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Going Round with Monolithic Domes

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***Abstract*—** The present time has been introduced to a multitude of buzz words like eco-friendly green and sustainable. Construction field is no exception to it.. With the introduction of monolithic construction these requirements are being addressed. Monolithic domes are among the sustainable construction models in such a way that they are energy efficient, ecofriendly nature, much durable & disaster resistance. This document focuses on the safety and sustainability of monolithic domes against the natural forces. The document also highlights the relative supremacy that monolithic domes possess over the conventional building construction methods when it comes to cost efficiency, durability, strength, resilience and energy efficiency.

***Keywords*—** Monolithic domes; Ring beam footing; Polyurethane foam; Thermal insulation; Sustainability

1. INTRODUCTION

The whole purpose of building a structure is to provide the occupants with protection and sustain the environment without shooting the economic constraints. Since the days of yore, man has sought refuge from danger within caves, huts and tree houses. Although the primitive structures have evolved much technologically over the time yet the modern shelters still fail to meet the requirements of “sustainable environment” and many a times succumb to the natural forces. Sustainable, according to Susannah Hagan, has a broad meaning, and girdles environmental as well as social responsibility; economy, health and safety. Their extraordinary structure empowers them to withstand even the worst cataclysmic events for instance, storms, tornadoes and seismic tremors. The monolithic domes are in this manner especially famous in the areas of the world generally presented to catastrophic events. Monolithic dome is a thin wall reinforced concrete shell structure cast in one piece form created by the revolution of a segment of circular curve about its vertical diameter. The Monolithic Dome has concrete thin shell having a three-inch layer of urethane foam which is covered by a fabric on its exterior. The form may be permanent or temporary and may or may not remain the part of the finished structure. “Thin Shell” is the generic name for a Monolithic Dome.

2. CONSTRUCTION PROCESS

Modern construction process of dome construction is a lot different from the original concrete-over-dirt method previously used for dome construction. The present construction methods were developed by three brothers from Idaho: Barry, Randy, and David South. The first dome built by utilizing this approach was constructed in Shelley, Idaho.

2.2 Ring Beam Footing

Continuous reinforcing steel bars are implanted in the ring beam foundation. These reinforcements ensure a connection between the foundation and the dome shell. The ring beam provides a solid base to construct the dome on. Rebar is bent over so that the Air form can be slid over.

2.3 Monolithic Air form Erection

Monolithic construction process largely depends upon an Air form. The Monolithic Air form is a balloon like, inflatable structure that determines the shape and size of a dome. It is made of PVC-coated nylon or polyester fabric.

a) Laying it out

The Air form is to be laid out over the foundation. The attachment of the airform to the base starts from one side and then moves to the opposite side followed by the quarter points, and their opposites and this continued in all the directions. The Airlock is then implanted at an apt location.

b) Attaching the Airform

There are numerous ways in which airform can be attached. The most adopted method uses a thin metal strap which is screwed on the outside of the airform with concrete screw anchors

c) Attaching Inflator Fans

After the Airform is attached, air tubes are welded in place followed by attaching the inflator fans using the air tubes.

d) Attaching Airlock

Once the air is turned on, the air lock is attached. The air lock not only serves as the entry point to the dome during the construction process but also as the pressure regulating system. The airlock consists of two doors in order to ensure a uniformly maintained pressure while entering.

In order to eradicate the chances of power loss, dual fans and dual power sources are used. Maintaining the air pressure inside a dome is the most central factor during dome construction. As the airform is inflated, the simplest way to adjust the pressure is by opening the airlock doors. When the

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Airform first becomes tight, it's necessary to make sure that the air pressure is minimum.

2.3 Polyurethane Foam Application

It is important to keep the surface of airform dry before the application of polyurethane foam. If this is not checked the moisture already present on the surface may cause blistering after the application of the foam. So time has to be given the airform to get dried naturally or it can be done by the application of the heat on the inside of airform.. The following are the steps involved in Foam Application

Step 1:

Monoform primers are applied prior to the application of the foam in order to enhance the strength of the bond between the airform fabric and the foam. It can be carried out using airless paint guns.

Step 2:

Selection of the foam depends upon the local conditions. In the event that the foam slides, it implies it is not setting sufficiently fast. In such a case fastest setting foam is to be used which is available for the climate and the season. The foam machine requires to be attuned such that it sprays one part Chemical A and one part Chemical B in 1:1 ratio.

Step 3:

Check the thickness of the applied spray by carefully examining with an ice pick. An excessive amount of examining may lead to formation of cavities in the foam which can cause blistering. The risk of puncturing the airform is also increased because of too much probing. So the testing of thickness has to be carried out carefully.

2.4RebarPlacementAndFinalFoamApplication

A rebar hanger is first attached at the top centre of the dome shell and it is secured in position by the application of foam spray. The top centre hanger is then used as a marking guide. The placement of rebar hangers is then carried out all around and the foam application is done so as to secure their position. Then the rebars are placed in both vertical and horizontal alignment and tied in place.

2.5Shotcreting

Shotcrete is a blended mortar of cement, sand, aggregate, and water applied at high speed onto a surface. The material is compacted by the force transmitted by the jet. A comparatively dry mixture is used in order for the material to support itself thereby minimizing sagging or sloughing. The cement, sand, aggregate, and water are first mixed by using appropriate means, and then pumped by a specially designed mortar pump.

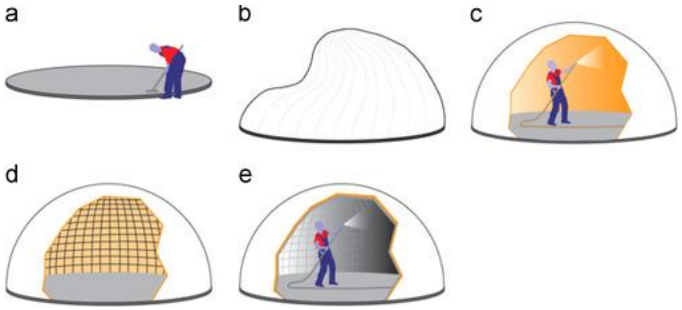

Fig 1 Construction steps involved

3.0 MAREIALSUSED

The materials used for construction of monolithic domes are standards with few variations that can be made according to the local conditions which are enlisted as:

Airform

Airform is a balloon like inflatable fabric which decides shape and profile of the monolithic dome. The airform has a provision of airlock which ensures the pressure regulation within it.

Polyurethane foam

Polyurethane foam spray is an insulating material which is sprayed on the interior of the airform. It provides a base for attaching steel rears.

Reinforcing steel

The steel reinforcement of the specified grade is used in the ring beam foundation and the dome shell.

Concrete

In the foundation a standard concrete mix is used. Shotcrete is applied to the interior walls of the dome shell which embeds the steel rebars.

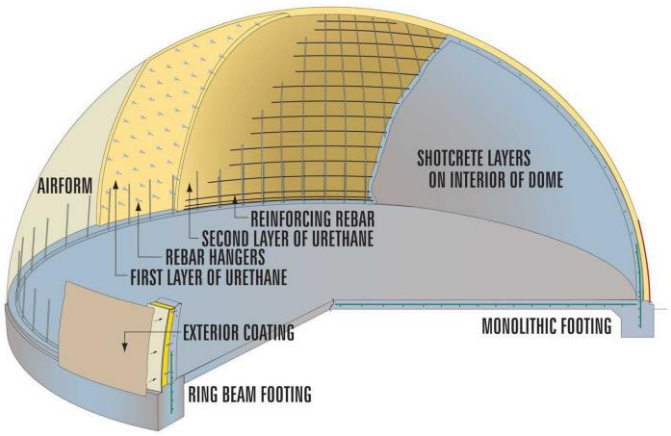

Fig 2 Monolithic Dome Scheme

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4.0 ECONOMIC ASPECTS

When we talk about the cost to build something, it's important to take a holistic approach that deals with the different aspects that will create or save money, which results in a net cost or savings analysis.

When considering a construction method, cost saving and minimal maintenance are important factors. Generally, the construction cost of monolithic dome is so less as compared to conventional buildings that it can emerge as an effective methodology for low cost housing. As the size of the building increases above approximately 2,000 square feet the construction becomes exponentially less expensive simply because of the reduced material needed for a dome versus square shaped structure, as well as the efficiency in the construction method. Although it's hard to put a set price on a Monolithic Dome because of the many existing variables, certain specific numbers have been used to try and give people a general idea.

The State of Arizona has the highest proportion of Monolithic Dome schools, and conventionally built school buildings in Arizona cost about 18% more than the Monolithic Domes that have been built there already.

4.1Economy in construction

Monolithic domes save construction costs in comparison to conventional buildings in two ways:

- By reducing the material need at the site
- By being built indoors since the inflated airform prevents weather delay.

Monolithic domes eliminate the necessity to build load-bearing walls which makes it possible to set out the walls in any convenient configuration in addition to this; the dome profile eliminates the need of roof. This translates to a significant reduction of investment costs, as well as saving construction time. Large cost reduction is also obtained due to the use of lesser quantities of building materials than in standard construction attributing to the fact that domes cover the least surface area for the volume they contain.

The construction of monolithic domes is carried inside the airform which ensures that there is no weather related delay in the construction process.

4.2Economy in operation

The initial investment maybe same for the monolithic domes as for any other construction method. However, the cost savings are made in the long run, that is, during the service time of the dome.

The dome's curvilinear design, its uncomplicated building process and its top quality materials ensure that maintenance is minimum.

The ability of monolithic dome to maintain its temperature also translates to a smaller need in tonnage for the air conditioning system. In fact, Monolithic dome construction asserts that the monolithic domes require a quarter of the amount of tonnage of air conditioning required by the conventional buildings. The energy savings associated with heating and cooling results in an average of 50-70% reduction in costs. In long term this energy saving results in cutting down the consumption of electricity and eventually the money electricity costs is also reduced.

Other savings associated with owning a Monolithic Dome relate to:

- the reduced costs in maintenance of the exterior,
- reduced cost in insurance premiums for the building and
- never having to rebuild in the case of a fire, bullets, and termite or mold infestation.
- hurricane and tornado resistance offered by monolithic dome
- earthquake resistance of the structures.

5.0 THERMALINSULATIONANDCLIMATECONTROL

The dome profile provides the least surface area for the volume encompassed by it. Therefore, the heat transfer through the surface with the outside air is decreased. The unitary construction of a monolithic dome also eliminates the seams and crevices which would otherwise let the air to escape. However this effect is alleviated in residential al buildings due to presence of doors and windows.

By laying down the insulating foam that is the polyurethane foam on the outside of the concrete shell, the concrete acts as a thermal mass inside the building which thereby reduces the interior temperature variations. The reduction achieved in temperature variations in monolithic domes is more than that achieved unconventional home's insulation inside a brick or stone layer. A three inch concrete wall that's adhered to the inside of the insulation doubles the effects of insulation. Concrete itself acts as a heat sink, holding and maintaining temperature fluctuations for days.

6.0 BUILDING SURVIVABILITY

The monolithic dome, when completed, is earthquake, tornado, and hurricane proof. The US Federal Emergency Management Agency (FEMA) rates monolithic domes as "near absolute protection". There is numerous evidence of the resistance of monolithic domes against the major natural catastrophes, few are enlisted as follows:

• Monolithic dome government building in Iraq endured a direct hit by 2300kg bomb in 2003.

• Monolithic domes endured direct hits by Hurricane Katrina in 2005 in Florida.

• Monolithic domes which came in the way of the 2005 and 2006 wildfires in Oklahoma and Texas persisted with just burning of exterior foam insulation.

The damage from tornadoes and hurricanes is owed to the strong rotary winds they contain and the windborne debris they carry. The conventional buildings fail to resist these because of the orthogonal and sharp design. The angels, sharp corners and the flat surfaces in the conventional buildings gives wind something to push against. Monolithic domes due their curvilinear design are safe against tornadoes and hurricanes. In fact monolithic domes are designated as "tornado shelters"

For most of the monolithic domes one of the most probable disasters is earthquake. It has been asserted that the earthquake forces don't even approach the design strength of the monolithic dome. Monolithic dome is so built that it can withstand external force equal to and greater than the earthquake and approach the design strength of concrete itself. Conventional buildings contain many joints between the walls, roof and foundation and these joints are called as moment connections. During an earthquake the structure is subjected to enormous side loads that cause the moment connections to weaken, fatigue and fail. A monolithic dome has no substantial moment connections for earthquake to damage. From side to side and bottom to top monolithic dome is exceptionally strong. Rarely will an earthquake create forces high enough to meet the normal load condition.

Apart from surviving all these gigantic natural forces, the monolithic domes are also fireproof and termite resistant which adds to their extended life span.

7.0 ENERGY CONSUMPTION

Monolithic domes are not only disaster resistant but also energy efficient. Owing the seamless design and structure tightness, monolithic domes happen to conserve a large amount of energy which leads to cost savings in operation.

The energy saving features of domes are concluded by an architect who states, "Domes embody the virtues of simplicity, economy, and energy conservation, and enclose the maximum amount of space with the least surface area. It is this surface area which consists of building materials, and comprises the exterior skin of the building through which heat is gained, or lost. This is the essence of dome efficiency."

Without changing a thing in the way that a Monolithic Dome is constructed there are several opportunities to gain points under Leadership in Energy and Environmental Design (LEED) systems. The energy performance of Monolithic Dome relates directly to the building envelope and Heating, ventilation and air conditioning (HVAC) design and these approaches have a place in the LEED rating process.

8.0 AESTHETICS

Monolithic domes are energy efficient, durable and cost efficient. However, their appearance is not very conventional because we are used to looking at buildings as four walls. We live in a square-building world and we are resistant to anything different. Yet, a dome is not as peculiar as it seems to be, it's just the newness that it offers. If the number of domes constructed beautifully and nicely starts increasing, the prejudice against domes will certainly diminish.

9.0APPLICATIONS OF MONOLITHIC DOMES

The various spheres of application which make the MD stand out are enumerated as follows:

Low cost housing

In the twenty-first century the population of the world is increasing at very fast rate. So it is essential to design urban life spaces in accordance's to the needs of modern time. Especially in a country India, it is immensely important to study the need for low cost housing because the population is expanding at an enormous rate and most percentage of the population is lingering under poverty. The focus should be on providing the best solution in the form of monolithic concrete domes that not only provide cost efficiency but are also disaster resistant over their lifespan.

Government shelters and emergency centre

Monolithic Domes hold tremendous potential as government quarters and shelter homes. It will not only render cost cutting but will also help to reduce the slum construction in India. Monolithic domes can be built as replacement for slums in India.

Military Applications

A brisk study of Monolithic Domes can show that they are the coherent buildings for most military applications. Their expense of construction is sensible. They require reduced materials to construct and are in general faster to build than conventional buildings. Energy reduction is generally half or more. They are stable and durable. And it is uncomplicated to lock down and defend the monolithic domes.

The enemy entities would find it very difficult to make their way through Monolithic Dome. More importantly, Monolithic Domes are capable of withstanding natural and man-made disasters. The government invests crores in military and research equipment. It would prove to be in good financial benefit for these tanks, planes, automobiles and all the other military and research equipments to be put away in Monolithic Domes instead of metal tents.

Biological containment

Biological containment by a Monolithic Dome is inbuilt because they are air tight structures, Monolithic Domes offer major protection from gas, radiation and bio-hazards Monolithic Domes have potential for extreme air tightness as shown by their use for fruit storage in Stockton California. The domes, which are used there, contain 42,000 square feet (3902 sq. meters) of floor space, demonstrating that huge airtight structures are possible to construct.

