layer Manufacturing

There is also minimal penetration in such sectors, and these limitations are primarily linked to usable content styles. The properties of new materials should be consistent with both the application and the deposition method. Any of the functionality for modern polymerized products are mechanical stability, chemical stability, thermal stability and biocompatibility [11].

I. Additive layer manufacturing growth trend and market status

AM techniques will easily, economically and efficiently construct any form of geometry as opposed to traditional production. This helps the AM method to blend into the numerous development fields. The AM technological concept was recorded by Chua et al. (2010) at the end of 1980. In 2012, the annual growth survey, the AM and 3D business state shows an annual increase to $1.7 billion for 2010-2011 and it is projected that the overall annual sales of the AM industry will raise to $3.7 billion by 2019 [12].

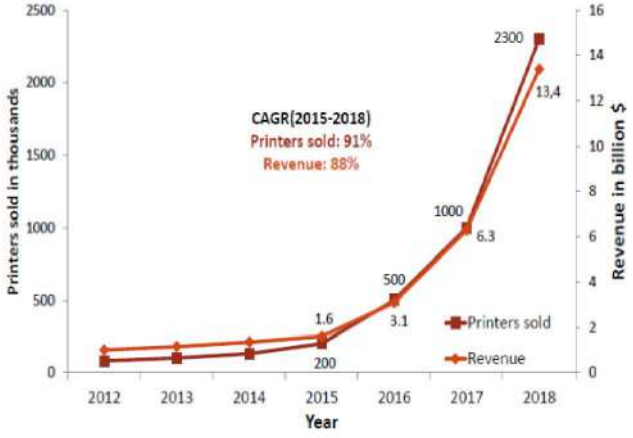

Fig 3: AM system unit sold till year 2015 [12].

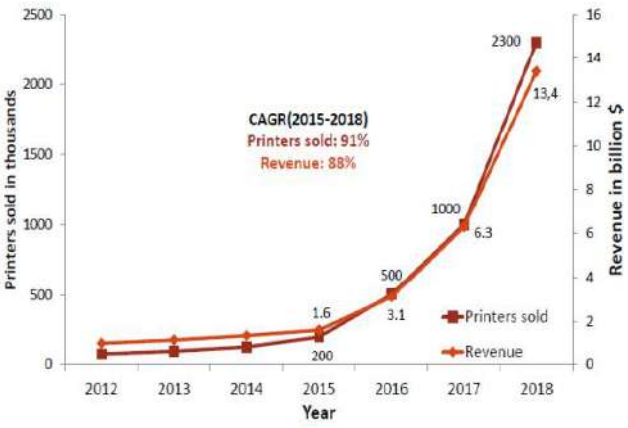

Fig 4: CAGR revenue analysis (2015-2018) [12].

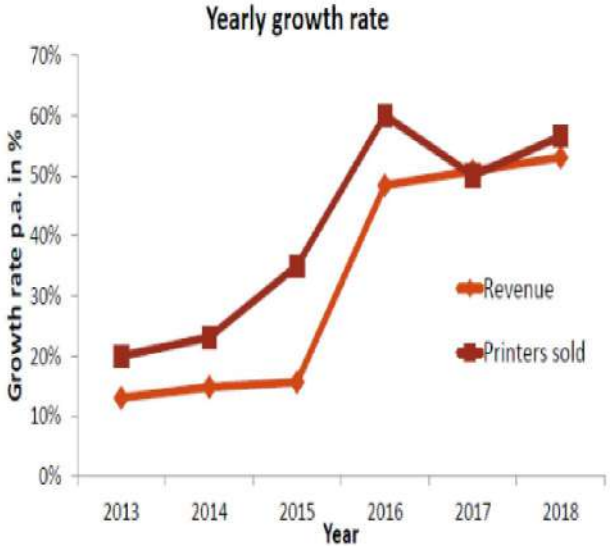

Fig 5: Growth rate per annum in percentage [12].

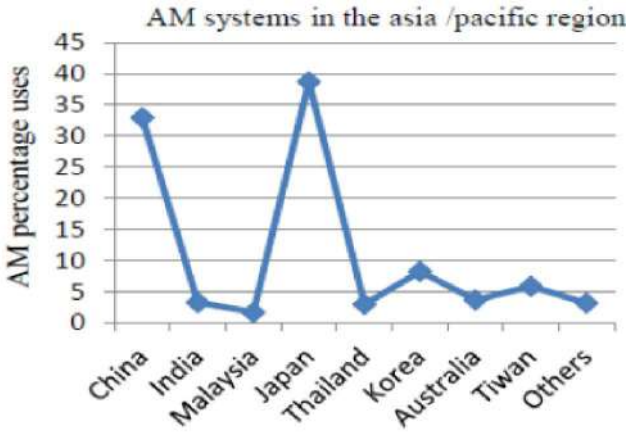

Fig 6: Approximate AM percentage uses in the Asia/Pacific region by the end of 2016 [13].

The laser spot has a smallest (D) diameter (α = 0, as seen in Figure 2.13), which enables the laser spot to concentrate on the scan floor more efficiently. If the value is $\alpha > 0$, the laser spot

diameter is D' = D/cos α on the scan field. The discrepancy between D' and D is seen as:

$$\delta = D\left(\frac{1}{\cos \alpha} - 1\right)$$

D, however, is predicted to improve explicitly with α although the diameter increase is not expected to be drastic (about 5.4% with α 19 kin + 0.42 mm in highest value). The consequence of this increase is therefore usually overlooked.

Problem Formulation

There are some issues, and costs and pace of development include obstacles to implement an additive process. Very few companies in India are available, so the key problem remains costing. Also, a regular framework for additive manufacturing does not have a high output pace that is the key demand of major manufacturers. Another problem affecting the manufacture of additive manufacturing is also post production, when the stepping effect comes from the gradual creation of one layer on another or from often finishing layers. Some respondents have also been worried about issues of intellectual property, particularly copyright and rights design.

Objectives of the Study

To sketch out the Landscape of Manufacturing Industry especially layer manufacturing Technology in India (a) Exploring the motivation of layer manufacturers in India (b) Exploring the motivation of layer manufacturers in India (c) To study about the production and Cost Effectiveness of Additive layer Manufacturing.(d) To explore the major obstacles and opportunities to adopt a layer manufacturing technology.

Research Methodology

The research utilizes the analytical structure of Conscientious Creativity to accomplish the study aims. In this sense, numerous scholars have provided responsible innovation structure (e.g. Scholten et al. 2015; Owen et al. 2013; Bluk et al. 2015). For example, Blok et al. (2015) "Responsibility is seen here as an add-on or extension to an innovation concept; responsible innovation = regular innovation + participation on ethical and social issues among stakeholders, by which processes of innovation will be more effective in achieving the balance of economic (profit), social-cultural (people) and environmental (planet) interests." Like that, Owen et al. (2013) 'Ethical innovation, by the successful stewardship of technology and innovation at present, is a shared contribution to the future.' The most commonly discussed scholarly work on RRI therefore leads to the need for collective commitment and reverence for decades to come [13, 14].

Experimentation or Data Collection

The study is a small group whose principal properties are known and new material is studied (Webster, 1985). Sampling often used to deal with various topics and identified them as a community of respondents selecting for the study sample from the wider population. The study would be obtained by all participants using either random or non-random sampling processes. The calculation or production of sampling data for the whole community will be quite complicated [15]. Some individuals have little access to inmates, accident refugees, psychiatric disorders etc. and are really difficult to access. Also, the vast scale of data attributed to the high population raises testing expenses and times. Some tests could be less accurate than a study data gathered carefully.

A.Data Sources and Sampling Design

Data were obtained in two phases for this analysis. The researcher uses the interview process in the first step to gather data from 50 industry locations via the implementation of snowball sampling in the various state of India [16]. In the second step, the researcher gathered knowledge using the case study approach from three actors. The researcher used the interview approach to gather data from interviewees using a semi-structured interview. In step two, in-depth interviews were used for case studies. Deep interviews are a method that helps the scientist to capture the complexity of human sentiments, opinions and expectations [17, 18].

Result and Discussion

The cost of output can be classified in two distinct forms, as stated in Young (1991)14. The first concerns certain "well-structured"

costs such as labour, supplies and equipment costs. The second is "unstructured costs," including those linked to building collapse, system installation and inventory. The emphasis in the literature appears to be more placed on well-structured additive layer manufacturing costs than on unstructured expense; nevertheless, the badly structured costs which mask some of the major benefits and cost savings in additive layer manufacturing. It may also be helpful to recognize the output of additive layer in lean production.

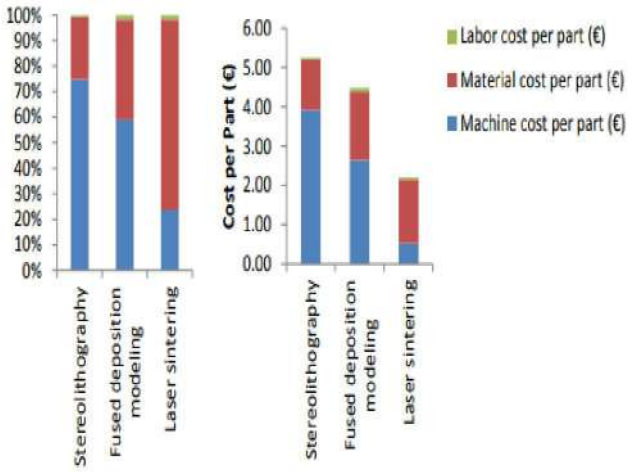

Fig7: Cost Breakout Analysis.

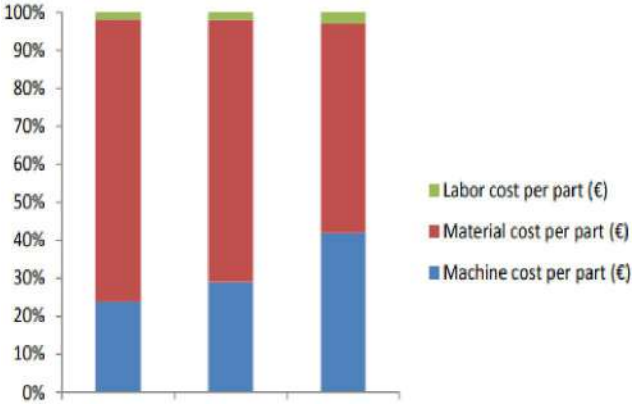

Fig8: Cost Comparison for Selective Laser Sintering.

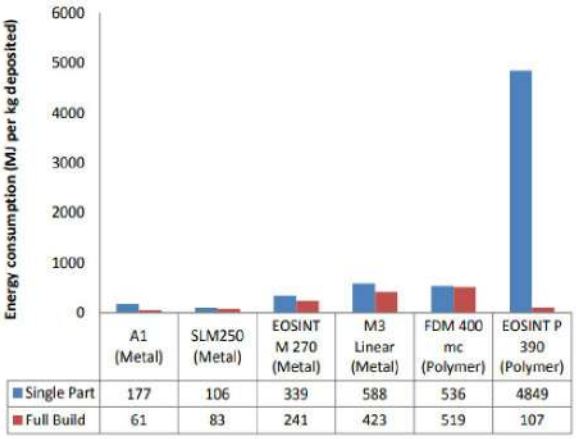

Fig9: Energy Consumption per kg Deposited.

Components should potentially not be evaluated as conscientious creativity and not merely as a challenge to theoretical validity but also to descriptive validity rather than their particular institutional contributions. There are some constraints on describing the amounts of responsible creativity. In India, the mostly accountable facets of creativity can be distinct from other European contexts in that dimension. Many respondents declined to address the precise query of the disparity between the Indian and the Western view on responsible innovation. In addition, accountability blurred by the confusion over the extent to which responsibility in the Indian perspective is basically adequate.

Conclusion

The study's aim is to explore the reasons that inspire entrepreneurs to implement additive manufacturing and how it functions as a responsible innovation. The research often looks at particular opportunities and obstacles in the phase of adaptation, and identifies some market models that lead to sustainable innovation. The explanations why responsible creativity is established are the growth of the organization's common interest and its lack of arrangements. The visionaries and the corporation now and then play an important role in the national improvement.

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PROMOTING PEACE AND EQUALITY THROUGH THE PRACTICE OF GOOD ISLAMIC GOVERNANCE: THE CASE OF ISLAMIC FINANCE

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ABSTRACT

The aim of this article is to examine the idea of good governance in Islamic finance (IF) practice and how it may contribute to the development of peace and equality within a community. Many have perceived that as a financial system, Islamic finance only focuses on commercial aspects or profit maximisation. This may not be the case, however, with Islamic financing. Islamic finance lays a premium on enhancing human well-being, social justice, and fair commercial relations. It recognizes the critical nature of environmental protection and prohibits reckless profiting at the cost of others or investing in enterprises that may cause harm to our society. The element of ibqa' (promoting good) and hifz (preventing harm) are the fundamental principles of Shariah in Islamic finance. This research is a qualitative studythat uses documentary analysis method. The data is gathered from primary and secondary data.According to the study's results, Islamic finance hassufficiently upheld the concept of Islamic good governance through Shariah governance framework. The application of Islamic good governance is observable in the practice of Shariah Governance Framework 2010. However, in the aspect of promoting peace and equality within a society as part of achieving a comprehensive human development and Maqasid Shariah,the contribution of Islamic financial institutions (IFIs) is still lacking. Even though several initiatives have been taken by some IFIs to expand their role in the society particularly in the sustainability agenda, the result is still insignificant due to several challenges in its implementation.

Keywords: *Waqf, Shariah governance and Islamic finance*

Introduction

After a decade since the incident of financial crisis, therehas been a mounting concern about the stability and sustainability of the conventional financial system and why it has failed so badly. The debate about the prospective impacts on global social welfare and environment became a core agenda for equallythe private and public sectors. Therefore, the world is seeking for alternative systems that could serve the long-term interests of people while adding value to the real economy. People are looking beyond financial gain but search for values and purpose. The financial system that is highly imbued with ethical, environmental, social and governance aspects is highly preferred.

These value-based financial deals are nothing new for Muslims. Islamic Finance products and instruments have been developed throughout the centuries. Around 650AD, Damascus witnessed the first trade of an Islamic bond known as a Sukuk. Muhammad (S.A.W.) was a trader himself. He recognized the market's ability to propel not only economic progress, but also communal success.

Islamic good governance in Islamic Finance Institutions (IFIs) is distinct from conventional corporate governance in that the former entails a broader set of responsibilities and obligations toward stakeholders, taking into account both the spiritual and worldly requirements of the Islamic community. Islamic good governance establishes a complete set of norms and obligations designed to protect Muslims' moral conduct against deception, exploitation, betrayal, and profiteering at the expense of moral and commercial value.It is a comprehensive framework that is based on *Tawhid*. This paper explores the concept of Islamic good governance and critically analyse such practices in Islamic Finance. Has Islamic Finance sufficiently upheld the concept of Islamic good governance? What Islamic Finance have done so far as regards to the promotion of peace and equality in the community? Whether Islamic Finance have done enough and what are the areas of improvement that Islamic Finance have to do?

Understanding the concept of Governance

According to Hyndman and McDonnell (2009), the phrase 'governance' derives from the Latin verb 'gubernare,' which meaning 'to direct, control, or steer'. Additionally, the word is thought to originate from the Greek verb 'kybernan,' which translates as 'to steer or pilot a ship.' This definition of governance implies that an organization is like to a ship, and

governance is the process of directing the ship toward a destination or objective.In realizing the ship reaches its destination, governance must be put in place to ensure that the crew and passengers will arrive at the destination safely. It seems like the board who determine the objective and regulation of organisations, but all parties must be involved and participated in the process, and finally forms what is meant by governance.

Initially, international economic institutions such as the OECD and the World Bank made good governance a priority in their programs, particularly those focused on socioeconomic development.In this regard, the World Bank (1992) hasdefined governance as "the manner in which power is exercised in the management of a country's economic and social resources for development". At this point, Good governance has become a part of governmental and political reform to be executed on third world countries to develop the global market economy. Ever since, the concept of good governance has become an extensive debate between international organisations such as UNDPand OECD when dealing with the issue of development and redefining the concept in line with their aspiration, agenda and policies. These organisations view that the realm of good governance is not only limited to revive the government that governs the country but also includes the other institutions bet it profit organisation or non-profit organisation, government or non-governmental organisation (Malik, 2017).

Governance, according to the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), is "the process of decision-making and the mechanism through which choices are implemented (or not executed)." This means that good governance is a technique of assessing how institutions conduct their operations and manage resources in a desired manner, while also taking into account the requirements of society or citizens. UNESCAP highlights the necessity of society's engagement or non-state actors in the decision-making process to maintain efficiency and democracy in their concept of good governance (Malik, 2017, p.29).

Governance is a term that can be applied to a variety of situations, including corporate governance, international governance, national government, and municipal governance.In the context of financial institutions, corporate governance is considered as an effective mechanism for ensuring the progress and development of the corporation and as a medium for the manifestation of good governance financial institutions (Nu NuHtay& Salman, 2015). Cadbury Code (1992) described corporate governance "as the system by which a corporation is directed and control." The OECD described it as "a set of relationships between a company's management, its board, shareholders and other stakeholders". Effective corporate governance is viewed as a means of ensuring the preservation of these long-term values of shareholders and other stakeholders and to prevent the issues of corruption such as corporate scandals, fraud and many others. It also represents a sound business operation.

Attributes of Good Governance

United Nation Development Programme (UNDP) gives a further illustration on the nature of citizen functions in the decision-making process in their characterization of good governance by asserting that: "The exercise of economic, political and administrative authority to manage a country's affairs at all levels. Governance is a neutral concept comprising the mechanisms, processes, relationships and institutions through which the citizens and group articulate their interests, exercise their rights and obligation and mediate their differences" (UNDP,n.d).However, OECD illustrates more specific characteristics of good governance by referring governance as "the management of government in a manner that is essentially free of abuse and corruption, and with due regard for the rule of law." Moreover, it must be based on participation, transparency, accountability, the rule of law, effectiveness, and equity (OECD DAC, 2006, p.147). Meanwhile, UNDP identifies nine core characteristics of good governance, (1) Participation; (2) Rule of law; (3) Transparency; (4) Responsiveness; (5) Consensus orientation; (6) Equity; (7)

Effectiveness and efficiency; (8) Accountability (9) Strategic vision.

In sum, the term governance or good governance connotes a wider perception than governmental and political perspectives and is subject to different interpretation and conceptualization according to the aims and aspirations of any particular entity, institution or organisation regardless of government or non-governmental, profit or non-profit institution. In the context of financial institutions, corporate governance is a part of the realm of good governance in any corporation. Despite the variety of interpretations of the idea of good governance, many agree on some components. Smith (2007), as mentioned in Malik (2017), further summarized it by dividing it into four key themes: constitutional reform, political reform, administrative reform, and public policy reform. Usually, the concept of good governance has been developed based on these four major themes with different attributes and interpretation according to the countries and institutions. Moreover, despite contrasting interpretation and conceptualisation of the term good governance, most concepts shared the same principles and philosophy which is to achieve certain goodness and development within society.

Good Governance & Islamic Governance

3.1 The framework of Good Governance in Islam

As discussed in the preceding section on the Western's view on governance and good governance concept, all the conceptions and attributes of good governance are not contradicted to the Islamic principles. Given that every Muslim is obligated to live according to Islamic teachings in all aspects of life, there is a need for greater examination of the notion of good governance from an Islamic viewpoint informed by the Quran and Sunnah. The notion of Islamic Good Governance has been shaped conceptually by Islam's worldview, which is founded on the principle of Tawhid. The term Islamic Governance and Islamic Good governance is always be used interchangeably and it is often be discussed within the framework political science, governmental and public administration.Islamic good governance, on the other hand, may be applied to many sectors, including social and economic growth.Therefore, this part mainly discussesthe main principles of good governance in Islam that underpinned the IFIsas a value-laden system. The concepts are: (a) the oneness of God (*tawhid*), (b) justice (*'adalah*), (c) accountability (*mas'uliyyah*), (d) trust (*amanah*), (e) mutual consultation (*shura*), (f) God consciousness (*taqwa*) and (g) enjoining good and forbidding evil (*hisbah*).

Tawhid (Oneness of God)

As a fundamental concept of Islamic Good Governance, Tawhid provides as the greatest Islamic vision for Islamic-based organizations.Al-Faruqi (1992, p.10) opines that *Tawhid* is the "conviction and witnessing that there is no God but God and a general view of reality, of truth, of the world, of spaces and time, human history and destiny."Chapra (1993, p.5)further elaborate that "the universe has been consciously designed and created by the Supreme Being,Who is One and Unique and does not come into existence by chance or accident." That is to say, everything in this world and cosmos exists for a reason. As stated in the Quran, a human being's primary purpose in this earthly existence is to serve as God's vicegerents on earth (Khalifah), with the riches provided to them as Amanah (trust). Additionally, the Khalifah's primary function on this planet is to create and enforce justice. According to Al-Ahsan and Young (2008), a Muslim is answerable not just to himself and other human beings, but to all humanity. Tawhid is recognized as the guiding idea of good governance in Islam, which is coherent with Choudhary and Hoque's suggested framework for Islamic corporate governance (2004). As vicegerents, the principles of Tawhid constantly require them to live up to their accountability and to uphold sound Islamic moral standards while carrying out their assigned duties (Choudhary &Hoque, 2004; Alam Choudhury &NurulAlam, 2013; Choudhury, 2018).

'Adalah (Justice)

Justice is considered as the primary foundation for creating peace, equilibrium, and harmony in

our world (Iqbal & Lewis, 2009). Justice is viewed as a collection of individual liberties and constraints, rights and obligations, as well as social advantages and damages, as taught by God via His Prophet in order for human beings to respect the rights of others. Justice involves the development of an institutional framework founded on equality, liberty, respect for private life, restraints on arbitrary governmental action, and mutual dialogue (Lewis, 2009).

Masu'liyyah (Accountability)

Human beings have a significant role in Islam as vicegerents of Allah, accountable not just to God but also to one another. In the Qur'an, Allah SWT mentions: "To Allah, SWT belongs whatever is in the heavens and whatever is in the earth. Whether you show what is within yourselves or conceal it, Allah SWT will bring you to account for it. Then He will forgive whom He wills and punish whom He wills, and Allah SWT is over all things competent." (Qur'an 2: 284).Allah SWT entrusts a man as the Khalifah (vicegerent) with the responsibility of safeguarding the well-being of everything on the planet. Additionally, in the hadith of Prophet PBUH, it is said that when executing obligations and tasks, one must have an awareness of accountability.Allah's Messenger said: "Surely, every one of you is a guardian and is responsible for his charges: The imam (ruler) of the people is a guardian and is responsible for his subjects; a man is the guardian of his family (household) and is responsible for his subjects; a woman is the guardian of her husband's home and his children and is responsible for them, and the slave of a man is a guardian of his master's property and is responsible for it. Surely, every one of you is a guardian and responsible for his charges" (Al-(Hadith Bukhari's Collection, Vol. 9, Book 89, Hadith 252). Islamic governance accountability is more about the decision-making process, which entails addressing these three questions: who makes decisions, for whom, and with what resources. This indicates that in order to build a strong Islamic governance system, one must be able to articulate responses to those three decision-making aspects (Iqbal and Lewis, 2009).

Amanah(Trust)

*Amanah*refers to the trust, reliability, trustworthiness, loyalty, faithfulness, integrity and honesty. In Islam, human beings are believed to be the steward of Allah and are responsible for the efficient utilisation of the wealth entrusted to them. As a trustee, stewards are responsible for maximising the value of the wealth toward benefiting the whole community. IbnTaymiyah was the first scholar to add trustworthiness to the existing list of *Maqasid* in relationship to faith.While corporate organizations are accountable to Allah for upholding and realizing Maqasid Shariah, they are also liable to stakeholder groups for meeting their expectations and ambitions in accordance with the conditions of Maqasid Shariah. Additionally, Shariah maintains that Allah SWT owns all money. This concept implies that, because Allah SWT is the ultimate owner of money, all human beings have the obligation to use the riches Allah has provided them appropriately. Thus, trust requires that a person assigned to a particular public office refrain from using it for self-aggrandizement or the profit of his kin (Hassan & Siraj, 2017). The misappropriation of public monies for personal gain is a felony, and the Qur'an describes the punishment for such crimes as follows: "Moreover, anyone who misappropriates must return with what he misappropriated on the Day of Judgement" (Qur'an 3:161).

Shura (Mutual Consultation)

As stated by Lewis (2006) the concept of *shura*can be referred to a living in mutual consultation along with tolerance and faithful dependence on Allah. As Muslims, they must seek to that ensure that their every action and life conduct must be based on open mutual consultation. Also, in the Qur'an it has been encouraged that any decision that involves more than one party, a consultation is needed in light of the principle of *Shura*, Allah SWT says: "And those who have responded to their lord and established prayer and whose affair is (determined by) consultation among themselves, and from what We have provided them, they spend." Since Qur'an has given serious attention about that decision making

involves more than one part, the leaders must play their role to encourage others to participate in the process of decision making (Iqbal and Lewis, 2009). Additionally, *Shura* is the key to Islamic moral value in the process of decision making (Abdul Rahim, 1998).

Taqwa (God-consciousness)

Taqwa has been defined as a state of being aware of God. This implies that Allah is aware of every action taken by humans. As Muslims, we believe that Allah SWT is always monitoring our acts, whether they are positive or negative. As a result of this concept of taqwa, people would exercise appropriate caution and adhere to Shariah when carrying out their responsibilities. In the Qur'an, Allah says: “But as for he who feared the position of his Lord and prevented the soul from (unlawful) inclination.” (Qur’an 79: 40).

Hisbah

Hisbah is a term that relates to the act of promoting good acts and abstaining from evil deeds. It is taken from a hadith of the Prophet SWT who stated: "Whoever among you sees a wrong, let him alter it with his hand; and if he is unable to do so, then with his mouth; and if he is unable to do so, then with his heart, which is the weakest of faith." (Hadith No. 34, as reported by Muslim). The institution of hisbah had a vital role in regulating commerce and economic practices throughout the prophet's lifetime.

Transparency is a critical component of how hisbah manifests. According to Abu Dauda and Yusha'u (2017), transparency and accountability are inextricably linked ideas that play a critical role in achieving good governance. That is, accountability is impossible without openness, and transparency is a necessary condition for accountability to be implemented. Transparency is a term that refers to the transparency with which government does its business.

Islamic Finance and Good Governance

Islamic Corporate Governance

It is critical to understand that Shariah Corporate Governance (ICG) is a complete framework that embodies an Shariah governance paradigm founded on Tawhid. 2004 (Choudhary & Hoque). Lewis (2005) emphasizes that Islamic Corporate Governance is distinct from conventional Corporate Governance in that it entails a broader set of accountabilities and obligations toward suppliers, customers, competitors, and employees, taking into account both the spiritual and temporal needs of the Islamic society. The Tawhid worldview has implications for the whole framework of Islamic administration, notably in the decision-making process necessary to accomplish the organization's mission. This procedure must be carried out in accordance with Shariah's goal (Choudhary & Hoque, 2004; Choudhury, 2018).

Additionally, the ICG presents a complete guideline that includes practices and obligations designed to protect Muslims' moral conduct against deception, exploitation, betrayal, and profiteering at the expense of moral and business value (Azni et al., 2018).Choudhury further defines an Islamic corporation is “a legal entity where the principle and proportionate of the firm’s shares owned by the shareholders based on equity participation and profit-sharing ratios and deals with legal and organizational structures that control the internal governance of a firm intending to define and attain an objective criterion by way of understanding the relations between variables supported by policies, programs and strategic coalition” (Choudhary & Hoque, 2004, p.58). While Hassan (2009) expounds Islamic corporate governance as “a system by which companies are directed and controlled with a purpose to meet the corporation’s objective by protecting all the stakeholders’ interest and right” (pp 277-293). This type of control over the business can only be accomplished by the company's practices, processes, and policies, all of which must take the business's objectives into account.Furthermore, Choudhary and Hoque (2004) contend that there are at least four principles and instruments of governing in Shariah governance, the principles as follows:

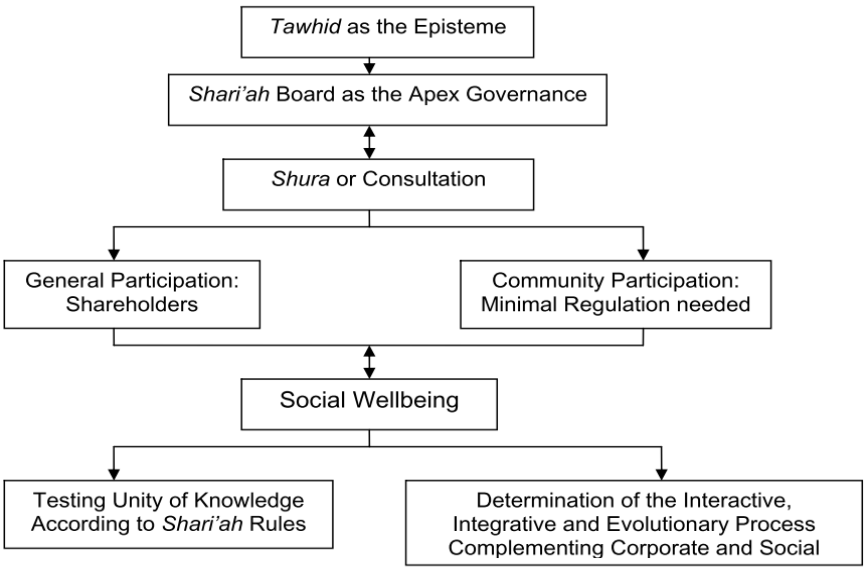
1. Extending the Tawhid unity of knowledge to the interacting environmental variables through

an interactive, integrative, and evolutionary process;
2. The fairness principle;
3. The idea of productive resource involvement in society;
4. The economic principle and recursive purpose between the preceding phases.