10.0ADVANTAGES AND DISADVANTAGES OF MONOLITHIC DOME

The advantages of monolithic dome can be enumerated as follows:

I. Streamlined construction process and use of only four main ingredients contribute to the economy of construction

II. The construction process of monolithic domes is fast and there is no weather related delay as the construction takes place inside the airform.

III. The maintenance cost of monolithic domes is less.

IV. Monolithic domes have the ability to withstand tornadoes, hurricanes and earthquakes

V. These provide protection against fire and flood.

VI. These are energy efficient and sustainable.

The disadvantages of monolithic domes can be enumerated as follows:

1. Only specially trained construction screw can carry the advanced construction technique.

2. There is wastage of space in the narrow corners.

3. The unconventional appearance of domes diminishes the appeal for their use by private residents.

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I. CONCLUSION

No matter where you live in the world, it is inevitable to escape the wrath of nature. What can be done is to build buildings that are disaster resistant that too well within the economical constraints. Moreover, environment is another that has to be considered while designing the buildings. Monolithic dome construction is the modern construction method which satisfies all these requirements. It is not only disaster resistant but also energy and cost efficient. The Monolithic Dome is a type of structure that has the potential to become one of the most sustainable buildings of the century. From the perspective of endurance and durability, its persistence and strength to endure and not burn or decay over time elicits a great deal of attention for the sustainable development industry.

In conclusion, monolithic domes are tomorrow's buildings available today. Every year thousands of lives and money would be saved if the structures to be built were mandated to be monolithic dome.

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Effect of Rhythmic Acoustic Structures on Human Beings Using Infrared Camera

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***Abstract*—** We are surrounded by different kinds of sounds whether relaxing or distracting. These sounds create an important impact on us knowingly or unknowingly. Rythmic sounds (relaxing) align our actions. The rhythmic acoustic vibrations are important as they affect us psychologically, physiologically and cognitively [1]. Rhythmic structures influence our emotions. It can reduce anxiety, anger, stress, and increase relaxation. The objective of the paper is to investigate the effect of rhythmic acoustic vibrations within the human subjects by using infrared (IR) imaging. In the proposed research, IR images obtained as a result of applying rhythmic acoustic vibrations have been used for studying their effect on human beings. The images were analyzed with respect to 3D temperature profiles. In most of the cases, the analysis of the temperature profiles of different subjects showed that the application of the selected rhythmic acoustic vibration activates the right side of the brain indicating relaxed state of mind.

***Keywords*—** Acoustic energy, Rhythmic sounds sound vibrations, sound therapy, acoustics, entropy, thermal imaging, IR imaging.

I. INTRODUCTION

Different Sounds can have different impact on human beings. When rhythmic stimulus is given to two interacting individuals, their interpersonal attitudes toward one another become more positive [2] which indicates that rhythmic acoustic affects our behavior. Hormones are secreted from our body all the time. There is an impact of the type of sound on an individual . If we are surrounded by a non-rhythmic sound the hormone called cortisol is secreted more from the body which is responsible for stress and fatigue in the body. Being surrounded by a rhythmic sound decrease the level of cortisol in the body which means less stress and a relax state of mind [3].

Acoustic sounds also affect the emotional and cognitive state of our mind as emotions are a major part of the human beings. Listening to the un rhythmic sounds may result in increase in anger, anxiety and thus disturbs the relaxed state of mind ,whereas the rhythmic sounds for example some soothing music may result in decrease in the heart rate ,lower blood pressure and stress, The rhythmic acoustic vibrations involves the whole brain. It not only improves memory, but attention, physical coordination and mental development too. It may also leads to boost the overall immune system of the body. It activates several regions of the brain, including auditory, motor, limb [4].

Effect of acoustic vibrations in the range of 13.5 kHz to 20.0 kHz at sound pressure level between 82 dB to 92 dB was investigated by Fletcher et al [5] on the development of stress in human subjects with reference to 1 kHz stimulus at 25 dB. It was reported by him that high frequency acoustic stimulus causes unpleasant effect and introduce discomfort with in subjects.

The acoustic vibrations help for reducing various human organ related problems. This technique has recently been used in several developed countries for detecting, analyzing, and treating the stress, depression and other related problems. Cakmak et al [6] investigated the effect of electric stimulation of intrinsic auricular muscle zones and demonstrated that gait of Parkinson disease patient improves as compared to the medication, which indicates that acoustic stimulus can also help in improving the condition of the patients of Parkinson disease. Improvements were reported by Jakobs et al for the patients having Alzheimer disease also [7] Photo acoustics is used for detecting medical anomalies particularly cancer and atherosclerosis [8].

The emotional state of mind can be estimated from the visual image of the face of the subject. In [9], a facial expression integrated sign language is developed using emotional state estimation an accuracy.

The thermal imaging has been used for various applications. Infrared imaging is used in clinical diagnosis to record slight physiological changes caused by fractures, burns, prostate cancer, dermatological diseases, lymphomas, rheumatoid arthritis, liver disease, bacterial infections, etc. These conditions are associated with various processes which generates a high-temperature heat source.

In [10], thermal imaging has been employed for predicting the future state of the plants even before the actual symptoms being appeared on them. In [11], IR thermal imaging has been used for separating the infected and healthy leaves by noticing their temperature range which is 0.5°C - 1.3°C higher in healthy leaves [12] suggests that thermal camera is also used for the detection of abnormal flow of blood in the affected area of the body because of the temperature change in that part.

The scope of this paper is to analyze the effect of rhythmic acoustic structure on the human beings. The detail of the thermal imaging is presented below in Section 2 the methodology of the investigations is presented in section 3. The results are presented in Section 4. Conclusions and future scope are discussed in Section 5.

II. Infrared Imaging

Each sound has a different effect on the human temperature profile To record this temperature, thermocouples, thermistors, and thermopiles are used But these are of uncomfortable size, poor response, and difficult to attach to subject skin. Hence thermal imaging or IR imaging is used that takes the thermal images of the body and note the temperature. It is generally used to study the flow of blood, the detection of various cancers, and muscular performance of our human body [13] [14]. Thermal images have been used to quantify and measure sensitive changes in skin temperature because of certain diseases [15].

As we know that the energy radiated by an object at temperature T is given by Stefan Boltzmann law $E = \sigma T^4$, where σ is Stefan Boltzmann constant

For the present investigations, Fluke Ti480 PRO thermal camera based on IR imaging is used. It has various features like IR-Fusion,auto focus, image enhancement,digital zoom (2X and 4X),image annotations, auto capture, wireless connectivity, HDMI connectivity,relative humidity adjustment, and temperature compensation. There is a touch LCD for displaying the thermal images with high-visibility. The images can be saved to internal or external memory. All thermal imagers need sufficient warm-up time for accurate temperature measurements and bestimage quality.Its temperature measurement ranges from -20°C to1000°C and has optical wide angle smart lense of 1.31 mRad.The images along with the metadata can be transferred to a PC having SmartView for further analysis.

III. Methodology

The methodology for analysis of effect of rhythmic acoustic structure on human beings using infrared imaging within human subjects has been divided into the following two sections:

Synthesis of stimuli

Effect of acoustic vibrations in human subjects is investigated by applying a rhythmic acoustic structure i.e. Shiv tandav stotram. The reason for selecting this was its historical significance. This has already been reported as it usually creates a perception of relaxation in human brains. For comparison, a subject is taken which is not exposed to this rhythmic structure. The amplitude of the tones was fixed at 10,000 and the sampling frequency was kept at 16,000 kHz.

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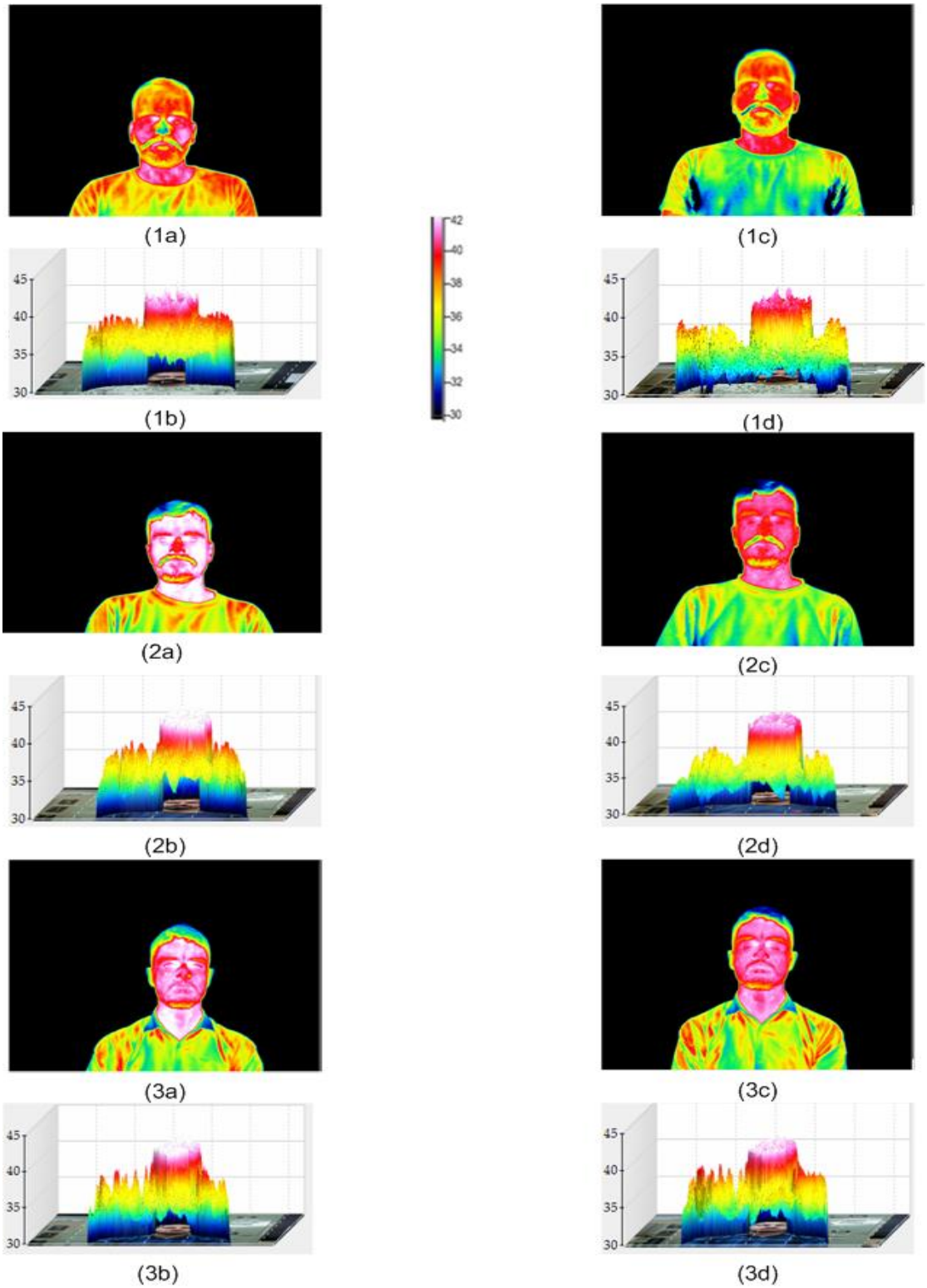

Fig 1 Thermal profiles of the 3subject chanting the stimulus. First, third and fifth row corresponds to the images before and after applying the stimuli and second, fourth, and sixth shows the 3D temperature profiles before and after applying the stimuli.

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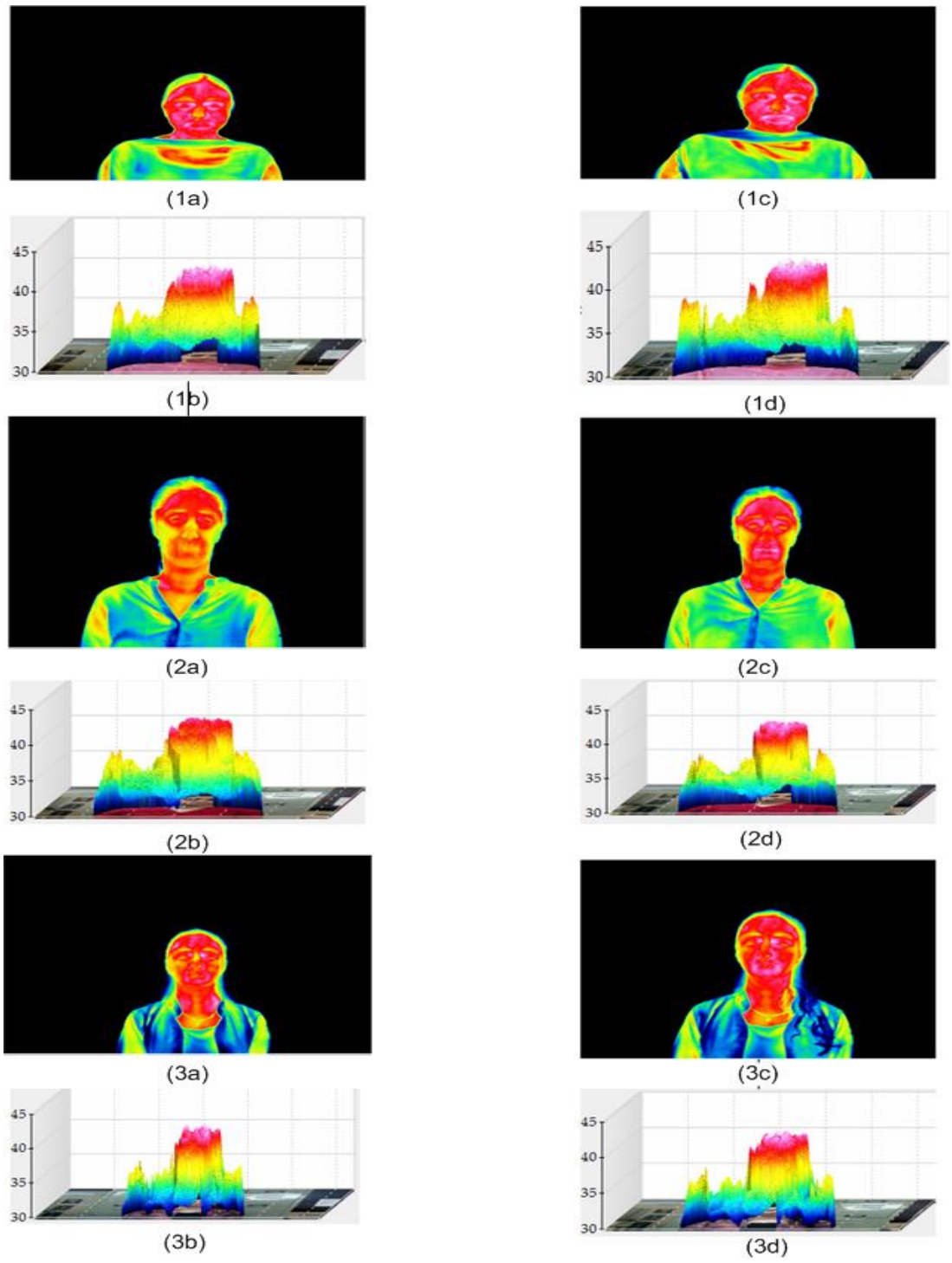

Fig 2 Thermal profiles of the 3 female subjects before and after application of stimulus the stimulus. First, third and fifth row corresponds to the images before and after applying the stimuli and second, fourth,and sixth shows the 3D temperature profiles before and after applying the stimuli.