Hassan (2009) emphasizes further that all of these concepts are the cornerstones of Shariah corporate governance, which adheres to Shariah-based laws. It establishes an Islamic corporation that is market-driven while adhering to the social justice concept.

Besides, an ideal Islamic governance system and procedures are required as part of its manifestation. It can be manifested through the mechanisms of *shura, hisbah*, Shariah supervisory process, and Shariah audit (Iqbal & Lewis, 2009). The Figure below indicates the model of Shariah Corporate Governance.

Model of Shariah Corporate Governance



Source: Choudhary&Hoque (2004)

Good Governance through Application of Shariah Governance Framework

The Shariah Governance framework provides as a guide for Islamic Finance in terms of implementing the necessary governance in order to conduct Shariah-compliant activities. Shariah governance frameworks must be carefully adhered to in order to guarantee that Islamic Finance is always Shariah-compliant. Effective Shariah governance also assures the Islamic financial system's viability. A complete Shariah governance structure, it is thought, is founded on four pillars: management and supervision; second, the Shariah Advisory Board; third, Shariah compliance and review; and fourth, openness and disclosure (Ahmad & Mohamad 2019). As a result, several international and national organizations, including the International Financial Services Board (IFSB), the Accounting and Auditing Organization for Islamic Financial Institutions (AAOIFI), and the Central Banks of the respective countries, have taken additional steps to establish Shariah-compliant governance frameworks for Islamic Financial Institutions.For example, the International Financial Services Board (IFSB) defines Islamic governance (SG) as "the set of institutional and organizational arrangements through which an IIFS ensures that there is effective independent oversight of Shariah compliance over each of the following structures and processes: Issuance of relevant Shariah pronouncement resolutions; Dissemination of information on such Shariah pronouncements/resolutions to the operative personnel of the IIFS who monitor the day-to-day compliance with the Shariah pronouncements/resolutions vis-à-vis every level of operations and each transaction; An internal Shariah compliance review/audit for verifying that Shariah compliance has been satisfied, during which any incident of non-compliance has been satisfied, during which any incident of non-compliance will be

recorded and reported, and as far as possible, addressed and rectified, and an annual Shariah compliance review/audit for verifying that the internal Shariah compliance review/audit has been appropriately carried out and its findings have been duly noted by the Shariah board" (IFSB-10, 2009p.2).

The supervisory instrument's independence is a critical component. Each participant of the Shariah board, whether it is the Shariah Committee or the Shariah Advisory Council, should always maintain a high standard of morality and intelligence, as well as professional independence, when carrying out their separate tasks. Professional independence refers to the capacity to make informed judgments following a thorough examination of all relevant facts and viewpoints and without undue influence from management or unrelated outside interests (Islamic Financial Services Board, 2009). The concept of independence must be followed at all times in order to avoid control or manipulation. This element of independence in the regulatory tool for Islamic financial organizations is consistent with Islam's trust concept. Inadequate independence would impede and complicate the supervisory process (Izzat&Mohd, 2018).

Regarding the formationand the process of Isalmic governance, IFSB highlight three main features of Shariah governance system and key functions that play an important role in ensuring the Shariah governance in IFIs (Hilmy& Hassan 2019). The table below portrays some of the main features and key functions of the Shariah governance system of IFIs.

Main features	Key Functions in Typical Financial Institutions	Key Functions Exclusive to IFIs
Governance	Director's Council	Supervisory Board for Shariah (SSB)
Control	Auditor, internal / external	Review of Shariah on an internal/external basis
Compliance	Officers in charge of regulatory and financial compliance, unit or department	Shariah compliance section within the company

Source: IFSB-10 (2009)

According to the preceding table, Shariah governance is structured in two ways: externally and internally. Internally, the organization is structured around a Shariah-compliant control system, an internal Shariah audit function, and boards of directors and all associated committees. While the external structure of Shariah Governance consists of a Shariah supervisory board, external audit companies, and Shariah audit and consultancy firms, all of which strive to guarantee Shariah compliance from the outside (Hilmy& Hassan, 2019).

The use of Shura in the Shariah Governance framework is evident in these two components of the Shariah Governance structure: the Shariah Advisory Council (SAC) or Shariah Supervisory Board (SSB) and the Shariah Committee. The Shariah Advisory Council's primary functions are to regulate Shariah law pertaining to Islamic financial matters, to issue rulings in cases referred to the Central Bank of Malaysia, to advise the Central Bank of Malaysia on Shariah issues pertaining to Islamic financial business, and to advise Islamic financial institutions and individuals on Islamic financial matters. These responsibilities of the Shariah Advisory Council fully embody the shura concept, particularly when the Central Bank of Malaysia or any Islamic financial institution seeks the Shariah Advisory Council's opinion on Islamic banking and finance problems requiring mutual consultation. Shariah Advisory Council opinions are formed by competent and eminent experts in Islamic banking and finance. This, too, is consistent with the Shura characteristic. Due to their knowledge and certification, members of the Shariah Advisory Council are qualified to provide such advise or rulings on Shariah matters (Zain, Zulkarnain, & Hassan, 2015). The characteristics of Shura can also be traced to the shariah committee, for instance, in matters of Shariah compliance or Shariah issues, not only the board of directors or Islamic financial institution may consult the Shariah committee for advice or opinion, but other related parties are also eligible to consult the Shariah committee for advice, specifically on Shariah matters (Zain et al., 2015).

Along with a strong Shariah Governance framework, it requires the unwavering commitment of the Shariah Committee (SC) as the primary player, the government as the regulatory body, Islamic financial institutions as the implementer, and other business-related individuals such as auditors, accountants, and lawyers. SC are thus accountable for the Shariah-compliant governance of Islamic financial firms. The SC's responsibilities include instructing the board members on Shariah matters and ensuring that operations adhere to Shariah principles at all times, endorsing and validating pertinent documentation regarding the products and services, as well as internal policies and manuals and marketing advertisements, helping related parties, and advising on any Shariah problems that arise prior to referring them(Zulkifli Hasan, 2007).

Additionally, a fair, open, and equitable governance mechanism will address all of Islamic finance's ethical and moral concerns. In this context, the Shariah governance framework, notably in the Islamic banking system, has recognized the different roles of Islamic banking institutions in delivering a fair service to all stakeholders, including minority owners and investment account holders. In accordance with the concept of justice, each body responsible for ensuring Shariah compliance at Malaysia's Islamic banking system, including Shariah Committees in banks and the Shariah Advisory Council at Bank Negara, is entitled to be placed in their proper position to optimize their duties. Failure to act fairly in carrying out their responsibilities would have a detrimental effect on the functioning of financial institutions (Izzat&Mohd, 2018). Meanwhile, the Shariah Governance framework's practice of openness is evident in the board and Shariah committee's disclosure practices. On this basis, IF is required to include information on its Shariah governance policies and procedures in its annual report (Bank Negara Malaysia, 2010). Such disclosures must contain the following:

(a) openness regarding the board's oversight duty for Shariah governance implementation and the IFI's overall Shariah compliance.

(b) transparency regarding the Shariah committee's Shariah governance responsibilities; and an evaluation of the IFI's Shariah compliance.

Islamic Finance and Sustainability Agenda

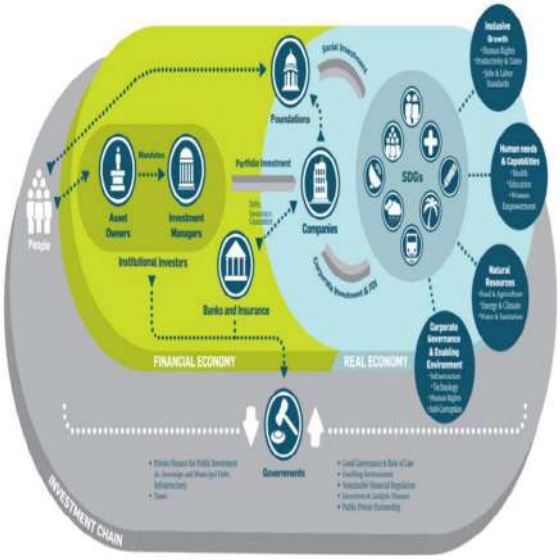
Islamic Finance and Sustainable Development Goals

United Nation Development Program (UNDP) defines Sustainable Development "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (UNDP, n.d.).Meanwhile, the Sustainable Development Goals (SDGs), also known as the Global Goals, were approved by all United Nations Member States in 2015 as a global call to action to eradicate poverty, safeguard the planet, and secure peace and prosperity for all people by 2030. The seventeen Sustainable Development Goals are interrelated, recognizing that actions made in one area have an effect on results in others and that development must find the right balance among social, economic, and environmental sustainability.The Sustainable Development Goals are comprised of 17 objectives. The primary objective of the Sustainable Development Goals is to solve the issues confronting 193 nations in terms of global economic, social, and environmental challenges by 2030. (UNDP, n.d.).

Numerous UN efforts directed at financial organizations might serve as a suitable jumping-off point for Islamic finance institutions interested in the SDGs. However, Islamic financial organizations have made a negligible contribution. Islamic finance is therefore advised to adhere to the current Principles for Responsible Investment (PRI), Principles for Responsible Banking (PRB), and Principles for Sustainable Insurance (PSI), which guide financial institutions worldwide in their efforts to align with the SDGs. PRI's mission is to get a better understanding of the investing implications of ESG issues and to assist its international network of investor signatories in incorporating them into their investment and ownership decisions. Meanwhile, PRB are intended to establish the basis for a sustainable banking system and to

assist the sector in demonstrating how it contributes positively to society. Additionally, the Principles for Sustainable Insurance serve as a worldwide framework for the insurance sector to address environmental, social, and governance risks and possibilities. Regrettably, as of February 2020, no takaful insurance firms are members of the PSI (UKIFC, 2020).

Inanother study also indicates theinactive participation of the Islamic finance industry in a society that is stem in the objective of Shariah the Islamic Finance industry. For example, the study conducted by Asutay(2015) as cited in Hassan and Mohamad Nor (2019) showsthe lack of achievement in *Maqasid Shariah* performance of Islamic bank and finance as the industry focuses mainly on self, faith and rights and stakeholding rather than wealth orientation. The study further indicates that there is a lack of contribution of Islamic Banking and Finance (IBF) in the social entity, intellect, posterity and ecology. Thus, IF must find the ways out to overcome this weakness by strengthening the very basic foundation of Islamic finance and explore the new potential of Islamic finance in achieving comprehensive development or sustainability, socio-economic justice that is rooted from objectives of Shariah. The recent creation of Value-based Intermediation (VBI) by Central Bank Malaysia is one of proactive measure to evaluate the contribution and participation of Islamic Finance in Malaysia as part of enhancing IF social responsibility and their achievement towards overall objectives of Shariah(Hassan & Mohamad Nor, 2019).Despite Islamic Finance's lack of participation in the SDGs, it has a potential role in promoting this sustainability agenda because it operates in the real economy through the provision of products and services that have a direct impact on sustainability areas such as climate, gender equality, jobs, infrastructure, and social services. Institutional investors are involved in sustainability concerns through the projects and businesses in which they invest cash and participate as active owners. Institutional investors also make direct real-economy investments in real estate, infrastructure, forestry, and agriculture. Banks and insurers are linked since they provide firms with debt, insurance, and guarantees. Funding is provided by foundations and philanthropic efforts to social businesses and civil society organizations that are directly involved in providing societal benefits. While the shown investment chain suggests a bright prognosis for finance flowing into the actual economy, this is not always the case in fact, which is one of the impetuses for the need for action (UKIFC, 2020). The figure below demonstrates how businesses, particularly financial institutions, are contributing to the SDGs' promotion.



Source: Adapted from UKIFC, (2020)

Additionally, Islamic finance may be characterized as ethical, inclusive, and socially responsible finance since it ties the financial sector to the real economy and encourages risk sharing, partnership financing, and social responsibility. As a result, Islamic finance has established itself as a viable method of funding global growth. This helps to explain why it is gaining popularity as a novel means of funding infrastructure. Operations in an Islamic financial system should be asset-backed, which helps to the stability of the financial sector, and governed by a framework of Islamic legal contracts that encourage profit and loss sharing.Additionally, social justice, solidarity, and reciprocity are emphasized, whereas investments in immoral activities are forbidden. Islamic finance has the ability to fill the financial disparity created by the Sustainable Development Goals and the transition to a green economy (Aassouli, 2020).

Islamic Financial Institutions Commitments in Sustainable Development Goals (SDGs) The initiatives ofthe Islamic Development Bank (IsDB)

The Islamic Development Bank (IsDB) is a global development institution dedicated to Islamic financing. It now has 57 members from four continents. It is a prominent and active player in the worldwide Islamic finance sector, with an excellent credit rating, operational assets in excess of USD 16 billion, and subscribed capital in excess of USD 70 billion. It engages in a variety of activities, including public and private project financing, development assistance, technical assistance, trade financing, small and medium-sized enterprise financing, direct equity participation in Islamic financial institutions, and research and education in Islamic economics and finance.According to the 2018 Development Effectiveness Report, the IsDB spent about US$6.5 billion in 2018 across 34 Member Countries in 71 projects and 272 grant-based activities, achieving a range of SDG targets (UKIFC, 2020).

The creation of Sustainable Finance Framework

The Sustainable Finance Framework, which was issued in 2019 and is complemented by the Green Bond Principles, Social Bond Principles, and Sustainability Bond Guidelines, details the IsDB's requirements for issuing Green or Sustainability Sukuk. Each category in the table below is dedicated to a certain SDG.

GREEN ELIGIBLE CATEGORIES	SOCIAL ELIGIBLE CATEGORIES
• Energy source that is renewable • Efficient energy usage • Environmentally sustainable pollution prevention and control • Environmental stewardship and land use management • Water and wastewater management that is both environmentally and economically sustainable	• Job creation • Affordability of housing • Affordability of fundamental infrastructure • Availability of key services • Socioeconomic progress • as well as empowerment

Source: Adapted from Islamic Development Bank (2019)

Additionally, IsDB developed this framework in accordance with the four components outlined in the Green Bond Principles, the Social Bond Principles, and the Sustainability Bond Guidelines as part of their best practice (Islamic Development Bank, 2019). Among these four components are the following:

1. The application of proceed
2. Evaluation and selection of projects
3. Procedural management
4. Reporting

Challenges and Opportunities

World Bank (2020) in their latest report highlights that the four challenges that could hampering the financial institution in relation to their commitment to SDGs, the challenges are as follows:

1. Islamic finance is mostly concerned with specific SDG projects, such as environmental renewable energy and green real estate. For example, in Malaysia, the issuances of project-based green sukuk have an excessive emphasis on renewable energy, with some exposure to green real estate. While this is commendable, it risks over-associating green sukuk with renewable energy and green real estate to the disadvantage of other industries. In this instance, the World Bank advocates expanding the use of green sukuk to fund a broader variety of projects, rather than just renewable energy and green real estate.
2. The next issue is determining whether assets and initiatives are green. The majority of financial institutions, particularly in emerging markets, do not differentiate their portfolios between green and non-green assets. As a result, they have been unable to establish a sustainable pool of green assets for green sukuk issuance. In this situation, it is anticipated that developing green taxonomies might aid in overcoming these obstacles by considerably improving the classification of green assets. Thus, the World Bank issued a guide on how to develop a national green taxonomy, titled Developing a National Green Taxonomy: A World Bank Guide.
3. A third difficulty is determining how earnings are to be used. By use of revenues

is a major criteria for green sukuk issuances; these issuances impose restrictions and prohibitions on the use of earnings for combined green and non-green projects. Generally, issuers of both types of sukuk would be required to finance the two distinct sorts of projects. For issuers in the public sector, effective policy coordination is essential. This is because the sovereign green sukuk issue will include a broad range of government agencies, including those responsible for finance, the environment, natural resources, and energy. This may provide a challenge for some public sector issuers, while others, such as Indonesia, do not appear to be concerned, since they continue to issue both types of sukuk concurrently.

4. New entrants to the market of green instruments will face a learning curve. When the green sukuk was formed, financial intermediaries operating on behalf of their corporate customers expressed early opposition due to their unfamiliarity with the notion of green financing.For potential issuers, the preparatory processes for the issuing of green instruments would take longer. Additionally, a green issue has a little premium in terms of cost. This is due to a variety of factors, including the expense of developing the green framework, the cost of an external reviewer's second opinion, and the cost of post-issuance impact reporting. In certain countries, the government will offer financial incentives to partially or completely pay some or all of these costs.

Opportunities for IF

Regardless of these impediments, Islamic financing offers the following opportunities: Green sukuk issuers with traditional production sukuk issuance facilities may consider using the same facility to issue green sukuk if they have created a green framework for the green tranche to be released.Where such measures are feasible, they may result in significant time and cost savings associated with the issuing of a green sukuk. Numerous prospective issuers may be unaware that the Green Bond Principles allow for the refinancing of revenues already used for green projects. This means that the issuer might begin their green project first and then issue the green sukuk. This is another possibility for a prospective issuer to consider (World Bank, 2020).

The recent issuance of Blue Sukuk to finance ocean-related projects, such as the Republic of Seychelles' blue bond, illustrates how sustainable financing continues to evolve. Given that several big consumers of Islamic finance have considerable exposure to marine ecosystems via their coastlines, a reasonable next step for marine projects would be to consider funding them via a blue sukuk. Similarly, to how a green bond might be converted to a green sukuk by superimposing a green framework on top of a sukuk, a sukuk could similarly be converted to a blue sukuk by superimposing a blue framework on top of a sukuk (World Bank, 2020).

The Way Forward for Islamic Finance

The global pandemic crisis of COVID-19 has posed challenges to the Islamic Finance. S&P Global Ratings also believes the global Islamic finance industry return to slow growth in 2020-2021 after strong performance in 2019 reinforced by a dynamic sukuk market. The measure to contain the COVID-19 pandemic has caused the significant slowdown to the Islamic Finance economis in 2020. However, Islamic Finance industry is expected to gain mild recovery in 2021 (Damak & Samira Mensah, 2020). In search for this recovery and growth, there are two main areas of Islamic Finance that must be given full attention to be the potential growth accelerator for this economic downturn. They are Islamic Social Finance and Financial Technologies.

Islamic Social Finance

Islamic Social Finance is seen as apotential socialinstrument that can help the core Islamic Finance economic across the countries, banks, and corporations (Damak & Samira Mensah, 2020: OECD 2020). The following Islamic Social Finance instruments are believed to navigate the current situation:

1. Qard Hassan: This device has the capacity to provide unrestricted breathing space till the atmosphere reaches a state of equilibrium. One example is when many GCC central banks offered financial

institutions with free liquidity lines in return for offering reduced credit to their corporate and small and medium-sized business clients.

2. Social sukuk: These instruments have the potential to boost education and health care systems during the current slump, as well as to draw environmental, social, and governance (ESG) investors (those investing for social purposes) and/or Islamic investors (those looking for Sharia-compliant investments).
3. Waqf: This might be utilized to aid people who have lost a portion of their income in getting affordable housing, health care, or education.
4. Zakat: Zakat is expected to aid households in compensating for revenue lost as a result of COVID-19.

According to the Islamic Development Bank Group (2020), each of these Islamic social finance instruments should be coordinated and incorporated into governments' fiscal strategies via safety nets and pro-poor expenditure. Governments may explore issuing Sukuk secured by a temporary cash waqf to generate social and philanthropic funds at below-market rates for the aim of funding various safety net projects. Cash and corporate waqf funds may be advantageous if the state starts restructuring its corporate asset holdings throughout the recovery phase.

Financial technology (Fintech*)*

Increased digitization and collaboration amongst fintech firms might help the Islamic finance industry maintain its adaptability in a more unpredictable climate and provide new development opportunities. This is because the lockdown methods used to resist COVID-19 have demonstrated that a company's or bank's ability to carry its business online is critical to its survival. For example, in certain countries, due to a lack of financial inclusion and specialized digital solutions, employees' remittances were delayed due to the closure of exchange and money transfer outlets. Additionally, Sukuk structure and issuance have been delayed due to a lack of technology, despite the establishment of a new platform with a simplified issuance procedure (Damak& Samira Mensah, 2020).

Conclusion

To date,Islamic Financial system has become an alternative system that could preserve the long-term benefit of people and at the same time add the values to real economic system. People are no longer looking for financial gain but also the real purpose and value in the business operation. The concept of Islamic good governance, which is founded on the principle of Tawhid, has practical implications for the IF system and operation, as it provides a comprehensive guideline consisting of practices and obligations to protect Muslims' moral conduct from deception, exploitation, betrayal, and profiteering at the expense of moral and business value. Islamic Good Governance, on the other hand, is a collection of Islamic principles derived from the Quran and Sunnah that serves as an ethical and moral value foundation for IF. By analyzing good governance in the context of Shariah governance implementation in IF, it is demonstrated that all Islamic principles of good governance are applicable to this SGF implementation.

Though, recently, the IF has received a lot of criticisms about their lack of contribution and participation in achieving comprehensive human development as part of *Maqasid Shariah* through the agenda of Sustainable Development Goals (SDGs) introduced by UNDP. Despite all these criticisms, there have been a lot of initiatives taken by IF around the world to overcome this flaw. The IsDB for example has taken a proactive action to be fully committed with SDGs by establishing a Sustainable Framework for the issuance of Green Sukuk by following the existing conventional framework. Lastly, since the pandemic of COVID-19 hit the world, it has posed challenges to IF to overcome the economic downturn and the market is expected to gain mild recovery in 2021. In response to this crisis, Islamic Social Finance and Fintech is seen as a growth accelerator for the IF in order to ensure its continuity and relevancy in any circumstances either good or bad.

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QUALITATIVE ANALYSIS OF SIMON'S AND GROVER'S ALGORITHM IN QUANTUM CRYPTOGRAPHY

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ABSTRACT

The enhancement of science and technology in one field contributes to the invention of a new one. As the problem-solving ability grew with technology, the idea of optimizing the existing solutions also grew in researcher. Traditional algorithm solves a particular problem but not always gives the efficient result. Quantum computation is an amazing amalgamation of mathematics, physics and computer science. As it incorporates physics in its model it becomes more probabilistic and general. Traditional computing use bits to handle data, Bits are 0 or 1. In quantum computing data is in the form of quantum bits called 'Qubits'. This can be either 1 or 0 or super position of both. There are many quantum algorithms written to perform many tasks. Simon's and Grover's algorithm are quantum algorithm well-known for their speedy approaches. This paper will give a brief information on Simon's algorithm and Grover's algorithm.

Keywords *— Quantum computing, Quantum mechanics, Qubits*

Introduction

Richard Feynman ignited the quantum computing revolution. He demonstrated in 1981 at MIT that a conventional computer cannot efficiently mimic the development of quantum systems. He suggested a fundamental concept for a quantum computer capable of doing such simulations. The basic difference between quantum and conventional computing is that quantum computing is based on quantum mechanics. In the quantum mechanical realm, it is founded on two laws: superposition and entanglement. A quantum superposition state of two pure states is a linear combination of these levels, with the coefficients reflecting the probability distribution of the pure states. Mathematics and Physics play a significant role in solving most of the engineering problems. The result obtained is extraordinary when compared to the result of traditional computing. Quantum Computing model was introduced in early 1980s by Paul Benioff. This was quantum model for Turning machine. Quantum computers, according to Richard Feynman and Yuri Manin, can solve problems faster than conventional computers. Owing to the exponential growth of the amount of data needed to fully represent a quantum system, classical computers are fundamentally unable to model such a system using sub-exponential time and space complexity.

Quantum computers, on the other hand, take advantage of the quantum systems' special non-classical properties, enabling them to process exponentially large amounts of data in only polynomial time. In classical bit information is in bits. It can be zero or one. The fundamental unit of quantum knowledge, the quantum bit or qubit, represents minute particles in atoms such as electrons, protons, and so on. It can take the value of 0, 1, or super position of both simultaneously. It is a million times more powerful than today's strongest supercomputers. In the field of engineering, producing and managing qubits is a huge challenge. Therefore, the approach of logic gates and abstractions created for classical computing is of no use in quantum computing. Root of Quantum lies in classical computing. Quantum algorithms have always had upper hand in front of classical algorithm when it comes to the black box problems. Simon's algorithm is one of the quantum algorithms which was found to exponentially speed up traditional algorithm. Grover's algorithm is a quantum algorithm used to search an unstructured database with the most minimum number of searches. Quantum Key distribution is one of the encryption techniques, which uses physics logic instead mathematics to encrypt data that makes it unbreakable. The properties of protons are used, once there is a different feature in proton is identified the, it alerts the intervention of third party. This paper starts with the introduction of quantum computing and then it moves towards the review of the Simon's and Grover's quantum algorithm. It concludes with the advantages and disadvantages involved with quantum computation.

Quantum Protocols and Quantum Algorithms

The capacity to replicate any classical computation is one of the benefits of having a universal set of quantum gates. The classical calculation must be broken down into the Boolean logic gates seen in "The Atoms of Computation", and then reproduced on a quantum computer. This shows a key feature of quantum computers: they can perform any task that a conventional computer can, and with at least the same computational complexity. Though it is not the goal to utilise quantum computers to tackle issues that can already be solved by conventional computers, this is an excellent illustration that quantum computers can handle a wide range of problems.

However, issues requiring quantum solutions frequently have components that may be solved using traditional techniques. These classical sections can be done on classic hardware in some situations. In many situations, however, the classical method must be applied to inputs that are in a state of superposition. This necessitates the use of quantum hardware to perform the classical method. This section introduces some of the concepts utilised in this project. Proof-of-concept algorithms, which were created to show the advantages of quantum computers, would be among the first algorithms learned. These algorithms are an excellent way to start since they demonstrate approaches that were subsequently converted into the "useful" algorithms that sparked interest in quantum computing, and so they will allow us to handle key concepts in their most basic form.

The proof-of-concept methods can also be used as a benchmark for hardware testing. The algorithms used in conventional quantum cryptography are as follows:

a) **Deutsch-Jozsa algorithm:** The Deutsch-Jozsa algorithm was the very first quantum algorithm to outperform the best conventional algorithm in terms of performance. It demonstrated that employing a quantum computer as a computing tool for a specific task can have advantages.

b) **Bernstein-Vazirani Algorithm:** The Bernstein-Vazirani algorithm is a continuation of the Deutsch-Josza algorithm. It shown that adopting a quantum computer as a computing tool for more complicated problems than the Deutsch-Josza issue has benefit.

c) **Simon's Algorithm:** Simon's method was the first quantum algorithm to exhibit an exponential speed-up in addressing a given issue when compared to the best conventional solution. This sparked the development of quantum algorithms are based on the quantum Fourier transform, which is utilised in Shor's factoring algorithm, the most well-known quantum algorithm.

d) **Grover's Algorithm:** This is demonstrated via Grover's algorithm. This technique can quadratically increase the run time of an unstructured search issue, but it may also be used as a generic trick or subroutine to improve the run time of a number of other algorithms. The amplitude amplification trick is what it's called.

e) **Shor's Algorithm:**Shor's algorithm is well-known for its ability to factor integers in polynomial time. The commonly used cryptosystem, RSA, relies on factorization being difficult for large enough numbers because the best-known classical technique takes super polynomial time to factor the product of the two prime numbers.

Applications of Quantum Computing and Quantum Cryptography

Quantum computing algorithms are used in quantum computers to complete the task in speedier way. Hence are experimented and embraced in many industries. Some of them are:

a) Cryptography: Cryptography is a technology used to enable secure communication. It hides information in a way that only an authorized person can view it. Most of the online security consist of encryption and mathematical algorithm which are very hard for an intruder to break in. There are algorithms like RSA, AES etc., which are hard to break even with high computing capabilities. But these algorithms are costly. If quantum computing algorithms like Simons are used carefully, they can be a boon for cyber security.

b) Medical research: Quantum algorithm can also be used to study the Anatomy of living

organisms to understand it better. This will in return help in discovering more powerful drugs to teach the patients.

c) Optimization solutions: Most of the quantum algorithms works best for optimization problems. Travelling salesman problem, NP-complete problems are solved efficiently by Grover's algorithm. Unstructured search problems like Sudoku are very accurately solved by Grover's algorithm.

d) Machine learning: Machine learning relies on massive and complex datasets to work. It is in control of knowing, inferring, and comprehending. It learns until it no longer makes mistakes and errors in its mission. Quantum algorithm like Grover's can train the data sets in lesser time. More the data is trained the more accurate will be the result.

e) Chemistry: Solving the problems related to atoms, and molecules are of huge importance in chemistry. This is where quantum chemistry comes into picture. This branch of chemistry uses quantum algorithms to get precise answer for the problem related to chemistry unlike traditional computing.

Quantum encryption safeguards both critical national security information and financial information in the public and private sectors. It has been thoroughly tested and proved to be secure. Here are some present and near-future quantum cryptography uses.

a) **Ultra-Secure Voting:** With political unrest and allegations of voter fraud rife in both developed and developing nations, it's apparent that making voting more secure is a must. Switzerland has used cryptographic techniques to safeguard online voting in federal and state polls since 2007. At a central vote-counting facility in Geneva, votes are encrypted. The results are then sent to a remote data storage facility over a specialised optical fibre line. Quantum cryptography is used to protect the voting results, and the most susceptible phase of the data transfer, when the vote goes from the counting station to the centralized source, is invulnerability.

b) **Secure Communications with Space:** Encrypted connections with satellites and astronauts are becoming increasingly important, and Quintessence Labs is working on projects for NASA to provide secure communications with satellites and astronauts from Earth. The project's objective is to develop a protocol that ensures communication security regardless of the technology or intelligence that an opponent has access to. It also includes a requirement to protect data both "at rest" and "in transit." This would improve astronaut safety in orbit and, ideally, eliminate the need for future upgrades beyond small speed improvements.

c) **A Smarter Power Grid:** The American electrical system is seen to be one of the most vulnerable targets for a cyber-attack. In reality, cyber adversaries are attacking some of the country's most important utilities on a "continuous" basis. Workers use a tiny encryption device to deliver completely secure signals over public data networks in order to manage smart power grids. Smart grids are critical for efficiently utilizing the available resources. Furthermore, with the right safeguards in place, they are far more secure than traditional grids.

d) **Quantum Internet:** Although contemporary internet is quite fast, it lacks the security of quantum-encrypted transmissions. The internet would be significantly slowed by quantum encryption. However, in the future, we may be able to seamlessly switch between "regular" and "quantum encrypted" internet, ensuring that our most important data are sent in the most secure manner possible. This would realise the aim of a fast and safe internet at the same time.