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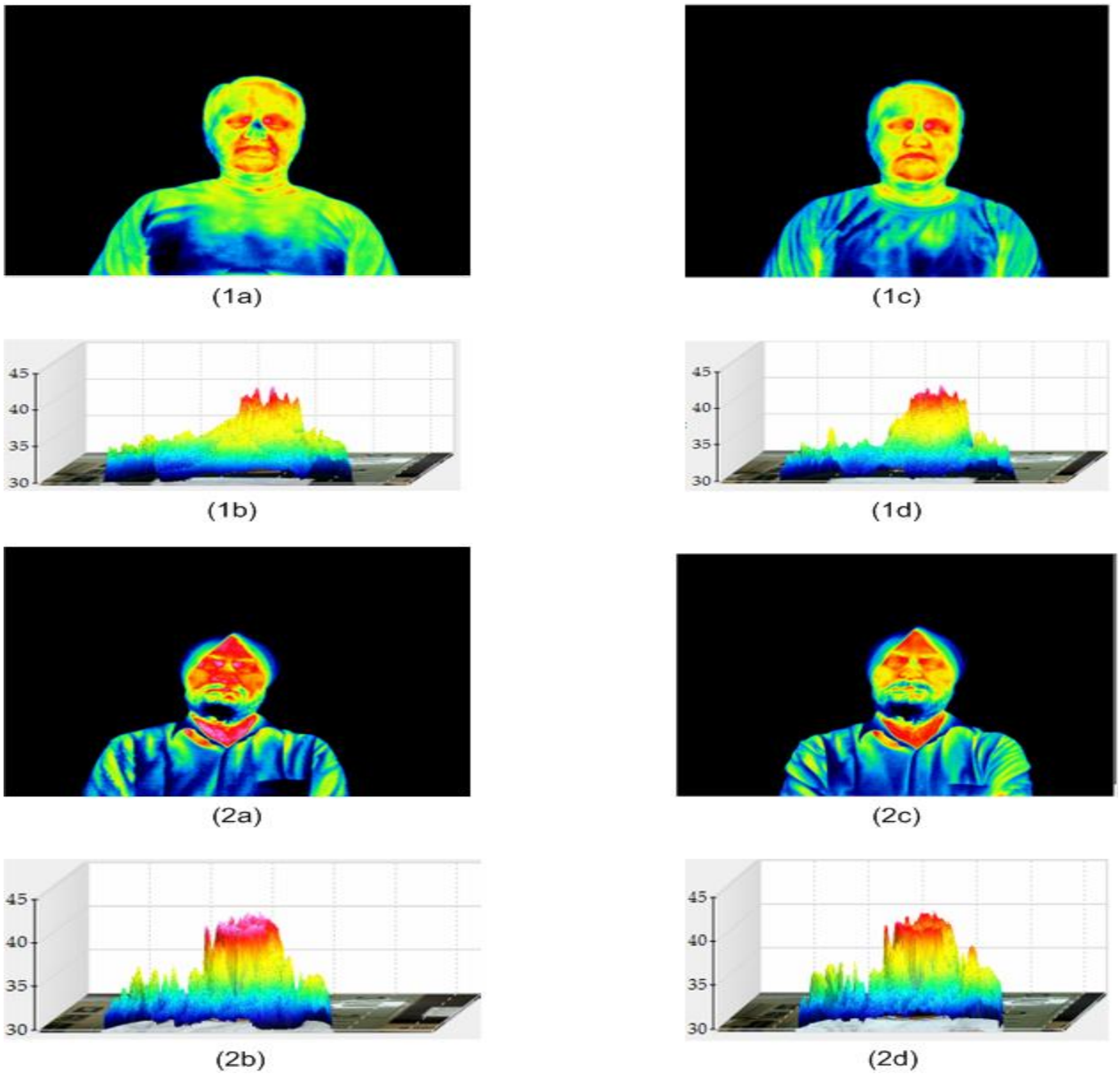

Fig 3 Thermal profiles of the 3 male subject before and after the application of stimulus First, third and fifth row corresponds to the images before and after applying the stimuli and second, fourth, and sixth shows the 3D temperature profiles before and after applying the stimuli.

Recording of the response

For the investigations,8 subjects were taken. Out of these five were males and three were females in the age group of 20-30 years. There was no psychological and physiological problem visible within the subjects. For performing this investigation an acoustically treated room with the appropriately positioned Fluke Ti480 Pro thermal camera on stand was used to take images before and after the actual application of the rhythmic acoustic sound Before recording it was made sure that there is no interference with any other thermal source. A waiting time of around 2 minutes was ascertained before actual application of the acoustic stimuli through headphones. The volume of the sound adjusted within a comfortable level of 72dB. The duration of stimuli was 5 minutes 30 seconds.

Analysis of the response

An analysis software called SmartView was used for analyzing the thermal images. The images from the thermal camera were downloaded to the PC. The emissivity was kept constant at 0.65 and the dynamic temperature range was kept fixed as (30^0C -42^0C). Investigations were carried out by visually viewing the 3D temperature profiles.

IV. Results And Discussions

The effect of rhythmic acoustic vibration in human subjects was investigated using Fluke Ti480 Pro, as explained in methodology. The effect on the subjects was almost similar except in case of few subjects. , The 3D temperature profiles for the subject s corresponding to rhythmic stimuli are shown in Fig 1, Fig 2 and Fig 3. Column 1 displays the images for different subjects along with their 3d temperature profiles before the application of stimulus Column 2 displays thermal images of the subjects along with their 3d temperature profiles after the application of the stimulus.

The analysis of the 3D temperature profiles obtained before the application of stimulus (Fig 1b and Fig 1d) and after applying the stimulus of the subjects who chanted the stotram shows that the shape of the temperature profile corresponding to the facial area shifts towards a rhythmic regular and smooth shape .There is a visible decrease in the temperature of these subjects indicating calmness in the brain This shows the rhythmic patterns corresponds to relaxed state of mind and hence the patterns obtained after its application results in relatively more rhythmic 3D temperature profile after the application of the stimulus. Relatively more changes are observed on the right side of the face indicating more activities within the left side of the brain, representing emotional changes within the brain.

In few subjects, stimulus showed some rise in the temperature in some portion of the face giving an indication of increased stress (Fig. 2, Fig 3b, Fig 3d) produced within the brain.

In Fig 3, Fig 1a, and Fig 1d the effect of the stimulus is highly visible in the subject where we can see the transition from an entirely un rhythmic 3Dtemperature profile ,to a rhythmic temperature profile. Thus the subject is in a state of relax mind after hearing the stimulus for the specified time.

V. Conclusions And Future Scope

Investigations were carried out to study the effect rhythmic acoustic structure on human subjects. The results showed that stimulus resulted in relaxation within most of the subjects. In conclusion it is certain that this stimulus is reall yuseful for reducing stresse. Detailed analysis of the effect of this on MRI, ECG, and EEG is on our future program.

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Execution of Artificial Bee Colony Algorithm to Compute the Best Function Values

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***Abstract* –** In the past decade, research scientists have shown enormous interest in Swarm Intelligence algorithms. One such algorithm is the ABC (Artificial Bee Colony) algorithm based on intelligent behaviors of honeybee swarms. The research paper elaborated on the proposed idea to evaluate the mean of best function values under different scenarios. The proposed idea in the research paper is discussed via a detailed flowchart. To prove the worth of the anticipated idea, three different cases are studied having assigned numerical values to the evaluation parameters. Matlab has been used as a research tool. The findings of the conducted research state that the value of the mean function values decreases with the increase in the colony size.

***Keywords* –** *ABC, colony size, employed foragers, food source, function values.*

I. INTRODUCTION

The three main prerequisite modules of the minimal model of forage selection leading to the beginning of cooperative intelligence of honey bees are food sources, employed foragers, and unemployed foragers [1, 2]. Food sources refer to the value of the food source which depends on factors like nearness to the food source and richness of energy and the easiness of extracting this energy [3]. Employed foragers refer to the food source which is currently been exploited. They transmit with them information about this specific source, its distance and direction from the nest, and the effectiveness of the source and share this information with a certain probability. Unemployed foragers keep on looking for a food source to be exploited [4, 5]. The Scouts bees are engaged in searching the environment surrounding the nest in search of new food sources [6] and Onlookers bees are assigned the job of waiting in the nest and finding a food source via the information shared by Employed foragers [7, 8]. The three important modes of behavior are recruitment to the nectar source and relinquishment of a source [9, 10].

II. IMPLEMENTATION AND CONTRIBUTION

This section elaborates on the proposed procedure for finding the mean function value against the error. The involved evaluation parameters have been mentioned below followed by the descriptive flowchart illustrating the anticipated idea. Thereafter, the three different cases are implemented using the projected technique.

A. Evaluation Parameters

The different evaluation parameters used in the proposed idea are as follows:

- *ColonySize* –> Number of Employed Bees + Number of Onlooker Bees
- *FoodNumber* -> ColonySize/2 (The number of food sources equals half of the colony size)
- *MaxCycles* –> Maximum number of cycles required to terminate the algorithm
- *ErrGoal* –> Error goal required to terminate the algorithm
- *Dim* –> Number of parameters of the objective function
- *Limit* – >Control parameter required to abandon the food source
- *Lb* ->Lower bound of the parameters to be optimized
- *Ub* –> Upper bound of the parameters to be optimized
- *ObjFun* –> Name of the objective function
- *RunTime* –> Number of runs

B. Flowchart of the proposed idea

Fig. 1 illustrates the descriptive flowchart detailing the working of the suggested idea.

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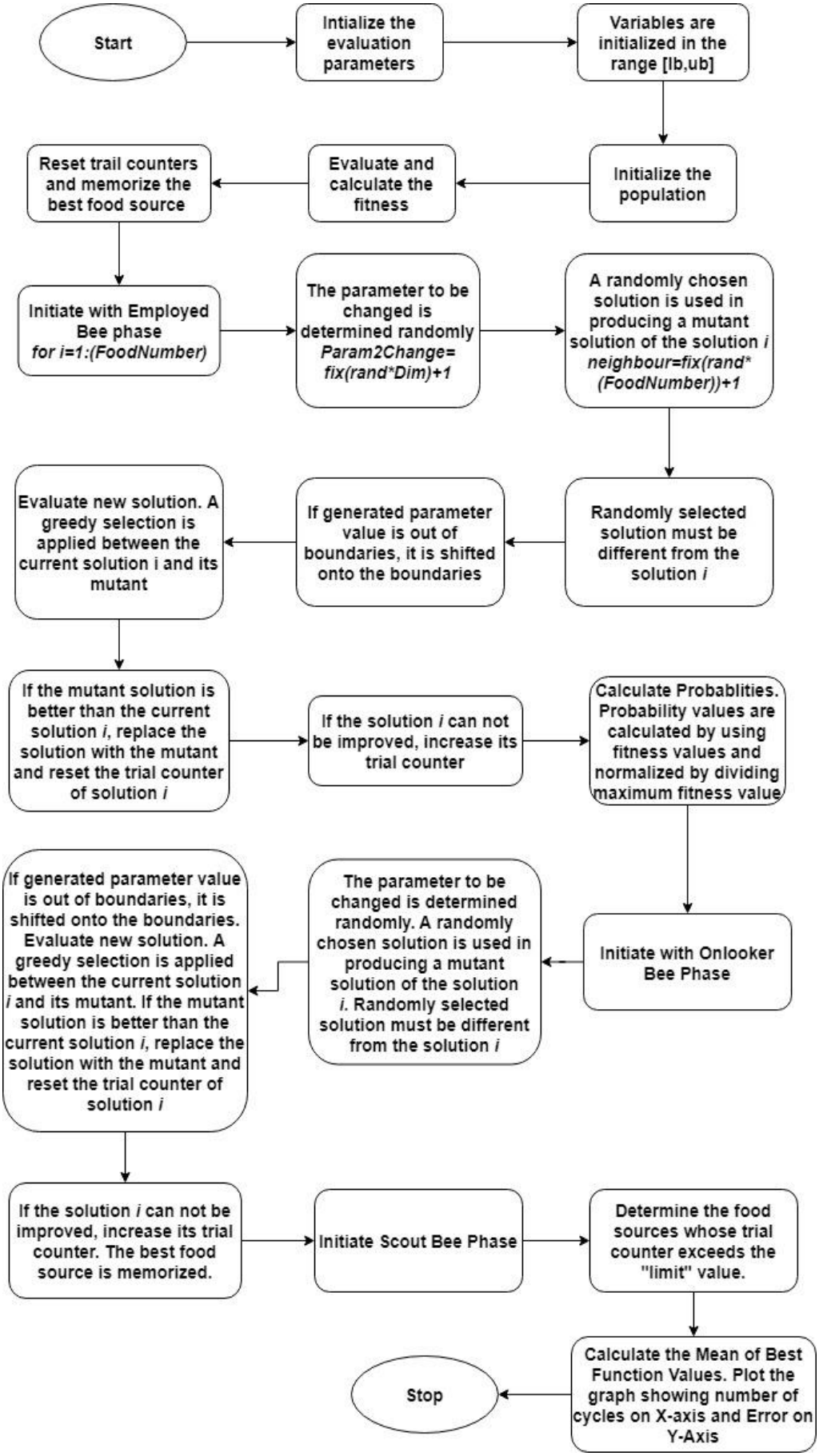

Fig. 1. Flowchart describing the proposed idea

C. Implementation

The three cases are implemented to prove the worth of the proposed idea. The values assigned to different evaluation parameters are stated alongside the parameters.

Case 1
ColonySize = 100
FoodNumber = 50
MaxCycles = 1000
ErrGoal = 1e-20
Dim = 5
Limit = 50
Lb = -600
Ub = 600
ObjFun = Sphere
RunTime = 1

Table I shows the obtained function values for the first 20 iterations.

Table I. Table shows the readings of function values of the first 20 iterations

Iteration Number	Function Value
1	1157.94
2	1019.97
3	133.353
4	39.3677
5	19.9372
6	19.3685
7	11.9424
8	10.8409
9	4.44137
10	4.44137
11	1.36486
12	1.36486
13	1.36486
14	1.23333
15	0.67647
16	0.612726
17	0.585729
18	0.547497
19	0.547497
20	0.280385

Table II shows the obtained function values for the last 20 iterations.

Table II. The table shows the readings of function values of the last 20 iterations

Iteration Number	Function Value
981	$2.04654*10^{-17}$
982	$2.04654*10^{-17}$
983	$2.04654*10^{-17}$
984	$2.04654*10^{-17}$
985	$2.04654*10^{-17}$
986	$2.04654*10^{-17}$
987	$2.04654*10^{-17}$
988	$2.04654*10^{-17}$
989	$2.04654*10^{-17}$
990	$2.04654*10^{-17}$
991	$2.04654*10^{-17}$
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997	$2.04654*10^{-17}$
998	$2.04654*10^{-17}$

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999	$2.04654*10^{-17}$
1000	$2.04654*10^{-17}$

The mean value of the function values after executing all the 1000 iterations as per the values of evaluation parameters of Case 1 is $6.10623*10^{-14}$. Fig. 2 shows the graphical representation of the obtained results. The X-axis represents the number of iterations (cycles) and Y-axis represents the error.