Literature Survey

Quantum Cryptography, the focus of this work is on quantum cryptography and how it adds value to a defence and security strategy for totally secure key distribution. The scope of this article includes the flaws in existing digital cryptosystems, the fundamental ideas of

quantum cryptography, real-world implementations of this technology, as well as their limits, and lastly, the quantum cryptography's future path. The findings of an apparatus and protocol for implementing the quantum key distribution, in which two users who share no secret exchange of information a random quantum communication consisting of extremely weak flashes of polarized light [1].

Quantum Cryptography using Quantum Key Distribution and its Applications, this article uses a technique called cryptography to ensure secure message transmission between the sender and recipient. Traditional cryptography methods rely on either a public key that is widely known or a private key that is kept secret. In any scenario, eavesdroppers are able to discover the key and therefore locate the message sent without the sender or receiver's awareness. Quantum cryptography employs the Quantum Key Distribution (QKD), a random binary key distribution that allows communication parties to identify the existence of a potential eavesdropper. This article also examines a few quantum cryptography applications and their drawbacks [2].

Quantum Cryptography: An Emerging Technology in Network Security, the focus of this research article is on quantum cryptography and how it helps to network security. The goal of this research study is to look at the flaws and security problems in contemporary encryption, as well as the underlying ideas of quantum cryptography, the distributed communication deployment of this technologies, and the strategic development of quantum cryptography [3].

Quantum Computing: A New Era of Computer Science, Quantum computer technique is based on quantum physics rules that enable high processing through the capacity to be in many states and execute all conceivable permutations at the same time. When quantum computers are fully operational, it will be relatively simple to tackle a wide range of issues, including the precise solution of very complicated chemical processes. He continues by stating that quantum computer processing is extremely quick, and that it is also quite powerful when used in this manner. Everything is accessed, and every aspect of our work is dependent on computers, whether directly or indirectly. Quantum computing, as a breakthrough in the field of computing, will usher in a new era and a new experience for society, in which various problems and difficulties will be solved quickly. Somehow, the quantum computer's implementation is tough; there may be issues such as the difficulty of controlling quantum particles, the fact that quantum computers create a lot of heat, necessitating a cold environment, and the fact that quantum computers are expensive. The quantum computer is not designed for tasks such as word processing or email [4].

A Generalization of Bernstein-Vazirani Algorithm to Qubit Systems, with a difference that is polynomial in the number of queries, a quantum method for solving the parity issue outperforms its most efficient conventional counterpart. This was demonstrated by E. U. Bernstein and U. Bernstein Vazirani was one of the first to show that quantum data processing may outperform conventional information processing by a substantial margin. Because it commonly works with bits/qubits, the problem and its solution are frequently presented for a 2-level system. The authors investigate an extension of the Bernstein-Vazirani method using a generic qubit system [5].

Learning Simon's quantum algorithm, when compared to a traditional randomised search, Simon delivers an enormously quicker quantum method. Simon demonstrated a relatively basic and scalable quantum circuit to solve Simon's problem, a mathematical game. The goal is to discover an attribute of a black-box function, a secret bit string s, that determines which function belongs to which family of operations. The authors used a unitary network to train it to identify the best circuit for detecting the hidden bit string connected with Simon's oracle. The circuit linked with Simon's method is actually restored, allowing quantum parallelism to be utilised to explore the oracle unitary [6].

Quantum Computing and Shor's Algorithm, essential features of quantum mechanics' mathematical formalism in general

and quantum computing in particular, emphasising the distinctions between quantum and classical computing He concludes with a review of Shor's algorithm, a polynomial-time quantum computing technique for factoring composite numbers that is quicker than any known conventional factorization process [7].

Analysis and Simulation of Grover's Search Algorithm, the Grover search method is the most widely used and effective quantum search technique. The authors demonstrated the flow of the quantum search algorithm as well as simulations of quantum circuit models for n-qubit systems. The inaccuracy of the search value, as well as the measuring probability, are investigated. The Grover's search method was emulated on a classical computer for further research. The posterior distribution of the measuring result of the search value is given using a quantum simulator, and the computing efficiency is examined in the study. The algorithm's efficiency is demonstrated by the simulation result [8].

Quantum Cryptography based on Grover's Algorithm, examines the Grover algorithm's core concept and implementation in the instance of a four-qubit system. The Grover method, in particular, allows the authors to get a maximum chance of getting the desired outcome. Some aspects of quantum cryptography and the Grover's algorithm-based Quantum Secret-Sharing protocol are also discussed. They focused on the Grover algorithm's fundamental notion and implementation in the context of a four-qubit system. Some aspects of quantum cryptography were also discussed, as well as a quantum secret-sharing system based on Grover's algorithm. [9]

Quantum Rough Counting and Its Application to Grover's Search Algorithm, by rebuilding the output distribution, the suggested counting technique employs Deutsch-approach Jozsa's to estimate the number of items meeting specific search requirements. The modified Grover's search incorporates counting into one phase of the algorithm and utilises the counting result to calculate the number of Grover's iterations required to obtain such items. The authors show that the suggested modified Grover's search is optimum by analysing the anticipated probability of the proposed method while taking into consideration the issue size, the number of satisfied items, and the query complexity [10].

Quantum Attacks without Superposition Queries: The Offline Simon's Algorithm, in the case of a quantum attacker confined to classical queries and offline quantum calculations, this manages to utilise the algebraic nature of cryptosystems. In comparison to the present literature, we get better quantum-time/classical-data trade-offs while utilising only as much hardware (quantum and classical) as a typical exhaustive search with Simon's technique. Due to their algebraic nature, our method may be regarded in two complimentary ways: recycling superposition queries throughout the iteration of a search using Simon's algorithm, or reducing the memory need in some quantum assaults based on a collision search [11].

Quantum Communication Based on Simon's Algorithm, [12] the research is based on Simon's method for quantum communication. In the instance of Simon's method, quantum communication outperforms classical communication by a factor of $O(\sqrt{2}N/N)$. Finally, it has gone through quantum communication using Simon's method. For any x, Alice and Bob have agreed to employ a function f, such as $f(x) = f(x \oplus s)$. Alice isn't familiar with the letter s. Bob has known s for a long time. Alice's objective has been to figure out what Bob has selected with confidence. If Alice has learnt the s, Alice and Bob have communicated N bits of knowledge with each other through O(N)-communication. To acquire the s in the classic example, Alice needs at least $O(\sqrt{2}N)$-communication with Bob.

Implementation of SIMON & SPECK Algorithm, authenticity and confidentiality, as well as the security of transferring information and communication, are critical. Basic security components include cryptographic techniques such as block cyphers and stream cyphers. The competing aims of cryptography design are security, simplicity, and adaptability. The speck and Simon families of block cyphers

were created with the goal of providing security on limited hardware with a focus on design simplicity. Each of them, Simon and speck, comes in a range of widths and key sizes. Furthermore, by enabling a configurable block-size, it reduces the inefficiency of encrypting slightly longer communications. Many lightweight block cyphers were created with the intention of performing well on a single platform rather than providing great performance. While Simon and speck both give or offer outstanding performance on hardware and software components, speck is flexible enough to allow for a range of platform implementations and is simple to analyse using current methodologies. Both perform well in a wide range of lightweight applications, however the Simon is optimised for hardware performance, while the Speck is optimised for software performance. Analyse the "Simon and Speck" block cypher family in our project, then simulate and synthesise it [13].

Quantum cryptography focus on the cryptography, performed using quantum concepts. The aim is to examine the flaws and security loops in modern cryptography, as well as the fundamental principles of quantum cryptography, real-world application implementations of this technology, and the quantum cryptography's future course [14]. The flaws in today's digital cryptosystems, the basic principles of quantum cryptography, the real-world application of this technology, as well as its drawbacks, and finally the quantum cryptography's potential course. The results of an apparatus and protocol designed to enforce the quantum key distribution, in which two users with no secret information exchange a random quantum transmission consisting of very faint flashes of polarized light, are defined.

Quantum key delivery and other quantum, encryption approaches would undoubtedly improve the security of confidential data in the future. Quantum encryption is a significant and meaningful move in the right direction, allowing us to feel more confident about how and what we share in the future. As a result, a significant input from QKD into fundamental physics is anticipated, leading to a new perspective on quantum mechanics' foundations. It's possible that the viewpoint is more "practical" than "philosophical." The explanation to how it relates to current secure networks, and define its unique physical layer and its advanced quantum cryptographic algorithms. Protocol suite, and IPsec extensions are required to incorporate quantum cryptography with the protocol. Quantum cryptography can be used in practice to provide continuous key distribution for Internet virtual private networks, as demonstrated by the DARPA Quantum Network. However, some crucial elements of quantum cryptography theory remain a mystery. This includes a wide range of potential attacks as well as the extensive quantum mechanical theory that underpins photon formation, propagation, detection, and other processes. In short, quantum cryptography is now evident in practice, but the issue of whether it is theoretically feasible remains unanswered. As a result, although the network appears to function, it may not be completely stable [15].

Quantum Cryptography & its Comparison with Classical Cryptography, a method, whether ancient or modern, must be well-constructed and useful. A further level to secure communication may be added by applying quantum mechanics concepts to encryption; such a system can detect eavesdropping and ensure that it does not happen at all. The work provides a quick overview of the current state of quantum cryptography research. The core principles of quantum cryptography are presented using the BB84 protocol as an example. The work primarily compares quantum cryptography to classical cryptography [16].

Simon's Algorithm

Simon's problem is the computational problem that can be exponentially solved faster on the quantum computer rather than the traditional computer. This is observed according to computational complexity theory and quantum computing. Simon's problem often uses the black box. Quantum algorithms have always had an advantage over classical algorithms when dealing with black box problems. Since there are few possible plausible settings that would necessitate solving Simon's Problem,

the problem itself is of little real importance.

Simon's problem was introduced in 1994 by Daniel Simon based on the decision tree complexity and complexity model. Simon showed this problem as the quantum algorithm which is commonly known as the Simon's algorithm. This algorithm solves the problem exponentially faster than any of the classical algorithms. Simon's algorithm requires less computation time than any of the best classical probabilistic algorithms. Simon's algorithms served as the model for Shor's algorithm.

Both problems are variants of the Abelian hidden subgroup problem, for which quantum algorithms are now known to exist. The main goal of Simon's algorithm is to reduces the number of queries to the black box, which allows us to calculate exponentially faster.

Simon's algorithm requires $O(n)$ queries to the black box, whereas a classical algorithm would need at least $\Omega(2^{n/2})$ queries. Simon's algorithm is optimal in front of any quantum algorithm to solve this problem requires $\Omega(n)$ queries.

The Simon's algorithm follows the six main steps:

a) Initializing the 2^n qubit register to |0>

b) Applying the Hadamard gates to the qubits in the first register

c) Then apply the bit string function

d) Next measure the second register

e) Then apply the Hadamard gates on the first register

f) In the final step we measure the first register with equal probability.

For example, if there are 2 qubits, with secret string b=11, so that f(x) = f(y) if y= x ⊕b. For the problem, the quantum circuit looks like,

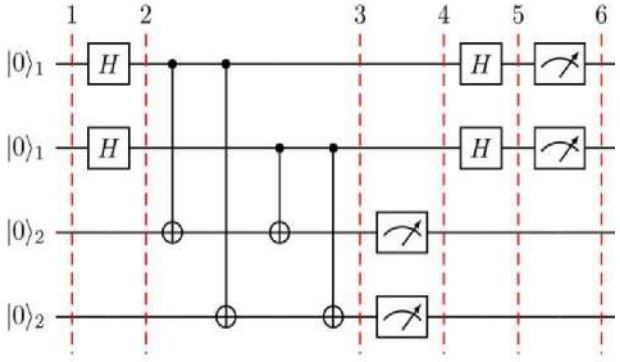


Figure 1: Quantum Circuit

For the given circuit, we apply the Simon's algorithm methods,

a) For the given 2 qubits input registers, initialize the register to 0 state:
$|\psi_1\rangle = |00\rangle_1|00\rangle_2$

b) Apply the Hadamard gates to the first register:
$|\psi_2\rangle = \frac{1}{2}(|00\rangle_1 + |01\rangle_1 + |10\rangle_1 + |11\rangle_1)|00\rangle_2$

c) For the secret string key where b=11, query the function, which is implemented as:
$\mathbf{Q_f = CX_{1a2a}CX_{1a2b}CX_{1b2a}CX_{1b2b}}$
The function when it's queried,
$|\psi_3\rangle = \frac{1}{2}(|00\rangle_1|0\oplus0\oplus0, 0\oplus0\oplus0\rangle_2$
$+(|01\rangle_1|0\oplus0\oplus1, 0\oplus0\oplus1\rangle_2$
$+(|10\rangle_1|0\oplus1\oplus0, 0\oplus1\oplus0\rangle_2$
$+(|11\rangle_1|0\oplus1\oplus1, 0\oplus1\oplus1\rangle_2)$
Thus,
$|\psi_3\rangle = \frac{1}{2}(|00\rangle_1|00\rangle_2 + (|01\rangle_1|11\rangle_2 + (|10\rangle_1|11\rangle_2 + (|11\rangle_1|00\rangle_2)$

d) Now measure the second register, there's a 50/50 chance we'll witness one of two things $|00\rangle_2$ or $|11\rangle_2$. In this example, we assume $|11\rangle_2$, the system's state is then where the second register has been excluded because it has been measured.
$|\psi_4\rangle = \frac{1}{\sqrt{2}}(|01\rangle_1 + |10\rangle_1)$

e) Next apply the Hadamard gates to the first register,
$|\psi_4\rangle = \frac{1}{2\sqrt{2}}[(|0\rangle + |1\rangle) \otimes (|0\rangle - |1\rangle) + (|0\rangle - |1\rangle) \otimes (|0\rangle + |1\rangle)]$
$= \frac{1}{2\sqrt{2}}[|00\rangle - |01\rangle + |10\rangle - |11\rangle + |00\rangle + |01\rangle - |10\rangle - |11\rangle]$
$= \frac{1}{\sqrt{2}}(|00\rangle - |11\rangle)$

f) In the final step, we measure the first register will give either, |00> or |11> which is equal to the probability.

g) If |11> is observed, then, **b.11=0**
which shows, **b ≠ 01** or **10** and **b = 00** or **b = 11** are the two remaining possible solutions where **b=00** is a trivial solution to the equation.
If we measure |00> or |11> as:
b.11=0
b.00=0
These two equations are only equations which satisfy the b=11 which can be verified by picking random inputs. For example,
01⊕ **b =10**

f(01) =f(10) = 11

Grover's Algorithm

Lov K Grover introduced Grover's algorithm in 1996. Grover's algorithm is the quantum computing algorithm used to speed up the unstructured search problem quadratically. In his paper Grover gives an example of finding a name in the phone directory, where names are arranged in random order.