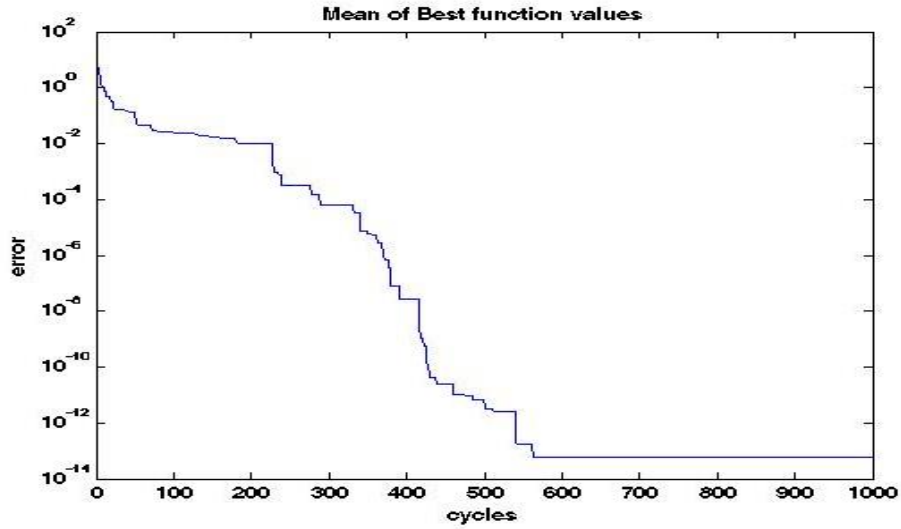

Fig. 2. The figure shows the obtained results as per Case 1 in graphical form

Case 2

ColonySize = 500
FoodNumber = 250
MaxCycles = 1000
ErrGoal = 1e-20
Dim = 5
Limit = 50
Lb = -600
Ub = 600
ObjFun = Sphere
RunTime = 1

Table III shows the obtained function values for the first 20 iterations.

Table III. The table shows the readings of function values of the first 20 iterations

Iteration Number	Function Value
1	749.694
2	749.694
3	749.694
4	352.889
5	352.889
6	39.5169
7	30.083
8	27.8051
9	27.548
10	25.0099
11	25.0099
12	20.9254
13	11.4407
14	7.58002
15	1.21996
16	1.09626
17	1.09614
18	1.08615
19	0.115712

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20	0.11343

Table IV shows the obtained function values for the last 20 iterations.

Table IV. The table shows the readings of function values of the last 20 iterations

Iteration Number	Function Value
981	$1.77879*10^{-17}$
982	$1.77879*10^{-17}$
983	$1.77879*10^{-17}$
984	$1.77879*10^{-17}$
985	$1.77879*10^{-17}$
986	$1.77879*10^{-17}$
987	$1.77879*10^{-17}$
988	$1.77879*10^{-17}$
989	$1.77879*10^{-17}$
990	$1.77879*10^{-17}$
991	$1.77879*10^{-17}$
992	$1.77879*10^{-17}$
993	$1.77879*10^{-17}$
994	$1.77879*10^{-17}$
995	$1.77879*10^{-17}$
996	$1.77879*10^{-17}$
997	$1.77879*10^{-17}$
998	$1.77879*10^{-17}$
999	$1.77879*10^{-17}$
1000	$1.77879*10^{-17}$

The mean value of the function values after executing all the 1000 iterations as per the values of evaluation parameters of Case 2 is $2.33147*10^{-15}$. Fig. 3 shows the graphical representation of the obtained results. The X-axis represents the number of iterations (cycles) and Y-axis represents the error.

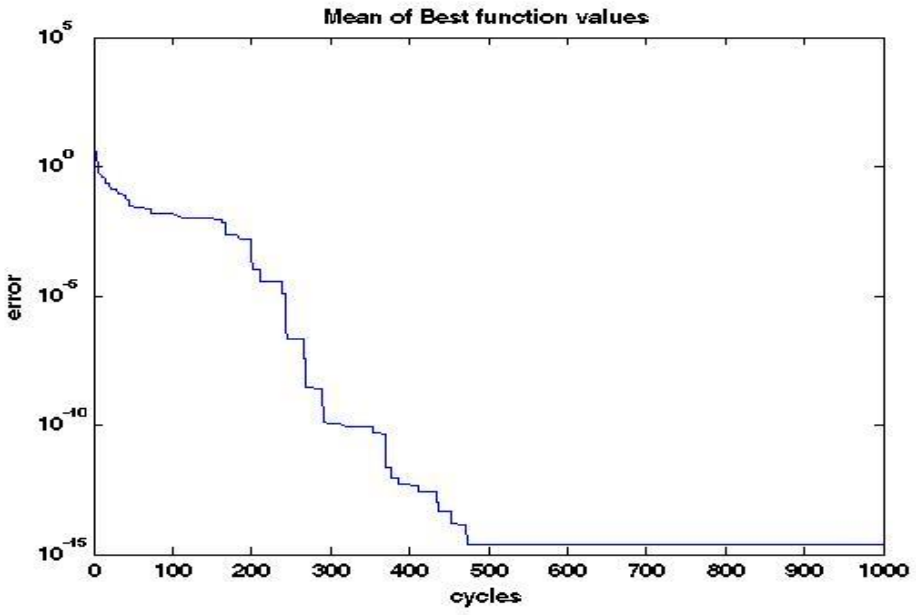

Fig. 3. The figure shows the obtained results as per Case 2 in graphical form

Case 3

ColonySize = 1000
FoodNumber = 500
MaxCycles = 1000
ErrGoal = 1e-20
Dim = 5
Limit = 50
Lb = -600
Ub = 600

ObjFun = Sphere

RunTime = 1

Table V shows the obtained function values for the first 20 iterations.

Table V. The table shows the readings of function values of the first 20 iterations

Iteration Number	Function Value
1	637.59
2	617.462
3	280.828
4	196.28
5	91.6113
6	81.8048
7	68.2997
8	58.1714
9	6.72478
10	3.92446
11	1.51921
12	1.51829
13	1.17357
14	1.17357
15	1.13782
16	1.13782
17	1.13782
18	0.398886
19	0.257782
20	0.257782

Table VI shows the obtained function values for the last 20 iterations.

Table VI. The table shows the readings of function values of the last 20 iterations

Iteration Number	Function Value
981	$1.13355*10^{-17}$
982	$1.13355*10^{-17}$
983	$1.13355*10^{-17}$
984	$1.13355*10^{-17}$
985	$1.13355*10^{-17}$
986	$1.13355*10^{-17}$
987	$1.13355*10^{-17}$
988	$1.13355*10^{-17}$
989	$1.13355*10^{-17}$
990	$1.13355*10^{-17}$
991	$1.13355*10^{-17}$
992	$1.13355*10^{-17}$
993	$1.13355*10^{-17}$
994	$1.13355*10^{-17}$
995	$1.13355*10^{-17}$
996	$1.13355*10^{-17}$
997	$1.13355*10^{-17}$
998	$1.13355*10^{-17}$
999	$1.13355*10^{-17}$
1000	$1.13355*10^{-17}$

The mean value of the function values after executing all the 1000 iterations as per the values of evaluation parameters of Case 3 is 0. Fig. 4 shows the graphical representation of the obtained results. The X-axis represents the number of iterations (cycles) and Y-axis represents the error.

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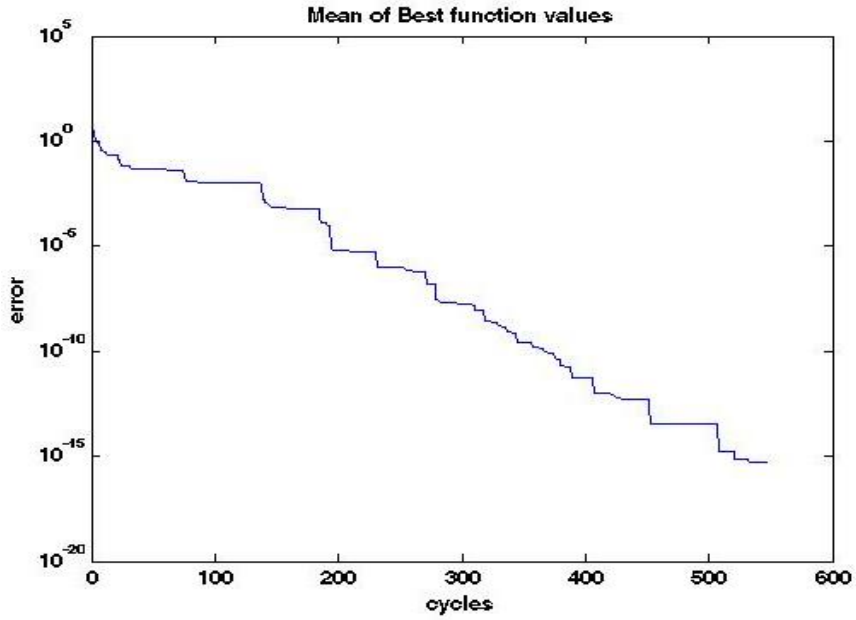

Fig. 4. The figure shows the obtained results as per Case 3 in graphical form

III. CONCLUSION

The findings of the conducted research work state that the value of the mean of function values decreases with the increase in the colony size. In the future, the readings of evaluation parameters can be altered and new findings can be obtained.

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Digital Door Lock System Protected Using 4 Digit Passwords

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***Abstract*—** Everyone wants to lead a safe and secure life in the present society and there is a great need for modern security systems in the present society due to the increase in the thefts and bankrupts. And our lifestyle has changed a lot. Everyone is very busy and we often forget the keys of the locker, house, etc. So there is an alternative for this common problem proposed in this paper by making a digital lock that works on a 4-digit password. In our proposed system, a microcontroller is embedded in a digital door lock and this is the central main controller of the system. Technically speaking, a simple digital door lock based on microcontroller technology interacting with the user by an LCD and a numeric keypad for interactivity with the system. The operations for the opening and closing the door are mentioned on the screen for the easy operation. The main advantage of this project is due to its low-cost, since we have to use it 24 by 7 and good efficiency of the PIC controller makes the project suitable for use in real life. The user can change the password whenever he wants to. This lock system gives user more security and a low cost way of locking-unlocking. It can also be integrated into a cloud server using Some connectivity techniques and the lock can be remotely controlled which brings the home automation into the picture.

***Keywords*—** Microcontroller, Digital door lock, Keypad lock, LCD, Rack and Pinion.

I. INTRODUCTION

In the present era of innovation and automation, every individual wants to do work simply and efficiently. In this era due to busy schedules and work, we often forget our keys and also misplace them. According to a survey conducted by Pebblebee.com published in an American news website named “Daily News” [1] says that keys are the most common item that is lost. Another survey [2] says on average American adults waste around 2.5 days in a year searching for lost items. We end up with mental stress and frustration. And there is another major problem with us is we are unable to share a single physical key with our family members, staff and neighbours in hurry to work or else we rely on some other neighbours to hand over the keys. There are many digital lock systems proposed that operate using RFID (Radio Frequency Identification) [3][4]. There are also many high-end security locks using Biometrics like fingerprint [5], Iris scan[6] to open the door lock. There are also devices with strong encryption for the door lock opening[7][8][9].In this paper, we are proposing a simple digital door lock based on PIC18F4520 microcontroller interfacing with the user using a 16x2 LCD and 4x4 numeric keypad. The operations for the opening and closing the door are mentioned on the screen for the easy operation. The operation and PIN for the lock are similar to the operation of the ATM. This simple interface for door locking to save our efforts and time can be used in house door locks, Lockers, and many more industrial uses. It comes with a feature of alerting the nearby people with a buzzer sound if someone tries to tamper lock by entering wrong passwords or random passwords.

II. METHODOLOGY

Theoretical Overview

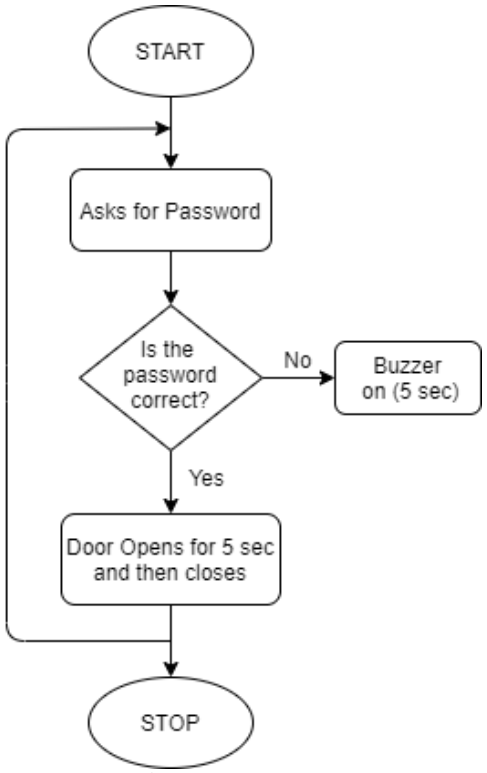

Fig. 1 Flow chart for Digital Lock system

The system which is connected to the door opens when we enter the correct password into it. The main components of this device are a microcontroller (PIC18F4520), keypad, motor, L293D. After all the setup is done, the user enters his password, if the password is correct, then the door unlocks using Rack and Pinion Gear Mechanism. If not, the door will remain closed and triggers the buzzer to notify the people nearby.

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Hardware

Keypad: We have used the 4X4 keypad, it will be having 16 built-in push-button contacts connected to row and column lines. The microcontroller can scan these lines for a button-pressed state. This keypad will consist of 4 rows and 4 columns in which these 16 built-in push buttons are connected.

Fig.2 4x4 Keypad Module

Rack and Pinion: It is a linear actuator in which it converts rotational motion into linear motion and vice-versa. It consists of a circular gear and a linear gear. This mechanism helps to lock and unlock the door.

Fig. 3 Rack and Pinion

Buzzer: A buzzer is a sound signalling device, which will be creating sound according to the developer instructions.

Fig. 4 Buzzer

Motor(Side shaft): In this system, we are using a side shaft motor of 150rpm. Inorder to create the motion for the rack and pinion, in which this motion is for unlocking the door.

Fig.5 Side shaft DC motor

Motor Driver(L293D): This motor driver will be interfacing between the microcontroller and the motor. The main purpose of this motor driver is to convert the low current signals which were received from the microcontroller into high current signals and sending it to the motor. It also consists of H-bridge which helps us in changing the direction of the motor.

Fig.6 L293D IC

LCD display: The LCD display which we have used is 16×2 in which it can display 16 characters in one row and it consists of two such rows.

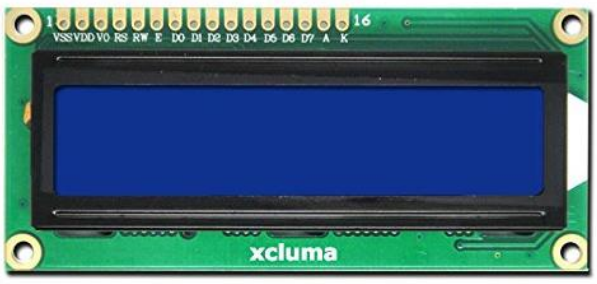

Fig.7 16x2 LCD

PIC18F4520 Microcontroller: It is an 8-bit PIC (Peripheral Interface Controller) Microcontroller based on RISC architecture by MICROCHIP. We opt this module as the brain of the project. For this project, we used the PDIP package MCU. It is a 5V logic level device. It comes with a 40 pin

interface. The PIC18F4520 contains 256 bytes of EEPROM data memory and 32k of program memory. It consists of a 10 bit A/D converter. The Microcontroller has one 8-bit timer and 3 16-bit timers. It comes with different operating modes that helps in better power management. These modes are mainly divided into 3 categories namely Run Mode, Sleep Mode and Idle Mode.