Figure 2: List of N items

Consider the list of N = 2^n items above. If the aim is to search the blue box 'w', the total number of searches on an average case will be N/2 and in worst case it will be N number of searches. This is easy only when 'N' is small, when the size of 'N' is large then the classical computing algorithm would not be giving optimum solution.

On a quantum computer solution for the same problem can be found out in √N steps using Grover's algorithm. This algorithm uses amplitude amplification trick in order to find out the quadratic run-time. It gives high probability for unstructured search problem with unique input to a black box-function that will produce particular output. It does not consider the lists internal structure.The first step is to create a circuit using qubits, oracle and measurement gates.

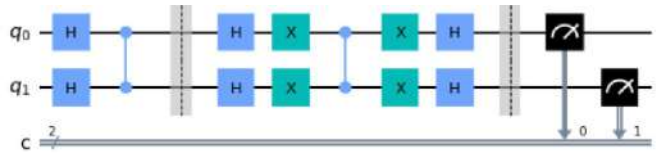
For example if the structure should be comprised of 2 qubits then our state lists will be |00⟩,|01⟩, . . . |11⟩(the states from |0⟩→|3⟩. Let the winning element be |11⟩. Grover's algorithm solves the oracle by adding negative instance to it. For any |x⟩

$$U_\omega|x\rangle = \begin{cases} |x\rangle & \text{if } x \neq \omega \\ -|x\rangle & \text{if } x = \omega \end{cases}$$

Oracle is a black box through which the queries are passed to get answers. In this case oracle will look like the below:

$U_\omega|x\rangle = U_\omega$ ½ (|00⟩ + |01⟩ + |10⟩ + |11⟩) = ½ (|00⟩ + |01⟩ + |10⟩ - |11⟩)

The circuit will look as below:



Repeat √N times

Figure 3: Circuit

All the states are expressed in superposition:

$$|s\rangle = \frac{1}{\sqrt{N}} \sum_{x=0}^{N-1} |x\rangle.$$

In the Oracle there will be phase inversion process. It changes the input of the element that needs to be searched into its negative counterpart.

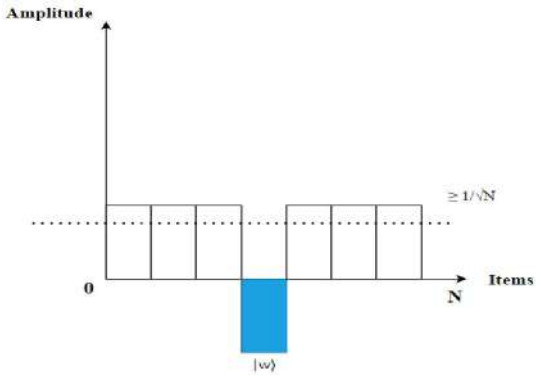


Figure 4: Phase inversion

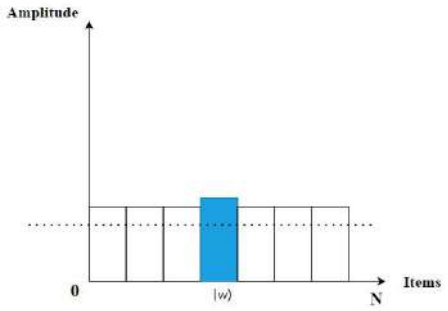


Figure 5: Amplitude stretching

All the other input remains the same when passed through oracle. Then it is passed through diffuser where the √N evaluations happens. This is repeated for 2 to 3 iterations and final measurement is taken. Thus, the Grover's algorithm solves the problem of unstructured search in O(√N), which is far better than any classical algorithm.

Results

The obtained, quantum circuit is passed through the simulator, the results are shown as below:

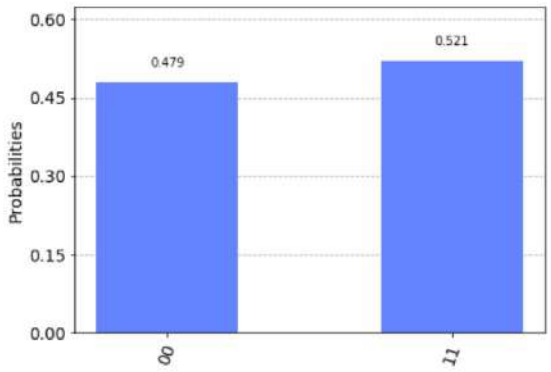


Figure 6: Trivial solution

When the Grover's algorithm is passed through oracle circuit, because of the amplification trick, the probability of choosing the needed element is very high.

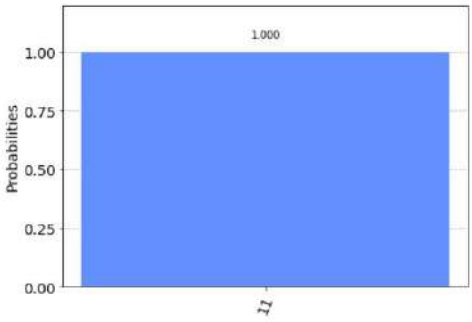


Figure 7: Probability of choosing specified element

Comparison

Quantum computing algorithm uses mathematical and physics approach in its methodology. Some algorithms need more qubits to get the error free result and some algorithm require a smaller number of qubits to get the most efficient result. Everything depends on workflow of the algorithm. Both Simon's and Grover's algorithm were written to solve different problems. Even though the root lies same but there are few differences in the work flow.

Table 1. Comparison in workflow

Keys	Simon's Algorithm	Grover's Algorithm
Purpose	Black-box finding	Unstructured search
Initialization	Initializes two n-bit register from n-bit strings to 0	All the n-qubits are initialized to 0
Hadamard transformation	Transformation is applied to first register.	Transformation is applied to the whole system.
Time complexity	O(n)	O(√N)
Applications	Prime factorization	Exhaustive search problems.

The above table gives the comparison of workflow in Simon's and Grover's algorithm.

Conclusion

Quantum computing can execute most of the tasks very fast in comparison with classical computer, the atoms change even more faster than traditional computing in quantum computing. But all the tasks can't be done better by quantum computing when compared to traditional computer. Simon's algorithm was the first quantum algorithm to provide an exponential speed-up to classical algorithm in solving a specific problem. Grover's algorithm can speed up an unstructured search problem quadratically.

The main disadvantage of quantum computing is that it needs new algorithm for every task unlike traditional computing. Quantum computers cost more. It is hard to ignore noise in qubits. Hence the result will not me more accurate in noise prone environment.

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SOCIAL ACCEPTANCE OF RECLAIMED WASTE WATER-A CASESTUDY

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ABSTRACT

A survey was conducted for the people of Hyderabad city to know the residents willingness to use reclaimed water for non-potable purposes.Online questionnaire as well as personal interviews were conducted for 1000 members all over the city. The study concluded that female responders were more in comparison with male responders. Engineering students, faculties and job holders responded in greater numbers. 18.6% of the population consisted of water recycling facilities. 48% of the sample population didn't have any water treatment plant. The maximum respondents were willing to use reclaimed water was for gardening and sanitary purposes and the minimum people accepted to use reclaimed water for agricultural, pet maintenance and miscellaneous purposes. This study recommends that awareness to all sections of the society is essential for use of reclaimed water. This practice should be followed specially in urbanized cities like Hyderabad.

Key words:*reused water, sample population, social acceptance*

Introduction

Household reclaimed waste water refers to the process of diverting household waste water to be used for non-potable purposes. Increased demand for water and imbalanced precipitation in urban areas has highlighted the use of alternate water resources. Current population of India is 1.38 billion (indiapages.com). Hyderabad was founded in 1591 as a small town .By the year 2021, its population has peaked to 10.2 Million (United nations world population prospects). Urbanization has led to the shortage of water resources.Previous studies on urban agglomeration in Hyderabad has been carried outby Ashok kumarlonavathetal.,which tells about the rapid growth of Hyderabad. According to the news letter published in THE HINDU on march 13th 2021, only 26.5% of the sewage is treated inTelanganaregion.This states that there is an increasing demand for use of reclaimed water resources. Reclaimed waste water is an alternate source as well as it reduces the pressure on water resources. (Bakopoulou *et al.* 2010). An integrated system for water reuse would provide more efficient ways of water reuse (R.J. Chiou et.al.,). However, public acceptance is very important in this aspect. Many projects fail because of lack of public awareness due to common factors such asIlliteracy, doubts, social and cultural beliefs and many other factors. Many authors specially worked on public acceptance of reuse of waste water and found that their willingness was greater in applications where skin contact is very less. (Mohammad Ali Baghapouret.al.,).This paper focussed on public opinion regarding the reuse of waste water for miscellaneous purposes.

Location of study area

The satellite imagery of studyareais created using the tools in ArcGIS 10 and Landsat satellite image .The area taken forthis study isboundedby17°13′38″Nto17°34′39″Nlatitudes and78°13′52″E to 78°40′58″E longitudes, covering a total area of 1,872.77 km^2. It covers Hyderabad urban agglomeration and parts of Ranga Reddy district

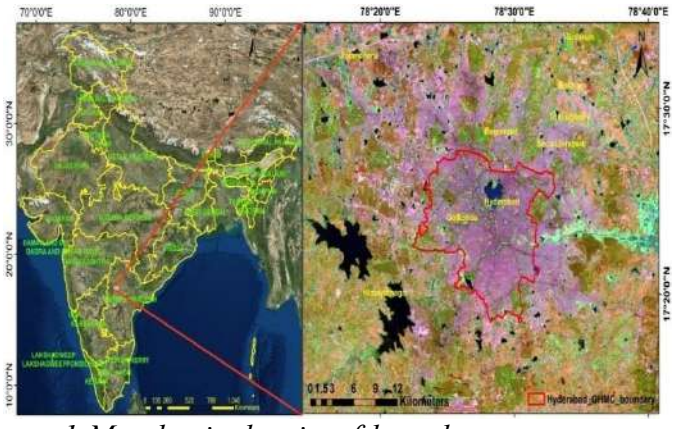


Image 1. Map showing location of the study area

Description of study area

Hyderabad constitutes 4th largest city in India. The city is located in the northern part of Deccan plateau and south western part of Telangana state, on the banks of river musi. The Hyderabad Urban Development Area spreads over 1,905 sqkm . It is divided into 3 areas .a) core b) sub-urban and c) peri-urban

area. The average annual rainfall for the city is 5.36 inches. The average monsoon rainfall is 3.6 inches. Hyderabad has several sources of drinking water like Musiriver and Hussain sagar in the middle of Hyderabad, Durgamcheruvu in Madhapur and Osman-sagar in the south western part of the city.

The two dams built on Osman Sagar and HimayatSagar constitutes the source of drinking water for Hyderabad city. City has a population of 68.1 lakhs. According to HMWSSB, estimated sewage generation in the city is 1.781 million litres. Amount of sewage that is treated in various parts of the city is 772 MLD (43%). The rest of the sewage (57%) is released untreated into musi river. Most of the treatment plants are unable to treat the excess inflow.

This untreated waste water is responsible for the spread of infectious diseases. Therefore, the aim of the present study was to assess the public opinion regarding the reuse of water.

Objectives

- To measure the willingness of people to use reclaimed water in different localities
- To assess the public opinion and percentage of public acceptance towards use of reclaimed water
- To spread awareness and encourage public on use of reclaimed water for non-potable purposes

S.No.	Percentage
Gender	
Male	38.2%
Female	61.8%
Age group	
17 to 20	44.2%
21 to 30	34.7%
31 to 40	10.1%
41 and above	11%
Occupation	
B.Tech students	44.2%
Asst.Professors	10%
Job holders	

Methodology

Questionnaire and sampling: Questionnaire forms were prepared and distributedonlineto measure the willingness of people in various localities towards use of reclaimed water. Interviews were also conducted in each area by randomly selecting 20 members in each locality. Questionnaire was divided into 4 main parts:

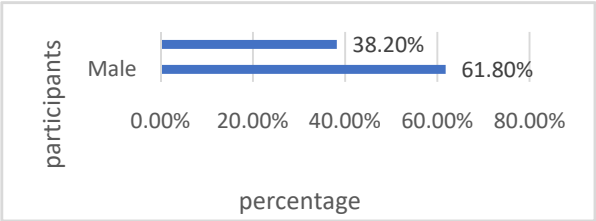
1) Demographic variables: Age, gender income, sex etc
2) Sources of wateravailable: surface water, bore well waters, tankers etc.
3) Presence of recycling unit: If the community had a recycling unit or not
4) Information regarding willingness of participants to use recycled water for different purposes: sanitary, agricultural, pet maintenance,gardening and miscellaneous purposes.recycling for water for improving the standards of community was alsoevaluated.1000 questionnaire forms were distributed among different categories of people and in 10different selected locations all over the Hyderabad city. Personal interviews and discussions were also done online through google meet platform.The selected locations and demographic data is shown in the table below

Table:1 Table showing selected locations:

S.No	Locations	No of samples Questionnaires distributed
1	Nagole	100
2	saroornagar	100
3	Charminar	100
4	secunderabad	100
5	chadarghat	100
6	Banjara hills	100
7	koti	100
8	Ameerpet	100
9	West Maredpally	100
10	Punjagutta	100

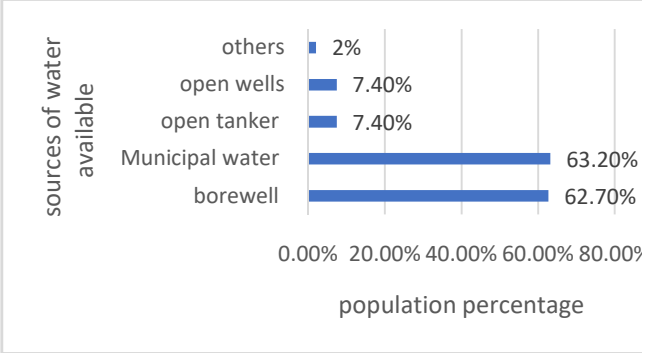
Resuls: The sample population consisted of people from different corners of Hyderabad district. Out of 1000 responses, male responders were more in number(61.8%) than female responders (38.2%).