Fig.8 PIC18F4520 Microcontroller

Hardware Implementation:

1) *Explanation*:Hardware implementation includes integration of PIC microcontroller of the type 18F4520, a 4x4 matrix keypad, LCD display, L293D motor driver and side shaft motor of 150 RPM. It also consists of a power system to execute the project. The algorithm of the project is converted to the executable code in C language and embedded to the microcontroller using some softwares. Hence, Microcontroller is able to verify the secured lock and to unlock the door if the password is correct. The door shall be locked and unlocked using rack and pinion gear mechanism. If the password input is wrong, it would trigger a buzzer to notify the people nearby.

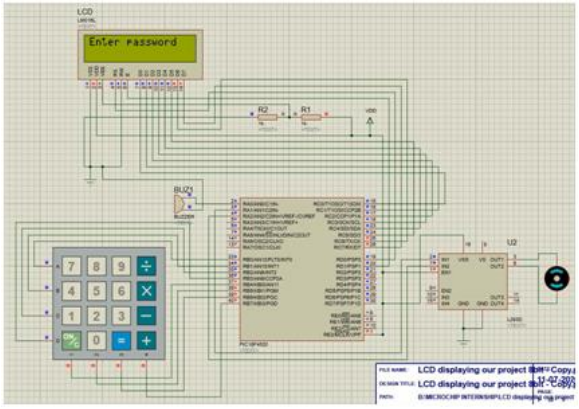

Fig.9 Circuit Diagram

D.Software :

1) *XC8 compiler:*MPLAB XC8 compiler supports all 8-bit PIC and AVR microcontrollers. We used XC8 to compile the C code that is written in MPLAB X IDE. An XC8 compiler is compatible with Windows, Linux and also MAC operating systems.
2) *MPLAB X IDE:*It is an integrated development environment to build the code. It acts as a platform for compilers. We include all the necessary libraries here. It is an open source software used to configure the MCU's.
3) *Proteus:* Proteus is a virtual simulation application where our circuit is to be built. An hex file containing the program is to be imported to proteus. This application helps in prototyping our projects. It helps the electronic enthusiasts to make schematics or develop Printed Circuit Boards. It is the ultimate tool for simulating any type of electronic circuit.
4) *Fritzing:* It is an hardware initiative tool used to make circuit diagrams, PCB and schematics. It is an easy to use tool for making PCBs. We have to import the necessary components to our model and draw the complete circuit. Thus, we can make permanent circuits of our project. It works on both Mac and Windows OS.
5)

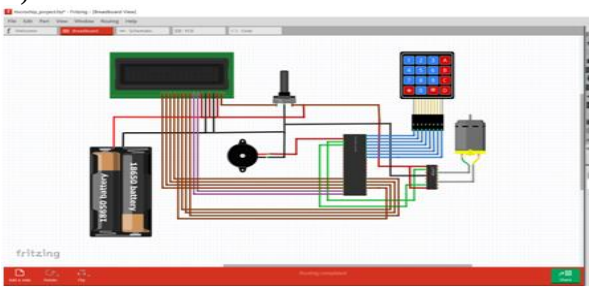

Fig.10 FRITZING Circuit Diagram.

III. RESULTS

As mentioned above, we have connected all the components to the microcontroller and fixed the side shaft motor, rack and pinion to the door. Initially the LCD screen will be displaying a welcome message as shown in fig.11.

Fig.11 LCD Displaying "Hello Welcome to Our Project"

Then It will ask for entering the password as shown in fig.12.

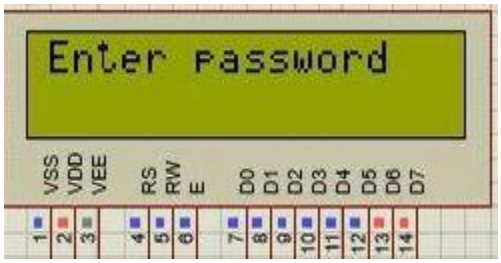

Fig.12 LCD displaying "Enter Password"

Then after entering the correct password, Let us assume the correct password be 1234 then the motor rotates in clockwise direction for 3 seconds

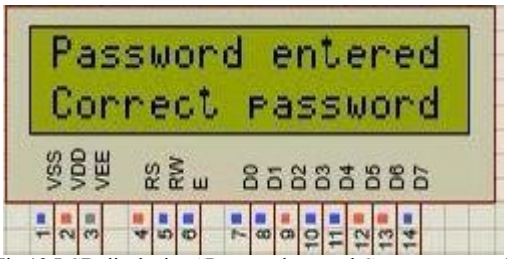

Fig.13 LCD displaying "Password entered Correct password"

to drive the rack to open the door as shown in fig.14.

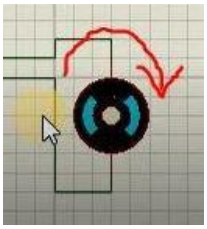
Fig.14 Motor rotating in Clockwise direction

After opening the door, we have to close the door, the instruction for it will be displayed on the LCD screen as shown in the fig. 15. We have to click "+" on the keypad.

Fig.16 LCD displaying "Enter + to close"

After entering the "+", the motor rotates in the anti-clockwise direction for 3 seconds, to drive the rack backwards as shown in the fig. 17.

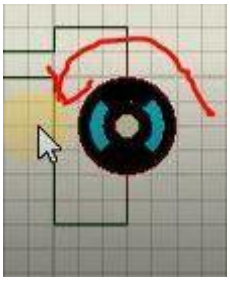
Fig.17 Motor rotating in Anticlockwise direction

So, after the process is done the LCD displays "Door Closed" as shown in the fig. 18.

Fig.18 LCD displaying "Door closed"

If the person enters the wrong password. The LCD displays "Wrong Password" and in addition to it the buzzer activates. As shown in the Fig. 19.

Fig.19 LCD displaying "Wrong password"

TABLE I. Table styles.

IV. CONCLUSION AND FUTURE SCOPE

The simple digital door lock proposed in this paper would help in maintaining the security of the doors, lockers and many more applications at low cost and simple way of installation. The alerting feature of this project for tampering by entering wrong passwords will help in preventing thefts.

This simple work can be further carried out for the more security and easy operation by connecting this lock to a cloud platform and integrating with a mobile app so that the owner/user can know the status of the lock(open/close) , remotely access the lock and also get notified when some wrong password is entered. In simple words users can monitor the complete status of the lock remotely. These further works can help in making the lock more secure and reliable.

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Smart Fault Detection and Protection System for Transmission Lines

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***Abstract*—** Electrical power leakage is one of the major problems that the power department faces in recent times. To overcome this problem, we came up with a system that can detect these faults in transmission lines automatically & intimate the authorities with a specific location through SMS service. This paper mainly focuses on those section of power line that connects the transformer with the consumers. These faults directly affects the consumers so these should be found & should be repaired as soon as possible .This could be done by developing a system that uses sensors to sense the incoming & outgoing values & detect the fault.

I. INTRODUCTION

In India, Geographical conditions are not uniform throughout the country. The terrain consists of Mountainous regions, Arid Regions, Grasslands, and areas having subzero temperatures. The Power Transmission lines have to be transmitted to the far-flung areas via these rugged terrain conditions. Due to the geographical and climatic conditions of these terrains, the Power transmission lines experience several faults. These faults may be caused by the lightning, birds, felling of trees at the time of storms etc. As a result of these faults, the power supply and hence power quality is severely affected. These faults even lead to damage and destruction of power apparatus. So, in order to maintain the quality and continuity of supply, these faults should be found and rectified as rapidly as possible.

A large number of methods are utilized for the fault detection in transmission lines which mainly use voltage and current transformer readings at the substation or switching station end for the fault analysis. Most analysis methods rely on the values of either current or voltage phases measured by means of current or voltage transformers at substations or switching stations.

Methods of fault detection can be classified into one terminal and two terminal methods depending upon whether the system requires data from one end or from both ends of the transmission line, other than above mentioned method. Recently several fault location methods are proposed like travelling wave based methods, impedance based methods, voltage based methods and knowledge based methods. The most commonly used method for the fault detection is the impedance based fault detection system because of cost effectiveness and high accuracy.

Present Fault Detection System

The power transmission system in India faces a large number of problems due to which frequent power outages are common in our country. In the present system whenever a fault occurs , the users inform the authorities which then manually shut off the entire section of the transmission line for maintenance. A large Number of methods exist for the fault detection in transmission lines. These methods include wavelet transform method, Impedance Method, Voltage Method and knowledge Based method. Out of these, the wavelet transform method is the most accurate one but at the same time thus method is too complex and expensive to implement. Other type of Faults in the transmission lines include line to line fault, line to neutral fault (short circuit fault), line to earth fault, Open circuit faults etc. These faults can also be expressed as transient faults, symmetrical faults & persistent faults.

A transient fault is that type of fault that is no longer present when power is disconnected for a short period of time. Most common fault occurring in power lines are transient in nature. Typical examples include tree contact, bird contact, lightning strike or conductor clash. Transient fault may still cause damage to both at the site of the original fault or elsewhere in the network as fault current generated.

A persistent fault does not disappear when power is disconnected. Faults in underground power cables are often persistent. Underground powerlines are not affected by trees or lightning, so faults when they occur are most probably due to damage.

Symmetrical /balanced fault which affects each of three phases equally. In transmission line faults roughly 2-3% are symmetry where as asymmetrical faults are those faults in which three phases are not affected equally.

In practice, most faults in power lines are asymmetrical in nature. Symmetric faults can be viewed rarely where as asymmetrical faults are difficult to analyze.

II. PROPOSED SYSTEM

The proposed system consists of two units. First unit may be at the Generating Station end, Grid Station end, or Substation end. The first unit is called Main Unit. This main unit comprises of Volage sensor (to measure the line and phase voltages), Current Sensor (to measure line and phase currents), an Arduino microcontroller, a Communication

Module (either RF or GSM Module) to receive the data sent by the sub unit, a GSM Module which communicates with the concerned authority with an SMS (containing location and type of fault), an alarm system (to alert the manforce at the Generating, Grid or Sub Station about the fault occurred), a LCD display (to monitor the values of currents , voltages and to find out the type of fault occurred), Relays and Drivers.

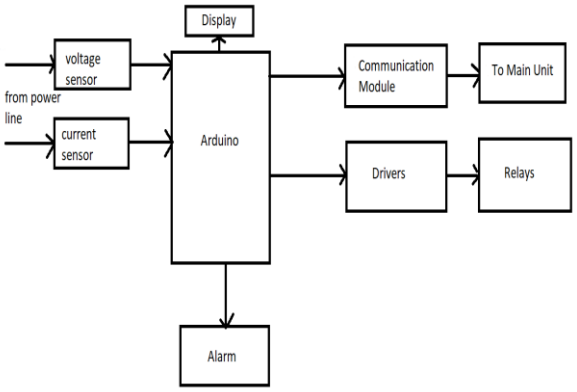

fig 1. Sub Unit

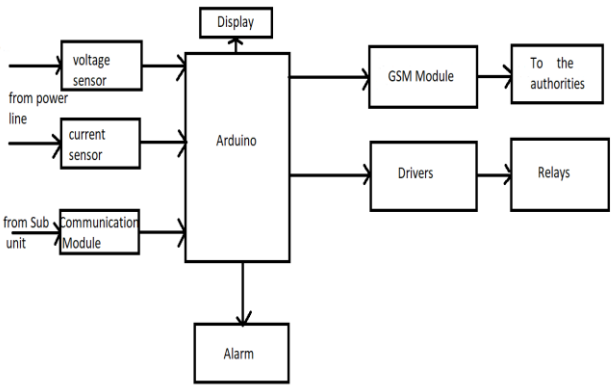

fig 2. Main Unit

The second one is subunit whose main function is to find the faults in the transmission line and inform the corresponding location to the Main unit.The sub unit comprises of voltage sensor (to measure the line and phase voltages), Current Sensor (to measure line and phase currents), an Arduino microcontroller, a Communication Module to receive the data sent by the sub unit.), an alarm system (to alert the manforce at the Generating, Grid or Sub Station about the fault occurred), a LCD display (to monitor the values of currents , voltages and to find out the type of fault occurred), Relays and Drivers.

The proposed system makes the use of ELCB's , Relays and other circuit breakers as used in the existing system and utilizes the Current Transformers and Potential Transformers in the Current and Voltage sensors respectively.

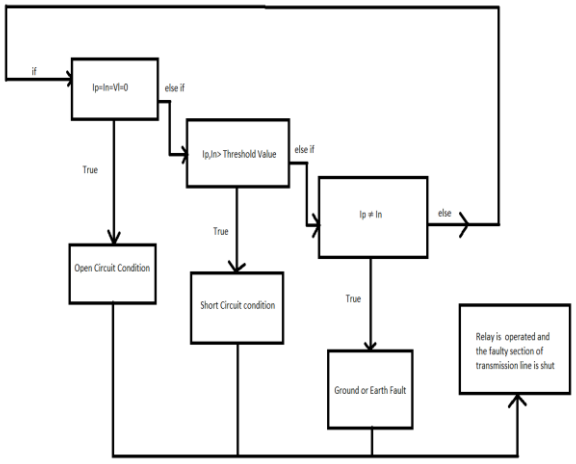

fig 3. Operating algorithm of proposed system

Working of the proposed system

In this paper, we have proposed a system which is able to automatically detect, sense and make the authorities aware of any fault occurring on the transmission line by making the use of main unit and sub unit.

In case of sub unit, it first checks the readings of line and neutral currents and various voltage values and sense the various faults as mentioned below.

If phase, neutral currents and line voltage all equal to zero, then the system assumes open circuit condition and relays are cut off in this way.

Else if phase and neutral currents are greater than a particular threshold value which is to be set manually, the system assumes short circuit condition and the relays are operated.

Else if phase and neutral currents are not equal, then the proposed system assumes ground or earth fault and the relays are operated

Else if not a single above mentioned condition is not met, then the sub unit system repeats the whole process as a whole. When the relays are operated in any case of fault, then only the faulty section of the transmission line is cut from the rest instead of the whole.

The main unit which placed at a sub, grid or generating station, also does the same job as the sub unit but it uses an additional SMS feature by making the use of a SIM900 GSM module.

The main unit also checks the values of various currents and voltages and if some values are found which correspond to a fault, then the relays are operated automatically and the main

unit sends a SMS to the concerned authorities regarding the information of the fault. If there is no fault at the main unit end, then the main unit checks the data of the sub unit. Upon checking if any fault is detected, the main unit similarly sends a SMS to the concerned authority mentioning the type of fault and the identification code of the sub unit which senses the values corresponding to a fault.

Design Considerations and Equations

To design the system we have to consider the design equations. The design equations are used for taking necessary actions whenever a fault is present in the transmission line.

When the power line is having no fault present on it whenever,

$$Ip=In \quad (1)$$

and both are below threshold. If the line is open circuited then,

$$Ip=In=V=0 \quad (2)$$

Where Ip and In are the phase and neutral currents and V is the phase to neutral voltage. The condition for short circuit can then be,

$$Ip>Threshold \quad (3)$$

and that for ground fault is, $Ip>In$ (4)

III. Result And Merits over the Existing System

By using the algorithm Shown in the figure 3, a prototype system can be developed with ease, which is able to detect the faults automatically, which are caused due to the geographical and climatic conditions of a region. Using this system, only a section of transmission line is cut off from the rest of the transmission system, thus ensuring safety to the living beings and continuity of supply to the remaining consumers who are living away from the section of transmission lines which is faulty. In proposed model, Main unit and the sub unit work simultaneously in order to detect the faults automatically and does not require any manual input or workforce to operate. Both the main and sub units utilize micro controller controlled relays which operate when the control signal is generated by the microcontroller. Besides, each sub unit is allotted a unique identification code so that the location of the fault can be easily found out (as identification code is also sent through the generated SMS). The system can be used both in case of underground transmission systems as well as the overhead transmission Systems. Also, this system is more cost effective than the present system.

IV. Conclusion and Future Work

Power lines in our country are subjected to faults due to various factors and it is very difficult to identify and maintain it in short interval of time. This may cause many electrically induced accidents and hence must be prevented. This project finds a solution for this problem by implanting a set of units on various points on power distribution line and measuring the instantaneous values continuously. The fault can easily be detected, identified and located using this arrangement. This system can help the authorities to maintain the power line easily and can avoid line fault induced accidents up to a limit. In future, the performance of this system can be modified.If, in case, there will be some over current in the system due to some fault, then to protect the arduino from damage we will add a fuse in the system which will burn whenever there is an over current flowing in the line, thereby protecting the whole system from destruction & when the unit will be cut off from the whole transmission system due to some fault, then the fault detection will be carried out by the relays i.e.; distance relays whose function is to give distance of fault in the transmission line & gives signal to ELCB to cut off the system.

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Artificial Intelligence Assisted Smart Mirror

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***Abstract*—** According to a survey [1] and research carried out by Today Show and AOL [2], the average person spends 55-56 minutes every day in front of the mirror. In today's fast-moving world, there is a need to manage time very efficiently while being healthy and content in one's life. Considering these observations, this paper constitutes the demonstration and creation of a project aiming to utilize every minute spent in front of a mirror in things like keeping track of mental health and making the best use of smart emerging technologies. In the proposed project idea, this paper presents another interactive smart mirror with some technological capabilities like emotion tracking, voice-activated talking bot with personal assistance, face recognition, the door unlocks, controlling lights, fans, and much more. The proposed mirror also displays day to day schedule, reminders, meetings and engagements fetching all of the required information from the user's Google account and real-time information such as live weather updates, local time, and latest headlines. Moreover, it keeps on displaying positive messages, compliments one's outfit, and greetings depending on what time it is.

***Keywords*—** Smart Mirror, Raspberry PI, Artificial Intelligence, node.js, Python, JavaScript, Two-way mirror

I. INTRODUCTION

It is said that every second count and the saying is considered to be among the best of letter and spirit. There is rarely a home on earth without a mirror. Normally, a majority of people spend almost half of an hour in front of a mirror on a daily basis. With the advancement in technology the mirror should also adapt to move towards many emerging technologies like smartphones, tablets and laptops. The proposed solution to the problem is to turn the mirror into a Smart Electronic device like Alexa, Google Assistant.

Taking advantage of AI technology it is embedded in it to make smart and usable in all technological aspects. The most important goals of the Smart Mirror are to save the user's time and consequently, help in being more productive and also to allow receive all the updates on a timely basis. A smart mirror also reduces the great haste of completing morning routines by presenting the user with the basic information needed to check in the morning such as date, time and pre-planned meetings. A face recognition facility is used to recognize the person facing the mirror to access other essential services. It provides users on the spot answers to their basic questions from the internet, does a little calculation, and remembers things for the user. It proved the best person to talk to when the user is residing alone and no one is there to complement the outfit. The Smart Mirror can command the household appliances and access personalized services. The key parts of this smart mirror include a micro-controller called Raspberry Pi which can be considered as the brain of the whole system. The micro-controller is powered by scripts written in Python language for mirror software as well as a personal voice assistant which connects to and retrieves the required data from the internet. Some of the apparatus are controlled by voice. Nowadays Artificial Intelligence is an indispensable feature in our daily life and hence Smart Mirror has become so popular that in the future most of the daily used objects will be connected and able to communicate.

II. RELATED WORK

The proposed smart mirror facilitates access to personalized services such as assistance, emotion tracking, face recognized door unlocks, retrieval of important engagements and notifications from user's Google account, real-time weather updates, and news headlines. Even while functioning as an ordinary mirror, it complements the user's outfit and greets concerning the time.

Some of the previous works in this field are written briefly in this section.

1. A system [1] that lets users control the household smart appliances and provide access to personalized services; ensuring comfort in accessing these services without requiring any human intervention
2. Mirror [2] embedded with additional functionality to display personalized updates and news and provide personal assistance as well. This mirror seeks the user's interests and the updates from the user's Google account.
3. The functionality of facial recognition-based security [3] makes a smart mirror capable of detecting multiple users in an environment and being used as a security device.
4. Mirror capable of interacting with TV and allowing users to select their taste of music. The capability to let the users communicate among themselves using audio recording and email makes it acceptable for a family of several members.
5. Advancement in added plugins and supported languages make a smart mirror robust, configurable, and makes a way to advancements in this field [4] and the uses of smart mirrors.
6. Speech recognition-based mirror can be extensively used in home security along with PIR sensors to detect the presence of humans in front of it.

III. FUNCTIONAL OVERVIEW

The proposed mirror is designed to embed technology with a free-standing mirror which provides a fancy, beautiful look along with some dramatic smartness. Figure 1(below) shows a

schematic view of the proposed smart and interactive mirror. The mirror is a technically augmented interaction device that comes with facial based authentication system. The objective of designing this mirror is to provide a natural interface in the ambient household environment for accessing various information services (news feed, personal calendar, multimedia, etc.) As well as controlling household smart appliances (light, fan, unlocking doors by face recognition, etc.) whenever required. The mirror will do the thinking for the user using the technicalities embedded in it. It can do all of the necessary calculations, currency conversion, complimenting the outfit, general greetings, and a lot more. The use of a personal assistant will keep things simple and easy to use. The mirror provides some of the common information most people check their smartphones or tablets for, such as getting to know their upcoming events and schedule.

The functionalities of the smart mirror are summarized below as:

1. Natural mirror: The mirror made use of a two-way mirror which acts as a natural mirror and at the same time displays the monitor's screen behind it. (See Figure 2)
2. Weather and News Headlines: News headlines from popular news websites of the desired location are displayed along with the reflection. The mirror makes use of the RSS feed provided by the website to display news headlines and uses a weather API for displaying the real-time weather information.
3. Time, Calendar Events, and Personalized Deadlines: The mirror also displays the local time and location-specific events and uses Google API to sync the user's deadlines from Google Calendar.
4. Google Voice Assistant: User's Google account is attached with the mirror Raspberry PI and thus the mirror answers the personalized questions asked by the user like "What's my Name", "What are my recent deadlines", etc. and fetches its answers from Google Assistant API. The voice output by the Google Assistant has synced with the backlit blue led lights which provide a cool and natural touch with the technology.
5. Greetings and Compliments: The mirror compliments on the user's outfit occasionally by displaying text over the mirror and also via voice whenever the user asks for it vocally.
6. Face recognition triggers Door Unlock, Lights/Fan Control via voice command: The raspberry pi is programmed to recognize the user's face whosoever is in front of the mirror, and greets accordingly. It is connected with other appliances like lights, fans, etc. that can be switched ON/OFF just with the help of a voice command.
7. Streaming Videos from Smart Phone: Users can stream any video containing in their phone storage or in the YouTube directly on the smart mirror wirelessly. It needs the user to download the Raspicast app from the play store and connect their phone to the same local network in which Smart Mirror is.
8. Ringing phone any connected with Smart Mirror google account just with a voice command like 'Find my phone.' Or 'Where is my phone?' Smart Mirror efficiently utilizes one of these Google Assistant's features.

IV. Prototype Design and Architecture

As mentioned above, the mirror uses the following parts: Monitor, Raspberry PI, SD Card, HDMI Cable, 220 Volt Power Supply, Two-way mirror, Blue LED Strip, Wooden Frame that are assembled to make the final prototype.

Following devices and part are used in the proposed Smart Mirror described below:

1. Raspberry Pi 3: The Raspberry PI is a microcomputer that powers the whole system, displays the Magic Mirror interface, and runs the Google Assistant and the voice-control system. It has a quad-core ARM cortex A -5 processor, and it enables the developer to run Linux based operating systems on it. The Raspberry Pi 3 has an integrated LAN port and Wi-Fi module to make a wireless connection with the internet. Raspberry pi also has double row General Purpose Input Output pins which can be used for connecting a variety of input-output devices.

2. The two-way mirror: A two-way mirror made of acrylic, also known as one-way mirror is used here for hiding the smart monitor display and to create an optical illusion. Itis basically a semi-transparent mirror which provides privacy and allows discreet viewing from the darker side. It relies on the lighting conditions to conceal the observation side.

3. The Monitor Display: The LED monitor is used to limit the power consumption and to prevent mirror glow at night as well. This acts as the Raspberry Pi monitor. The raspberry pi runs the program installed in it displays the application fetching required information with a mirror interface.

4. AIY Voice Hat: The AIY Voice Hat connect the Raspberry Pi to the Google Assistant and is part of Google's AIY Voice Kit V1. It includes onboard hardware to provide audio capture and playback, connectors for the dual min daughter board and speaker and GPIO breakouts to connect low-voltage components like micro-servos and sensors.

5. Stereo Microphone: Stereo microphones are recording devices that have two built-in microphones. (Simply two microphones in a single unit). This allows Smart Mirror to catch and identify user's voice commands more accurately and quickly because it allows recording sounds similar to how our ears will pick it up. For getting depth and direction at the same time, the two microphones record sound simultaneously.

6. Speakers for Output: A normal independent speaker is required for the speech output of the personal assistant.

7. Camera: This is to take the visual input of whatever in front of the Smart Mirror. It constantly sends video frames to the face recognition program to identify the owner.

8. A Box and a Frame: Frame hides monitor at the border and makes it a perfect looking mirror in front of the user. Box on the other hand houses all the rest of the components including the microphone, speaker, raspberry pi, connected wires. Thus, it looks neat and pretty.

V. PROTOTYPE IMPLEMENTATION

The system prototype is implemented considering the capabilities and constraints of the technologies used. These are web services, face authentication, mechanism, and browser viewable webpage. The raspberry camera is used to capture the live video streams in front of the mirror which is further processed for identification.

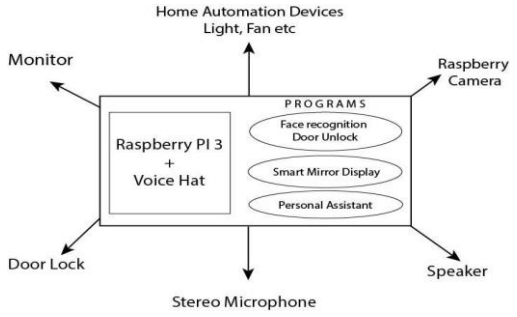

Fig. 1. Raspberry PI Connections

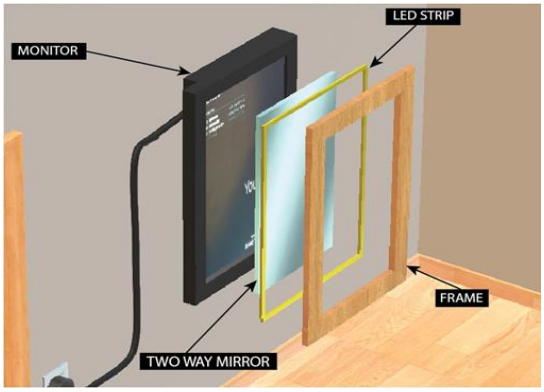

Fig. 2. System Architecture

A. *Monitor Screen*

The mirror display showing clock widgets, news headlines, and calendar events is achieved with the help of a growing open source project on GitHub MagicMirror² which is an open-source modular smart mirror platform. The Magic Mirror allowed converting a simple mirror into a personal assistant with a growing list of installable modules.

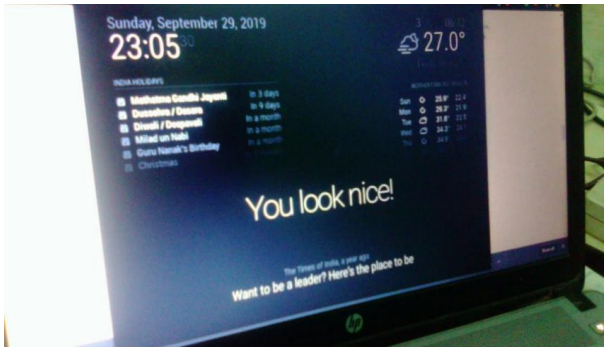

Fig 3. Magic Mirror Installed on PC

Fig 4. Magic Mirror over Two Way Mirror and Frame

B. *Voice Assistant with Raspberry PI*

For the smart mirror to work properly even from the distant voice commands, it uses an efficient stereo microphone and loud single speaker mounted on Voice Hat designed by

Google which perfectly fits over the Raspberry Pi. A python program has been installed on the Raspberry PI running a Raspbian OS which makes an API call every time a user triggers it using a 'Hey Gugu' voice command and other Google Assistant Voice commands. To configure the personalized Google Assistant, the user requires to create a project with Google Assistant API on Google Cloud Platform. The project created on the cloud server is used to make a Google Assistant API call with the help of a unique Client ID, Client Secret Key.

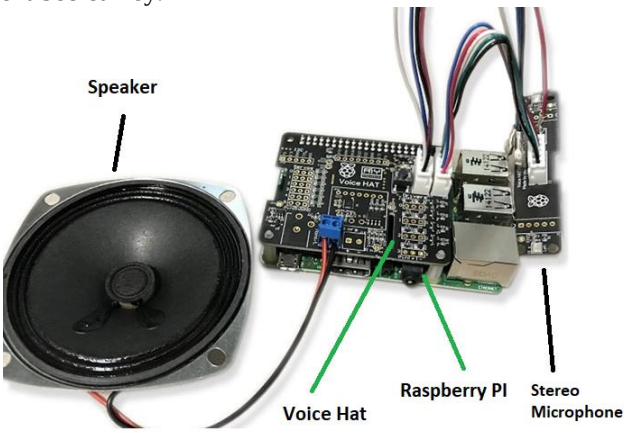

Fig 5. Circuit Diagram

C. *Face Recognition with Raspberry PI*

A Camera Module was attached with Raspberry PI to perform to Face Recognition Task. (See Figure 6)

Fig 6. Camera Module Attached with Raspberry PI 3

- Detect faces in an image:

  Face detection is a technique to automatically detect faces all the faces in an image. Multi-Task Cascaded Convolutional Neural Network [6] is used for this task. The three stages cascaded together use Deep convolutional networks to capture the face in a coarse to fine manner. This results in a list of bounding boxes of the coordinates of the faces. It can detect any number of faces in an image and hence the number of bounding boxes is not fixed.