Table-2:The demographic data obtained from online questionnaires form



Graph1: percentage of male and female participants

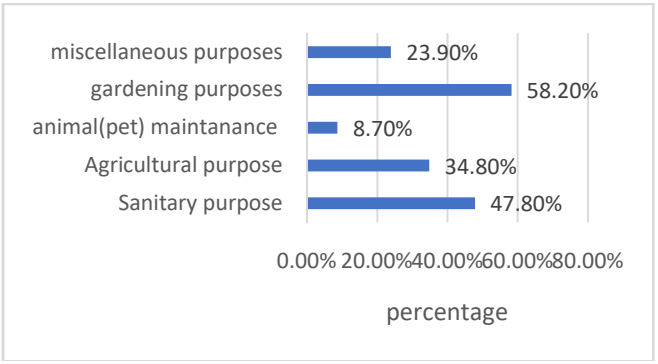
Most of the responders were educated and consisted of faculties and students. Only few responders were in the field of agriculture and farming. (63.3%) received water from borewells and 60.8%) from municipal water. The remaining constitutes water receivals from Agriculture, Mission bhagiratha (1.6%), water taps(0.6%) ,borewell sponsored by villagers(0.6%) and Dam water (0.6%).



Graph2: figure showing percentage of sources of water in selected sample population

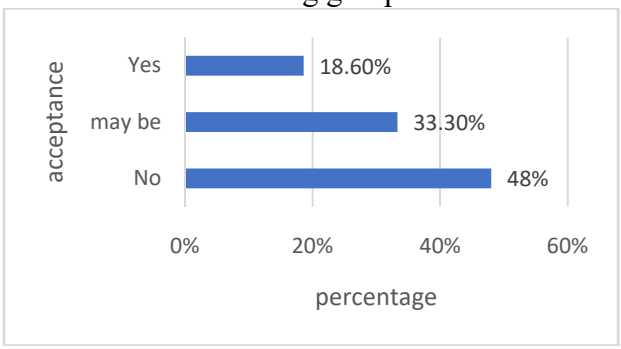
Among 1000 population, 16.7% of population refused to use recycled water for non-potable purposes. Aesthetic and religious options might be the reason of their refusal to use recycled water.83.3% of the sample population were willing to use recycled water for non-potable purposes. Their willingness to use recycled water follows the following order: Gardening purpose (58.2%)> sanitary purpose(47.8%)> agricultural purpose (64.0%) > miscellaneous (23.9%) > pet maintenance (8.7%).

Graph3: Figure showing percentage of sample population showing willingness to use reclaimed water



Graph4: Graph showing the acceptance of recycled water for different purposes

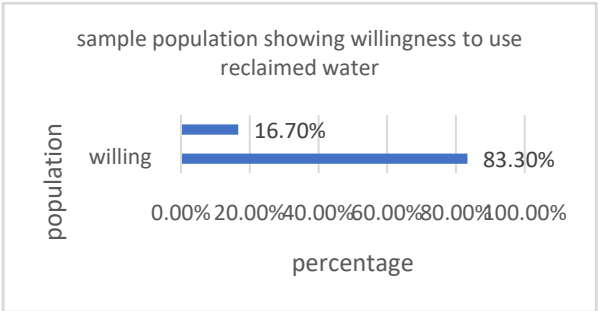
The statistical analysis have shown that students and faculties who are working in Industries with academic education have shown much interest and were more supportive towards the use of recycled water. The willingness to accept the use of recycled water was more in educated students than with uneducated and working groups.



Graph 5 :figure showing percentage of public acceptance of recycled water

Discussion

According to HMWSSB, 1.8 MLD of sewage is generated in greater Hyderabad area. 43% of the sewage is treated and the rest of the sewage is drained in Musiriver or Hussainsagar lake. Thereforeconcern on water reuse projects plays an important role in better implementation. Identifying views of the people on water re-use helps for the more better implementation of projects, specially in cities where urbanization is increasing, In 21st century, acceptance of



water re-use and its application is higher. However, such water might not be applicable for drinking as studied by Alhumond & Madzikanda (2010) regarding Kuwaitcitizen's acceptance of re-used water. According to Ormerod & Scottetal.,(2011), only 8% of Tuscan citizen in united states agreed with waste water reuse. Pharm et al., (2011) showed health issues arising from odour released after treating water in his studies , due to which 76% of respondents disagreed with waste water reuse.A study conducted in Australia and Israel by Dolnicar&Schafer(2009) and Friedleret al.,(2006) has shown strongly about the use of reclaimed water for non-potable purposes.

However, its applications for purposes such as washing, bathing etc has been reduced due to the skin diseases on contact with reused water.This study tells that 48% of the population in Hyderabad city does not have access to use reclaimed water and 83.3% of the citizenswerewilling to use reclaimed waste water.

Conclusion

Present survey revealed positive responses from engineering students and IT professionals. Awareness of water treatment process and positive perception towards it are the key drivers for the acceptance of reused water. Various Communication methods and sharing messages play a key role in this process. It also tells that a good amount of policy framework should be set up at institutional level for water recycling.Awareness of reused water can be spread by conducting advertisements through media, WhatsApp, video conferencing and workshops .Their knowledge and skills can be utilized in scaling up of water treatment facilities and reuse of treated water at community level.

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THE HOMOGENEOUS MONGE-AMPERE EQUATION AS A MODEL OF THE ION-BEAM ETCHING PROCESS

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ABSTRACT

The paper considers a mathematical model of the ion-beam etching process. An equation for ion-beam etching is derived. It is shown that this equation is an essentially nonlinear first-order hyperbolic equation. A nonlinear relationship is obtained that determines the angle between the best ionic flux and the normal to the etched surface. An expression is obtained that determines the law of motion of the abscissa of the points that lie on the etched surface. The law of motion of the interface between the mask and the working surface under the action of ion beams has been determined. It is found that the equation of the model equation of ion-beam etching can be reduced to a homogeneous nonlinear Monge-Ampere equation. Certain classes of exact solutions are presented for this equation. By the method of functional separation of variables, a power-law solution is obtained, which depends only on the set of constants and does not contain arbitrary functions. Also, solutions that linearly depend on arbitrary functions on the coordinate variable and on the time variable have been found. Assumptions and explicit conditions are formulated as to select the solutions corresponding to the considered model process from the families of solutions of the Monge-Ampere equation. A class of nonlinear partial differential equations of the first order is indicated, which can also be reduced to the Monge-Ampere equation.

Key words: *Model of ion-beam etching, Monge-Ampere equation.*

Introduction

In this article, the well-known Monge-Ampere equation arises from a purely technical problem. Interest in this equation arises both in differential geometry and in gas dynamics. Many modern works are devoted to the study of solutions of the Monge-Ampere equation. A solution in the form of triangulations was constructed in [8]. A method for constructing polynomial solutions for the inhomogeneous Monge-Ampere equation and some explicit formulas for the exact solution are proposed in [9]. In [10], a method for finding solutions in a parametric form is proposed. The most important questions in the theory of differential equations are the questions of solvability, integrability, uniqueness, and these points are covered in [11]. Complete convex solutions are constructed in [12]. The papers [13, 14, 15, 16, 17] study the properties of Monge-Ampère solutions, such as symmetry, analyticity, and behavior of solutions when the parameters of the Monge-Ampère equation change. In the future, the properties of the Monge-Ampere equations, with some changes and refinements, will be transferred to the equations of ion-beam etching.

Now, following work [6], we obtain a model equation for ion-beam etching. Let's start with the technological problem of etching furrows on a silicon wafer [1]. Let the initial profile of the treated surface be shaped like a step with the given characteristics (Fig. 1).

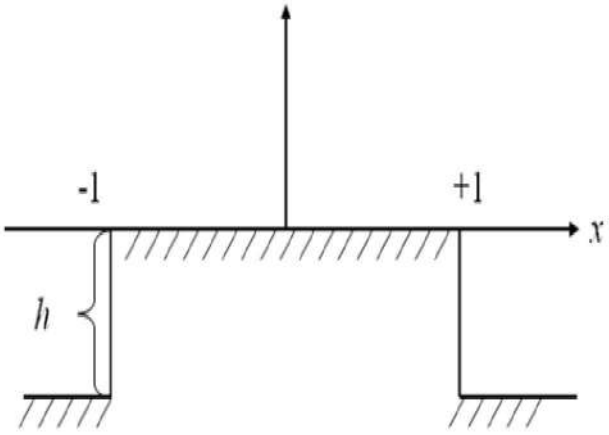

Figure 1. Target profile of the etched surface

To obtain the target profile, the material is exposed to ion radiation. A protective mask is applied to non-uniform destruction of the material on the silicon surface. The material of the mask and the material of the working layer

are different in their physical properties, namely, the sputtering rates of the material of the mask and silicon are different. Moreover, such processing is performed with a certain step on the silicon wafer. The result is alternating etched and unaltered areas. The surface relief of the plate is obviously determined by the non-etched material. The initial shape of the mask can be arbitrary. It can be assumed that the initial shape of the mask is a semicircle of unit radius. In the model under consideration, we assume that during the etching process, the protective mask rotates with an angular velocity ω relative to the vertical line passing through the center of symmetry of the mask.

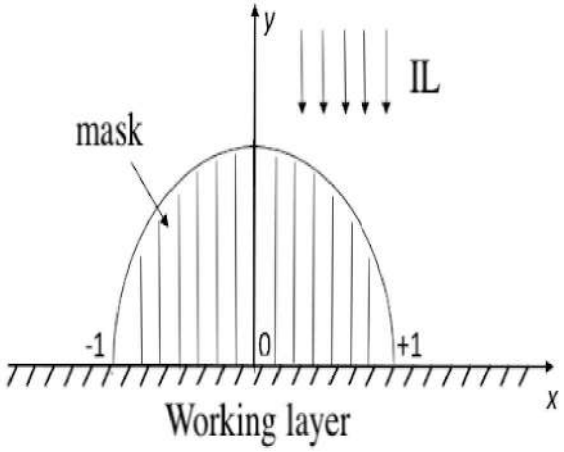

Figure 2.3. Initial form of protective mask

As a result of ion-beam etching, the mask and the open part of the working layer begin to degrade, changing their shape over time. At the end of the etching process and removing the remnants of the mask, a certain surface profile of the working layer is obtained. The nature of the process depends on the physical properties of materials I and II, on the characteristics of the ion beam, on the initial profile of the mask and its angular velocity of rotation. The study of this issue begins with the construction of a mathematical model of the ILT process.

Ion Beam Etching Equation

The vector along which the flow of ion beams is directed will be denoted by $\vec{\gamma}$. Let's find the coordinates of this vector so that its length is equal to one. To do this, we introduce a spatial coordinate system centered at point O (Figure 2), which coincides with the end of the vector$\vec{\gamma}$, and the origin of the vector is point B. The vector $\overrightarrow{BO}$ forms an angle with the Oz axis α. Since this vector has unit length, its projection onto Oz axis has coordinates$\overrightarrow{BO_z} = \{0, 0, \cos\alpha\}$, and its projection onto the xOyplane, which we denote as $\overrightarrow{BO}_{xy}$, has coordinates $\{\sin\alpha \sin\omega t\,, \sin\alpha \cos\omega t\,, 0\}$. Finally, we get that

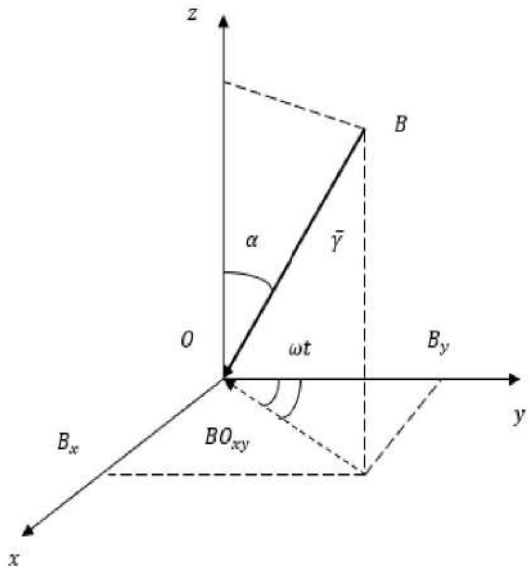

Figure 2. Projectionvectors

$$\vec{\gamma} = \overrightarrow{BO}_{xy} + \overrightarrow{BO_z}$$
$$= \{\sin\alpha \sin\omega t\,, \sin\alpha \cos\omega t\,, \cos\alpha\}. (1)$$

Figure 3 shows the part of the mask profile towards which the ion beam is directed. Let $\varphi = \varphi(x,t) -$ be a function of the required degree of smoothness that describes the evolution of the etched surface, $P_t = \{x, \varphi(x,t)\} -$ is the etching profile, the graph of the profile function of the etched mask at a given time t.

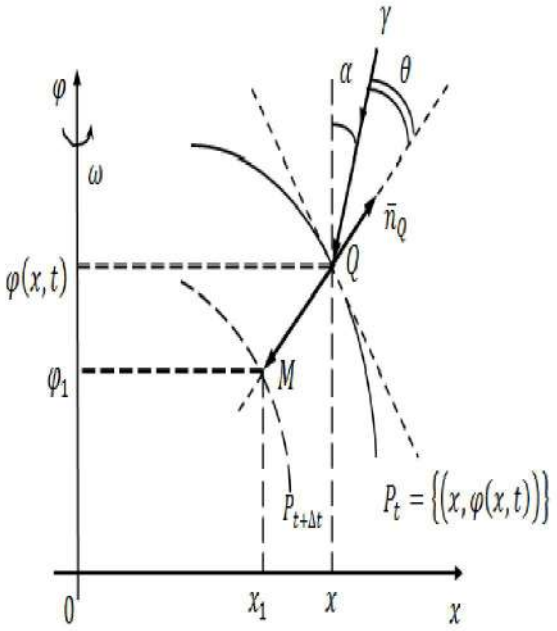

Figure 3. Evolution of the shape of a protective mask

Let us choose an arbitrary point on the etching profile $Q \in P_t$. Let us set the unit normal $\vec{n}_Q$ to the profile P_t at point Q:

$$\bar{n}_Q = \frac{1}{\sqrt{1+\varphi_x^2(x,t)}}\{-\varphi_x(x,t), 0, 1\} (2)$$

The angle between the direction of the ion beam and the norma$\vec{n}_Q$ will be denoted by θ. By virtue of the definition of vectors, we obtain that $(\vec{n}_Q, \vec{\gamma}) = cos\theta$, or

$$\cos\theta = \frac{\cos\alpha - \varphi_x(x,t)\sin\alpha\sin\omega t}{\sqrt{1+\varphi_x^2(x,t)}} (3)$$

It is worth noting that if we consider a flat model, without taking into account the rotation of the plate, then equation (3) will look differently:

$$\theta = \varphi_x.$$

Under the action of ion beams, after a time interval Δt point Q will move to point $M(x_1, \varphi_1)$ on the $P_{t+\Delta t}$profile. This movement will be carried out along the vector $-\vec{n}_Q$ with a speed $f(\theta)$.

The etching rate is determined by the function $f(\theta)$, which is usually determined experimentally and, as a rule, this function can be approximated with a sufficiently high degree of accuracy as follows: $f(\theta) = cos\theta(1+\alpha\theta)$.