- Create Face embedding:

  Face embedding is a vector that represents the features of the face in different spaces which usually have fewer dimensions to enable faster compute. Face Net model [7] is used to create embedding from the image of the face. This method uses Deep Convolutional Network trained to optimize the embedding itself. The benefit of this approach is that it has much better representational efficiency than other approaches for the task. The result is a 128-dimensional vector representing a given face image.

- Classify embedding for prediction:
- Given an embedding of a face image, now we can compute the similarity of an embedding with other face image's embedding. Linear Support Vector Machine (SVM) is used for the classification task. Because this method is very effective at separating the face embedding vectors and have shown to perform well in high dimensional data, particularly when the number of dimensions exceeds the sample size. It is also memory efficient. It takes input as a 128-dimensional vector and predicts the face class or name of the person.

D. *Custom Voice Triggers to Switch ON/OFF lights/fan/Automated Door*

These tasks are required to write a different python program parallel with the MagicMirror and Google Assistant SDK. The program uses the Cloud Speech API to make custom triggers and for controlling circuit components attached to the Voice Hat. For the efficient use of Voice Hat, the program used the existing AIY python library provided by Google to better receive the new custom triggers like 'Turn on the Light/Fan'.

VI. CONCLUSION

This paper puts forward an interactive Mirror that facilitates the user by saving their time, displaying widgets, and give a fusion of user and technology that becomes an improvement, not a new burden. This smart mirror becomes assistant for the user with intelligent and commonly used applications, apps such as calendar, music, news, etc. Facial recognition technology provides security to the Smart Mirror as it displays confidential stuff only when it recognizes the user. The future work that can be performed on this project to make it even smarter could be adding more widgets and attributes such as e-mails, some social media applications, traffic updates, recommendation of the best path to reach the final destination concerning the traffic, suggesting clothes and accessories, etc. In the future work, one can look over how the surrounding factors of the user and the environment can be used to furnish some more optimum service resources in the home environment. A good quality project can be produced with proper research first. Similar project ideas and products

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were analyzed for similarities, improvements, and flaws. Researched of each important part used in the development of the mirror system such as gesture control, voice control, MCUs, and others are one of the prime factors. Once enough information is collected about specifications and prices, strategic components were selected to be a part of the project from both hardware and software perspectives.

VII. ACKNOWLEDGEMENT

This paper, project idea, and the research behind all this would not have been possible without the continuous support of our Faculty Advisor supervisor, Dr. Amit Garg. His exceptional support, enthusiasm, and exacting attention to detail have been an inspiration and helped in keeping the work on track from just an idea to the final draft of this paper. Our team also looked over each other's interpretations and answered numerous questions with unfailing patience. We are most thankful to the SPIE Student Chapter, University of Delhi at Acharya Narendra Dev College that has provided financial support for this project. Finally, it is with true pleasure that acknowledged the contributions of amazing partners who have given their precious time to read every version of this paper and helped to improve.

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Performance Evaluation on Electric Vehicle by Solar Photovoltaic System

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***Abstract*—** Electric Vehicles widely used proposed in favor of toxic waste without charge transportation subsequently it has been observed to assist distance travelled through battery worked electric vehicle is exceptionally less as connected among the advance fuel powered steam engine over and above reduced regenerative energy recapturing because of the vehicles kinetic energy. Present subsequently a lot of types of losses in power converter which progress utilization of battery power. In favor of accumulation of distance travelled through electric vehicles with enlarge of recapturing of regenerative control we comprise on the way to obtain enhanced performance of the complete section used in electric vehicle comparable to electric motor, power converter in addition to power storage method similar to battery otherwise ultra-capacitor. Hybrid Electrical Vehicle contain important consideration for the reason that the requirement of developing alternative methods in the direction of generate energy used for vehicles appropriate to insufficient fuel based power global warming furthermore exhaust discharge limitations in the preceding century. Hybrid Electric Vehicle incorporates internal composition engine, Electric Machines throughout power electronic equipments. This paper concentration on Smart Charging, charging of Electric Vehicle commencing photovoltaic panels. Smart charging of Electric Vehicles is conventional to allow better saturation of Electric Vehicles with non-conventional energy, lesser the charging cost along with propose superior conservation of the grid communications.

***Keywords*—** Electric Vehicle, Smart Charging, Lithium-ion battery, Solar Energy, Photovoltaic Inverter, Power Converter.

I. INTRODUCTION

Transport scheme is particularly important to the absolute globe at the moment. The majority of them utilize of vehicles through the function of internal ignition engine [1]. By means of the internal ignition engine include produced along with continuously cause severe troubles in favor of model air pollution, global warming in addition to the immediate reduction of the Earths gasoline resource [2]. Electric Vehicles, Hybrid Electric Vehicles with Fuel Cell vehicles are the three representative vehicles consequently as to estimate in the direction of renovate conservative vehicle with interior combustion engine. The act of Electric Vehicle along with fuel cell vehicle is tremendous at the rear requirement [3]. Accordingly, well developed vehicle equipment research has been twisted to center on Hybrid Electric Vehicles [4].

Hybrid vehicles are a vehicle to assist supply power in two or more forms. All through a delegate Hybrid Electric Vehicle individual form is petrol through an engine because a petroleum converter. The extra is a bidirectional electrical storage device [5]–[6]. Through use of energy storage nearby several dissimilar conducts by means of the purpose of Hybrid Electric Vehicles concentrate petroleum utilization. Improve power in support of the period of braking, downsizing of the engine, in service engine extra effectiveness because shutting down the engine off although it is not affecting [7].

Modern Hybrid Electric Vehicles build utilize of efficiency based improving technology for instance regenerative braking which converts the vehicles kinetic energy enthusiastic to electric energy in the direction of indict the battery, to a confident degree wasting it as heat energy as conservative brakes [8]–[9]. A quantity of variability of Hybrid Electric Vehicles make use of their internal burning engine to generate electricity by revolving an electrical generator to furthermore recharge their batteries or else to directly be in command of the exciting drive motors [10]. Numerous Hybrid Electric Vehicles diminish inoperative emissions by finish the interior ignition Engine by redundant furthermore restarting it previously desirable this is predictable as a start stop system. A Hybrid Electric Vehicle produces fewer emissions beginning its inner burning Engine than a comparably sized petrol car [11]. Because, a Hybrid Electric Vehicles petrol engine is normally lesser than a comparably sized clean petrol flaming vehicle moreover if not used to directly force the car, geared to run at incredible effectiveness, complementary improving petroleum financial system [12].

Once compared to conservative burning drives, electric vehicles propose a numeral of compensations such as substandard local emission, superior power efficiency with inconsequential confidence on non conventional fuel. Individual input significance contained by the extension of electric vehicles is the energy storage method which is intentional to renovate engines based on conventional fossil fuel or bio fuel [13]. Investigators are focus happening two major alternatives in favor of the extension of Electric Vehicles. Electrical power storage by means of batteries along with the storage of power in chemical emergence like hydrogen [14].

Electrical vehicle based on electric propulsion system. No interior combustion engine is used. Absolutely the power is based on electric power as the energy source [15]. The main

benefit is the high efficiency in power conversion through its intention system of electric motor. On the other hand the hybrid electric vehicle is a substitute. It has been used extensive in the past few years.

II. Classifications Of Hybrid Electric Vehicles

A. Series Hybrid

In a Series Hybrid System the ignition engine drives an electric generator in its position of instantly driving the wheels. The electric motor is the purely resources provided that control to the wheels. The generator in collaboration charges a battery as well as power an electric motor to assist moves the vehicle. Although enormous quantity of power is crucial the motor draws electricity as of mutually the batteries in accumulation to the generator.

Series Hybrid pattern subsequently manage to survive a wide-ranging time diesel electric engine, Hydraulic earth affecting machinery, diesel electric ability groups, loaders. Series Hybrids be intelligent to support with ultra capacitors, which preserve advancement the effectiveness by resources of diminish the losses into the battery. They allocate peak energy in favor of the period of acceleration in addition to attain regenerative energy for the period of braking. Consequently, the ultra capacitors are kept exciting at low speed besides almost unfilled at top speed. Deep cycling of the battery is condensed the stress aspect of the battery is lowered. A composite transmission concerning motor by the side of with wheel is not essential as electric motors be experienced in surplus of a widespread speed range. If the motors be expressively implicated to the vehicle body, flexible couplings are necessary.

A few vehicle designs contain split electric motors in sustain of each wheel. Motor incorporation passionate to the wheels contain drawback to assist the mass increases, declining traverse routine. Rewards of specific wheel motors control simplified traction control, the intact wheels drive as well allowing lower floors, which is supportive for buses. A fuel cell Hybrid Electric vehicle constantly contain a series array, the engine generator collection is changed by a fuel cell.

B. Parallel Hybrid

Parallel hybrid system includes mutually an internal burning engine with an electric motor during parallel coupled to a mechanical transmission. The mainstream design combine an enormous electrical generator with a motor enthusiastic to one entity, frequently located between the burning engines furthermore the transmission, replacing simultaneously the knowable starter motor as well the alternator. The battery conserve be invigorated during regenerative breaking as well as during cruising. Since it is a confined mechanical link bounded by the wheels in addition the motor, the battery cannot be charged once the car is not disturbing.

C. Combined Hybrid

Combined Hybrid Systems enclose features of in collaboration series as well as parallel hybrids. It should be confirmed to facilitate in utmost identification these two provisions are called series parallel, complex otherwise power split. Current a double association surrounded by the engine as well as the drive axle, mechanical besides electrical. This split power conduit permits interrelate mechanical with electrical power by a minority rate in complexity. Power split strategy is integrated in the power train. The power to the wheel is competent of either mechanical or else electrical earlier than in assistance in parallel hybrids. However, the main standard behind the mutual understanding is the decoupling of the power supplied by the engine beginning the power demand during the driver. This agreement is auxiliary restricted than an unpolluted parallel arrangement since it requirements a further generator as well as mechanical split power configuration besides compute power to control the double arrangement.

III. Vehicle Types

A. Hybrid Electric Bus

Hybrid technologies for buses have been enhanced awareness then current battery developments decreased battery load significantly. Drive trains consist of non-conventional diesel engines as well as gas turbines. A small number of designs conscious on using car engines, modern design control paying concentration happening by resources of traditional diesel engines subsequently used in bus design on the way to accumulate on fabrication next to with research expenses. Several manufacturers are currently implementation attractive place narrative Hybrid design or else Hybrid drive trains headed for assist well attracted in available structure assistance special of leading redesign. A Hybrid motor vehicle is intelligent to transport gasoline economic scheme throughout the Hybrid drive train. Hybrid capability is additionally being promoted with environmentally disturbed transport authorities.

B. Hybrid Train

During correlation along with aircraft through automotive system, railway transportation is recognizable as individual a sustainable technique of transportation between reduced carbon emission. A little papers contain measured attractive position fuel cell moreover hybrid trains in the way of get better competence of these vehicles. Through a fuel cell is used as the power resource also in a diesel engine is used as the power source. The power system controls which control

resource is required to handle the power supply operation on a number of illustrations. The comparable control strategy is used by though in design, battery and super capacitor as well super flywheel is utility of the identical as energy storage policy.

C. Electric Boat

The electrification of ship is considerable used for improving the atmosphere furthermore used for the decline of lubricate utilize. In sizing condition of on board resource with energy storage arrangement is projected intended for a Hybrid Series construction on behalf of an envoy traveler boat. A Hybrid power arrangement consists of a Proton Exchange Membrane fuel cell (PEMFC) stack through batteries in agreement of an electric boat in which PEMFC distributes further motion used for the vehicle in accumulation to charge the battery whereas cruising. Furthermore, a novel urbanized plug in Hybrid Electric Boat was offered through intend of contribute in the direction of the atmosphere issue moreover decrease to exploit of gasoline.

IV. Smart Charging Of Electric Vehicles

Electric Vehicles enclose three limited ability which fabricate them an exceptional benefit in the grid. The elasticity to diverge their charging power as well as the ability to quickly ramp up/down the charging power with the competence of mutually charge along with discharge. While, this potential is currently unemployed. Presently Electric Vehicle charging is an unrestrained progression wherever the Electric Vehicle charges at a permanent power once connected to a charger along with charges till the battery is charged.

Through the employ of smart charging the Electric Vehicle charging power in accumulation to track be able to constantly control. Smart charging of Electric Vehicles be proficient of offer plentiful benefits to the Electric Vehicle proprietor along with the provider of the Electric Vehicle charging transportation,

- Reduce the charge of Electric Vehicle charging based on power charge.
- Recommend innovative profits stream resembling of vehicle to grid.
- Improve the employ of solar energy in favor of charging of Electric Vehicle in the sunlight hours. Electric Vehicle battery is able to be storage for renewable energy need not to store an extra storage is not essential.
- Decrease distribution arrangement losses.
- Dropping the peak demand scheduled the grid suitable to Electric Vehicle charging by demand side management.
- Employ the Electric Vehicles rapid ramp up or down possible to distribute directive services to the grid along with support services comparable to reactive power compensation as well as voltage control.
- Implementing multiplexing of Electric Vehicle charger in accumulation to using a single charger for a number of Electric Vehicles. This will extremely decrease cost of Electric Vehicle charging infrastructure.

The outdated approach to smart charging is in the way of considering one or few of these applications contained by an optimization to produce direct or else indirect economic revenue. However, this method is simpler, it does not occupy the absolute potential of smart charging in addition to make the profit realistically unexciting. In the future integration of a numeral of smart charging applications in a meticulous support will be the input. The income stimulus then adds up with the net achieve motivation extend into efficiently attractive in favor of large scale performance.

A. AC Smart Charging

AC Electric Vehicle charger the Electric Vehicle moreover charger operates in a MASTER and SLAVE manner correspondingly. A PWM pulse taking place the control pilot is accomplished of constantly recognizable on the Electric Vehicle charger in the way of control the greatest charging power. By means of the Pulse Width Modulation boundary as a constraint the Electric Vehicle establish the definite charging current as exposed in Fig. 1. It is the responsibilities of the Electric Vehicle charger in the direction of convey the requested current. Consequently with controlling the Charging Power, Variable Power, Dynamic, Smart Charging be able to be implemented.

For illustration, a unsophisticated achievement is to estimate the invention initiation a Photo Voltaic system with equally normalize the Charging Power accordingly to assist the Electric Vehicle charging be capable to track the Photo Voltaic production. In favor of demand side management, Electric Vehicle charging is able to recognizable based on the loading of distribution network assets. This conserve facilitate to condense the peak demand with the connected demand charges innovative version be permit announcement for Smart Charging along with Vehicle to Grid.

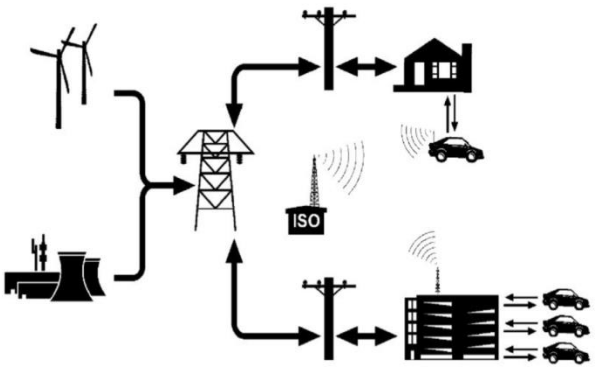

Fig. 1 Demonstrative Representation of Possible Vehicle to Grid Connection

B. DC Smart Charging

The Electric Vehicle persistently sets the upper limit current meant for charging with discharging (Vehicle to Grid) every 200 millisecond based lying on the battery managing arrangement as exposed in Fig. 2. Whereas the expulsion current limit is set at zero by the Electric Vehicle in that case Vehicle to Grid is not potential. Since the dissemination of Electric Vehicles enlarges insist for Electric Vehicle chargers will increase as well. At the same instance public charging location otherwise at workplaces, the Electric Vehicle resolve not be charging in favor of all the time they are parked. These resources that Electric Vehicle charging transportation is underutilized. In the way of conquer this Smart Charging be proficient to assist the multiplexing of a scrupulous charger to a number of Electric Vehicles.