Consider the vector $\overrightarrow{QM} = \{x_1 - x, 0, \varphi_1 - \varphi\}$. Let's calculate the increment of the second coordinate of this vector. To do this, we use the Lagrange finite-increment theorem:

$$\varphi_1 - \varphi = \varphi(x_1, t+\Delta t) - \varphi(x,t) = \varphi_x(x,t)(x_1 - x) + \varphi_t(x,t)\Delta t + o\left(\sqrt{(x_1-x)^2 + (\Delta t)^2}\right) (4)$$

On the other hand, based on the physical meaning of the etching law, it can be seen that the vector $\overrightarrow{QM}$ can be determined by the following formula:

$$\overrightarrow{QM} = -f(\theta)\Delta t\bar{n}_Q = -\Delta t\frac{f(\theta)}{\sqrt{1+\varphi_x^2(x,t)}}\{-\varphi_x(x,t), 0, 1\} = \left\{\Delta t f(\theta)\frac{\varphi_x(x,t)}{\sqrt{1+\varphi_x^2(x,t)}}, 0, -\Delta t\frac{f(\theta)}{\sqrt{1+\varphi_x^2(x,t)}}\right\} (5)$$

Next, we use relations (4) and (5):

$$-\Delta t\frac{f(\theta)}{\sqrt{1+\varphi_x^2(x,t)}} = \Delta t\frac{f(\theta)}{\sqrt{1+\varphi_x^2(x,t)}}\varphi_x^2(x,t) + \varphi_t(x,t)\Delta t + o(\Delta t)$$

Dividing by Δt and letting it go to 0, we get:

$$-\frac{f(\theta)}{\sqrt{1+\varphi_x^2(x,t)}} = \frac{f(\theta)}{\sqrt{1+\varphi_x^2(x,t)}}\varphi_x^2(x,t) + \varphi_t(x,t)$$

$$0 = \frac{f(\theta)}{\sqrt{1+\varphi_x^2(x,t)}}(\varphi_x^2(x,t)+1) + \varphi_t(x,t)$$

Finally, we have the equation of ion-beam etching:

$$\varphi_t(x,t) + f(\theta)\sqrt{1+\varphi_x^2(x,t)} = 0 \quad (6)$$

Note, further, that we have obtained a formula for calculating the value of the displacement in x. After equating the first components of the vector $\overrightarrow{QM}$ we have:

$$\Delta x = x_1 - x = \Delta t f(\theta)\frac{\varphi_x(x,t)}{\sqrt{1+\varphi_x^2(x,t)}}$$

After dividing by Δt , we obtain the expression $x'(t) = f(\theta)\frac{\varphi_x(x,t)}{\sqrt{1+\varphi_x^2(x,t)}}$, on the basis of which we can write:

$$x(t_1) = \int_{t_0}^{t_1} f(\theta)\frac{\varphi_x(x,t)}{\sqrt{1+\varphi_x^2(x,t)}}dt \qquad (7)$$

Note that the working layer is also sputtered, and the sputtering rate depends on the angle between the direction of the ion beam and the normal to the surface and has a form similar to the function $f(\theta)$. We denote this function by $f_1(\theta)$. We will assume that the etching process stops when the working layer is etched to a depth h. We will be interested in the speed of movement of point x_0 to the left, x_0 is the boundary point between the protective mask and the working layer.

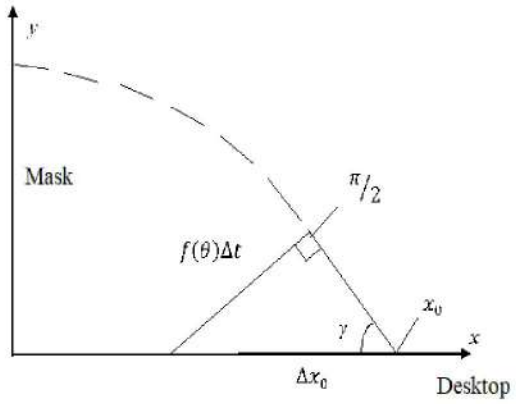

Figure 4. Evolution x_0

From Figure 4, we write the constitutive relations for Δx_0 and the angle: γ:

$$\Delta x_0 = \frac{f(\theta)\Delta t}{\sin\gamma}, \qquad \gamma = arctg\,\frac{d\varphi}{dx}|_{\varphi=0}.$$

Fromthisweget

$$\sin\gamma = v\frac{\varphi_x|_{\varphi=0}}{\sqrt{1+\varphi_x^2|_{\varphi=0}}},$$

$$\frac{\Delta x_0}{\Delta t} = f(\theta)\frac{\sqrt{1+\varphi_x^2|_{\varphi=0}}}{\varphi_x|_{\varphi=0}}$$

Passing to the limit $\Delta t \to 0$, we obtain:

$$x_0'(t) = f(\varphi_x|_{\varphi=0})\frac{\sqrt{1+\varphi_x^2|_{\varphi=0}}}{\varphi_x|_{\varphi=0}} \qquad (8)$$

In addition, we introduce another function $y(t)$such that:

$$y' = -f_1(t), \qquad y(0) = 0.$$

Obviously, $y(t) -$ is the evolution of the flat surface of the working layer. Thus, the process ends when $y(T) = -h$, where $T -$ is the end time of the end of the process. So, we got a mathematical model, which is described by the following equations:

$$\varphi_t + f(\theta(t))\sqrt{1+\varphi_x^2} = 0,$$

$$x_0'(t) = f(\theta(t))\frac{\sqrt{1+\varphi_x^2|_{\varphi=0}}}{\varphi_x|_{\varphi=0}},$$

$$y' = -f_1(t).$$

Withconditions:

$$\varphi(x,0) = g(x), \qquad x_0(0) = 1, \qquad y(0) = 0$$

Note that Equation (6) is valid in the region of $0 \le x \le 1, 0 \le t \le T$. The end time of the process T is determined from the condition

$$\int_0^T f_1(\tau)\,d\tau = h. \qquad (8)$$

Note that the etching depth function

$$h(t) = \int_0^t f_1(\tau)\,d\tau$$

is monotonic and the etching depth can be taken as a time variable. Let's make this transition. Let us recalculate the differentiation operator with respect to t:

$$\frac{\partial}{\partial t} = \frac{\partial}{\partial h(t)}\frac{dh(t)}{dt} = f_1(t)\frac{\partial}{\partial h}.$$

After such a change of variable and redesignation of $h$by t, the form of equations (6) and (8) is preserved, and the initial and boundary conditions take the following form [7]:

$$\varphi(0,x) = g(x), \qquad \varphi_x(t,0) = 0,$$

$$\varphi(t,1) = -t. \qquad (9)$$

Relationship between the ion-beam etching equation and the Monge-Ampere equation

Let us transform the equation of ion-beam etching (6). To do this, we differentiate it by t:

$$\varphi_{tt} + f'(\theta)\theta_{\varphi_x}\varphi_{xt}\sqrt{1+\varphi_x^2} + f(\theta)\frac{1}{\sqrt{1+\varphi_x^2}}\varphi_x\varphi_{xt} = 0.$$

Further, from terms 2 and 3, we take out the common factor:

$$\varphi_{tt} + \varphi_{xt}\sqrt{1+\varphi_x^2}\left(f'(\theta)\theta_{\varphi_x} + f(\theta)\varphi_x\frac{1}{1+\varphi_x^2}\right) = 0. \quad (10)$$

Now we differentiate the original equation (6) with respect to x:

$$\varphi_{tx} + f'(\theta)\theta_{\varphi_x}\varphi_{xx}\sqrt{1+\varphi_x^2} + f(\theta)\frac{1}{\sqrt{1+\varphi_x^2}}\varphi_x\varphi_{xx} = 0.$$

Similarly, move out the common factor from the 2 and 3 terms:

$$\varphi_{tx} + \varphi_{xx}\sqrt{1+\varphi_x^2}\left(f'(\theta)\theta_{\varphi_x} + f(\theta)\varphi_x\frac{1}{1+\varphi_x^2}\right) = 0. \quad (11)$$

Now, using elementary transformations from (11), we get:

$$\sqrt{1+\varphi_x^2}\left(f'(\theta)\theta_{\varphi_x} + f(\theta)\varphi_x\frac{1}{1+\varphi_x^2}\right) = -\frac{\varphi_{tx}}{\varphi_{xx}},$$

and after substitution in (10) we obtain the homogeneous Monge-Ampere equation [2, 3]

$$\varphi_{tt} - \frac{\varphi_{tx}^2}{\varphi_{xx}} = 0.$$

It is worth noting that in this way, equations of the form can be reduced to the Monge-Ampere equation:

$$P(\varphi_t) + Q(\varphi_x) = 0, \quad (12)$$

where $P(z), Q(z) -$ are differentiable functions of one variable.

Indeed, if we differentiate equation (12) with respect to t:

$$P'(\varphi_t)\varphi_{tt} + Q'(\varphi_x)\varphi_{xt} = 0, \quad (13)$$

now to differentiate (12) with respect to x we get:

$$P'(\varphi_t)\varphi_{tx} + Q'(\varphi_x)\varphi_{xx} = 0. \quad (14)$$

Further, we express $Q'(\varphi_x)$ from equation (13) $Q'(\varphi_x) = -\frac{P'(\varphi_t)\varphi_{tt}}{\varphi_{xt}}$, after substitution in (14) we obtain $P'(\varphi_t)\varphi_{tx} - \frac{P'(\varphi_t)\varphi_{tt}}{\varphi_{xt}}\varphi_{xx} = 0,$ and finally again we have the Monge-Ampere equation:

$$\varphi_{tt}\varphi_{xx} - \varphi_{tx}^2 = 0. \quad (15)$$

If we exclude the mixed derivative φ_{xt}, then we obtain the equation

$$\varphi_{tt} - \left(\frac{Q'(\varphi_x)}{P'(\varphi_t)}\right)^2\varphi_{xx} = 0. \quad (15^*)$$

This equation is a second order nonlinear hyperbolic equation.

Note that for the ion-beam etching model we have

$$P(z) = z, \qquad Q(z) = f\big(\theta(z)\big)\sqrt{1+z^2}.$$

The properties of solutions of the Monge-Ampere equation [3] are known and some model exact solutions of the Monge-Ampere equation [4] are obtained:

$$\varphi(x,t) = (C_1x + C_2t + C_3)G\left(\frac{C_4x + C_5t + C_6}{C_1x + C_2t + C_3}\right) + C_7x + C_8t + C_9,$$

$$\varphi(x,t) = (C_1x + C_2t)G\left(\frac{t}{x}\right) + C_3x + C_4t + C_5,$$

where $G(z) -$ is an arbitrary function and $C_k -$ are arbitrary constants.

Let us show that it is possible to obtain an explicit solution using the method of functional separation of variables [5]. We will look for a solution in the form

$\varphi(x,t) = u\big(z(x,t)\big)$, where $z(x,t) = X(x) + T(t)$. After recalculating the derivatives of substitution of the obtained expressions into equation (15), we obtain the equation:

$$\frac{u''(z)}{u'(z)}((T')^2X'' + T''(X')^2) + T''X'' = 0, \quad (16)$$

in which the variables can already be shared. To do this, we divide equation (16) by $T''X''$:

$$\frac{u''(z)}{u'(z)}\left(\frac{(T')^2}{T''} + \frac{(X')^2}{X''}\right) + 1 = 0$$

and it is possible to carry out the standard technique of separation of variables. Let the sought functions $X(x), T(t)$ be determined by the equations

$$\frac{(T'(t))^2}{T''(t)} = \frac{1}{\lambda}, \qquad \frac{(X'(x))^2}{X''(x)} = \frac{1}{\nu}$$

where $\lambda\nu \in \mathbb{R}$. The solution to these equations can be easily found and, as a result, we obtain

$$T(t) = -\frac{1}{\lambda}\ln|\lambda t + C_0| + C_1,$$

$$X(x) = -\frac{1}{\nu}\ln|\nu x + C_2| + C_3.$$

The function $u(z)$ is a solution to the equation $\frac{u''(z)}{u'(z)} = -\frac{\lambda\nu}{\lambda+\nu}$, and is determined by the formula:

$$u = ce^{-\frac{\lambda\nu}{\lambda+\nu}z}.$$

Putting everything together, we find a solution free of an arbitrary function, but with 6 arbitrary constants:

$$\varphi(x,t) = C_1\left(|\nu x + C_2|^{\lambda}|\lambda t + C_3|^{\nu}\right)^{\frac{1}{\lambda+\nu}} + C_4,$$

$$C_1, C_2, C_3, C_4, \lambda, \nu \in \mathbb{R}.$$

Note that when implementing the method of separating variables, division by $T''X''$. was performed. Such an operation can lead to the loss of solutions to the differential equation when $T''X'' = 0$. Let $T''X'' = 0$. Then $T'' = 0$or $X'' = 0$. Let's consider one of the cases (the other is completely symmetric).

We will assume that $T'' = 0$, that is, $T(t) = at + b$ and equation (16) will take the form:

$$\frac{u''(z)}{u'(z)}(a^2X'') = 0.$$

If $X'' = 0$, then $u(z) -$ is any twice differentiable function and we obtain the known solution $\varphi(x,t) = u(at + cx + b)$. If $X'' \neq 0$, then $\frac{u''(z)}{u'(z)} = 0$ and we obtain that $u(z) = C_1z + C_2$. The solution to equation (15) in this case is determined by the formula:

$$\varphi(x,t) = C_1X(x) + at + b.$$

Similar considerations for another case will lead to a solution of the following form:

$$\varphi(x,t) = C_1T(t) + ax + b.$$

To select solutions that satisfy the initial and boundary conditions, it is necessary to require the fulfillment of conditions (9). At the same time, the Monge-Ampere equation is a second-order equation, and a restriction on the desired solution is also required. We obtain it from the equation of ion-beam etching (6). This equation is valid for each point of the region in which it is considered; naturally, it also holds for $t = 0$:

$$\varphi_t(x,0) = -f\left(\theta\left(\varphi_x(x,0)\right)\right)\sqrt{1+\varphi_x^2(x,0)}.$$

So, as an initial condition, one can use relation (15 *) at $t = 0$:

$$\varphi_{tt}(x,0) = \left(\frac{Q'\left(\varphi_x(x,0)\right)}{P'\left(-f\left(\theta\left(\varphi_x(x,0)\right)\right)\sqrt{1+\varphi_x^2(x,0)}\right)}\right)^2 \varphi_{xx}(x,0)$$

For an arbitrary initial condition, it is almost never possible to write down an exact formula that gives a solution. One can only hope that for some $g(x)$ it will be possible to select the required family of solutions and determine the parameters that uniquely distinguish the desired function from the found family.

Conclusion

It is shown in the work that the model of the ion-beam etching process is described by a nonlinear hyperbolic equation of the first order, which can be reduced to the one-dimensional Monge-Ampere equation. A class of equations of the first order is established, the equations from which can also be reduced to the Monge-Ampere equation, for which some families of exact solutions are presented. It is shown that these families can be both finite-dimensional and infinite-dimensional. Conditions for the selection of physically meaningful solutions from these families of solutions are formulated.

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