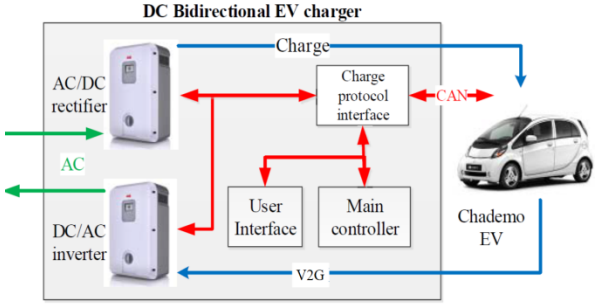

Fig. 2 Dynamic charging and Vehicle to Grid

V. SOLAR PHOTOVOLTAIC CHARGING OF ELECTRIC VEHICLES

In progression to make sure that the employ of Electric Vehicles consequences in net zero CO2 emission. It is significant to assist the charging transportation derive the complete majority of its power commencing nonconventional energy sources. It is here that the falling operating expense of Photo Voltaic more than the years with the simplicity of integrates enthusiastic to the distribution system contributing a key role. Workplaces related to office buildings in accumulation to industrial areas are crucial to make potential Solar Electric Vehicle charging all over the place the rooftops moreover car parks container be installed through Solar Photo Voltaic panels. There are a number of profits of charging Electric Vehicles commencing Solar Photovoltaic Panels furthermore the network decrease of CO2 emission.

Electric Vehicle along with Photo Voltaic can be installed protected to each other.

Electric Vehicle batteries are able to used as energy storage used for Solar Photo Voltaic.

Concentrated energy demand lying on the grid as the Electric Vehicle charging power is close by generate the Solar Photo Voltaic.

Compact cost of Electric Vehicle charging with condensed impact of changes in Solar Photo Voltaic feed in tariff.

A. AC Charging of Electric Vehicle from Photovoltaic

The charging of Electric Vehicle from Photo Voltaic can be accomplished by using a conservative Photo Voltaic, inverter plus Electric Vehicle charger which are together linked to the AC grid as illustrated in Fig. 3. Though, this AC interconnection is fewer resourceful than DC system.

Photo Voltaic as well as Electric Vehicle are fundamentally DC in nature, accordingly exchanging power over AC loads to supplementary conversion steps and losses.

Two inverters would be required, one each for the Photo Voltaic moreover other for Electric Vehicle.

Announcement will be essential among the converters if the Electric Vehicle have to be charged based on the Photo Voltaic energy.

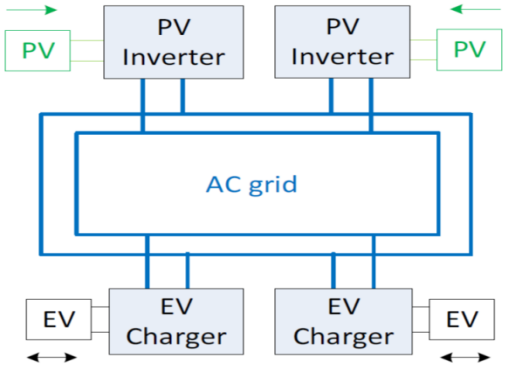

Fig. 3 Charging of Electric Vehicle from Photo Voltaic using separate Photo Voltaic inverter and Electric Vehicle charger

B. Integrated Electric Vehicle – Photovoltaic power converter with DC charging

An enhanced resolution is to operate a single integrated multiport converter foe Electric Vehicle, Solar Photovoltaic, grid is associated collectively as shown in Fig. 4. It contain three sub converters interconnected by means of a DC link, DC to DC converter for Photo Voltaic, DC to DC isolated converter for Electric Vehicle and DC to AC inverter to attach the AC grid. An isolated converter for Electric Vehicle is needed due to security moreover is prearranged in the Electric Vehicle charging principles. The Photo Voltaic converter have maximum power point tracking used for the solar array in addition to Electric Vehicle charger is illicit based on the charging current.

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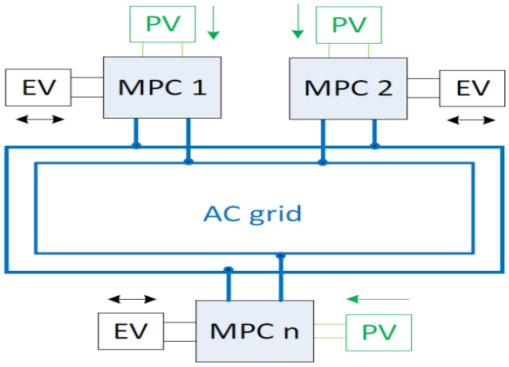

Fig. 4 Integrated multiport power converter to charges the Electric Vehicle from Photo Voltaic with AC grid

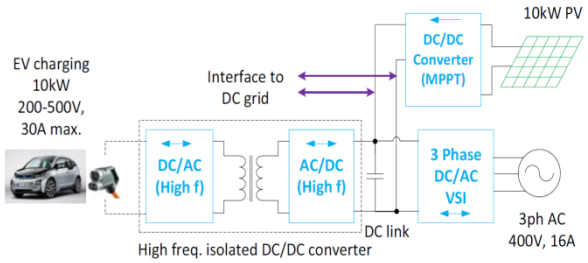

Fig. 5 Topology of Power Converter

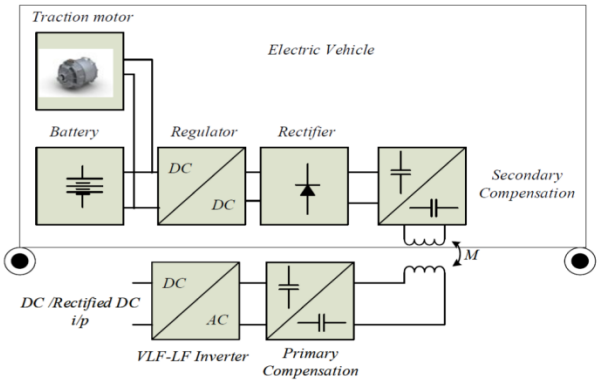

Fig. 6 Schematic representation of an Electric Vehicle Inductive Power Transfer system for various power conversion stages

Fig. 5 intended such an integrated three port converter for Electric Vehicle charging. A high frequency, bidirectional, isolated topology based on the flyback converter is used for the Electric Vehicle sub converter. This supports in dropping the dimension of the converter and enables implementing Vehicle to Grid. An interleaved enhance converter is used for the Photo Voltaic sub converter. This expertise uses electromagnetic energy transfer between droopily coupled charge pads which are situated with an air gap. A representation diagram of such a arrangement is exposed in Fig. 6.

PROGRESS ON CONVERTER

AC to DC Converter: The charging speed of DC current is a lot advanced to the charging rate created by AC current. Though the DC charging system structure resolve as well be tricky compared to AC charging system. While charging by DC current we have to convert the AC current provided from the power grid on the way to DC current.

DC to DC Converter: Furthermore, merely converting the AC current starting the power grid to DC current is not sufficient. We have to supplementary expansion to accomplish a appropriate current level to charge electric vehicles. This requires a DC to DC converter. The majority admired DC to DC converter is the phase shift prohibited full bridge DC to DC converter.

VI. BATTERY CHARGING MODEL

Charging by Constant Current and Constrained Voltage: This charging demonstration is used for the battery arrangement consisting of batteries within series. While charging process is nonlinear accordingly with the intention of life span of the battery charged during this method would be condensed. One more complexity is the small on the entire charging rate in estimation through further models.

Charging by Constant Voltage and Constrained Current: The majority apparent assistance of this illustration is to assist the charging instance would be much shorter than the most primitive model. Though by means of employing this illustration the preliminary current would be much larger as well as potentially destructive to the electric equipment contained by the battery coordination.

Rapid Charging: This charging replica uses intermittent current pulse as well as a enormous unresponsive current pulse to depolarize the battery. This depiction could extend the charging rate though has an adverse effect lying on the battery life span.
Three Stage Charging: This representation the charging process is estranged in two stages. At the primary stage Constant Current is engaged to charge the battery array awaiting the terminal voltage attain its rated value. Secondly steady voltage is practical with the current keeps diminishing. This representation can be regarded as co-operate among the primary and subsequent models.

VII. BATTERY TECHNOLOGIES USED FOR ELECTRIC VEHICLE

Lithium ion Battery: A few of the merits of Lithium ion Batteries are they contain a eminent capability and the several times the battery be able to be re-energized while still maintain its effectiveness, other than a low energy density and the quantity of power that can be store in a unit quantity.

Solid state Battery: These expertise provide a numeral of compensation is eliminate the electrolyte leaks or fires, extensive life span, decrease the requirement intended for enormous along with exclusive cooling mechanism as well as the capability to operate in an comprehensive warmth range.

Aluminum ion Battery: Aluminum ion batteries are alike to Lithium ion batteries except have an aluminum anode. Their benefit would be the improved protection at a decrease cost over Lithium ion batteries. In present technical study have been planned a resolution for one of the aluminum ion batteries utmost drawbacks. Its capability by means of an aluminum metal anode as well as a graphite cathode. These also tender appreciably decrease charging instance also the capability to twist.

Lithium Sulfur Battery: Lithium Sulfur Battery has a lithium anode in addition to a Sulfur Carbon Cathode. This equipment offers a superior notional power density furthermore an inferior charge resolution than Lithium ion Battery excluding contain small capability.

Metal Air battery: Metal Air battery has a clean metal anode with an ambient atmosphere cathode. Have a cathode made of atmosphere is viewed as an significant benefit. In audience are a lot of variant for the metal, lithium, aluminum, zinc, sodium residue the forerunner. A most essential drawback would be to facilitate the majority Metal Air or Metal oxygen prototypes contain troubles through capability with life span.

VIII. Conclusion

Environment protection by means of energy management has advised the enlargement of Electric Vehicles. However, the commercialization of Electric Vehicles is still facing challenges. The main enthusiasm is to assist they might not influence the consumers constraint appropriate to high price through short range. Consequently, Hybrid Electric Vehicles along with Fuel Cell Electric Vehicles are recently fast growing as well as seizing the opportunity to go to encourage. This manuscript examined challenges furthermore probability proposed for Fuel Cell Electric Vehicle which determine contain ongoing impending to be the attribute vehicle in the opportunity. Because, it is approximately zero emission through equivalent inspiring collection to internal Combustion Electric Vehicle. The diminishing of conventional fuel sources besides the growing of the carbon ejection force. This expertise used to have non-conventional energy sources as a propose attitude. Along with a numeral of technologies Hybrid Electric Vehicles contains the compensations of substandard fuel consumption, lesser operating costs, inferior noise pollution, small emissions, and lesser engine size alongside with extensive operating life.

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Endowment of Machine and Deep Learning in Covid-19 Scenario: A Review

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Abstract **-** Artificial Intelligence (AI) is a dominant tool having good potential in battling the COVID- 19. There has been a dash to use AI, ever since the outburst of the epidemic. This article provides a necessary review, examining the part of AI being played in battle in opposition to COVID-19. The two sub-fields of AI namely, machine learning (ML) and deep learning (DL) which can very well contribute to the battle in opposition to COVID-19, is conferred. This review helps in concluding that so far AI has been that impactful in opposition to COVID-19 as it should be. The usage of AI is weighed down due to a lack of good quality data, and too much unlabelled data. To overcome these restraints, a very balanced relationship between data privacy and public health is required, with precise human-AI interaction.

Keywords- Artificial Intelligence, COVID-19, Deep Learning, Machine Learning, Neural Networks, SARS-CoV-2

I. INTRODUCTION

COVID-19 infection was caused by a virus named, SARS-CoV-2 and, was acknowledged in December 2019 in China furthermore it was affirmed a global pandemic on 11 March 2020, via the WHO [1]. COVID-19 can be called as a severe disease which can be resolved, however it is said to be capable of becoming deadly, amid 2 percent casualty pace. The earlier commencing of the disease may cause death as a result of immense alveolar damage with respiratory malfunction [2]. An important measure to battle in opposition to COVID-19 is the efficient screening of patients, which will help in giving those infected instant treatments and care, and can be kept isolated to lessen the swell of the virus.

On the forefront, the world considered that the major facets of COVID-19 are similar to that of SARS but the dissimilarity is: within 17 years ever since SARS, a potent innovative tool has appeared which have the potential to be influential in keeping the virus in rational confines—namely, artificial intelligence (AI).

AI is proved to be a powerful tool having the potential to battle in opposition to COVID-19 [3] [4]. In favor of at hand required functions, AI can be defined as Machine Learning (ML), Deep Learning (DL), Neural Networks, along with Computer Vision appliances to instruct computers to understand data-based models in pattern recognition, prediction in addition to explanation processes [5]. Furthermore, ML and DL turn out to be recognized disciplines about AI towards analyzing, mining, and recognizing patterns from data. Retrieving the advancements of these sub-fields of AI in medical decision making, and computer-aided classification models are becoming more promising with the emergence of new data [17]. These purposes can be extremely helpful in predicting, recognizing (diagnosing), and explaining (treating) COVID-19 infections, moreover helps in controlling socioeconomic impact [6] [7] [8].

A rapid review of the actual and potential contribution of ML and DL (promising fields of AI) towards battling in opposition to COVID-19, in addition to existing restraints of these contributions will be discussed in this paper. This paper aims to illustrate quick take-away from the existing studies and discussion to serve as a swift description of recent advancements happening in relevance to the global pandemic in the field research, battling strategies along medical investigation.

The paper is structured as section 2 the contribution of ML in opposition to COVID-19; section 3 the contribution of DL in opposition to COVID-19; section 4 concludes.

II. THE CONTRIBUTION OF ML IN OPPOSITION TO COVID-19

Many countries have adopted social distancing and quarantine measures to slow down the stretch of COVID-19 and to mitigate the impact of the pandemic. In predicting risks ML has proven to be invaluable in many spheres and now, researchers are leveraging ML models to quantify the effects of these measures in specific parts of the world. Many ML tools used to predict the spread of disease follow the SEIR model, which groups people as susceptible, infected, exposed, or recovered.

In the case of COVID-19, ML can potentially help by designing models which target the efficient plus secure COVID-19 vaccine development, supporting diagnosis as well as decision making in handling the infection outburst and predictions of infection initial point and likely ending time for the pandemic. ML research has been conducted and published and the early results are promising. Table 1 presents some of the ML published researches to battle in opposition to COVID-19.

TABLE 1
THE CONTRIBUTIONS OF ML IN OPPOSITION TO COVID-19

Publishing Date	Proposed algorithm/technique/ device in the study	Dataset and period	Contribution of research in battling in opposition to Covid-19	Concluding the research findings
(May 12, 2020)[16]	Demonstrated an AI-Powered Infodemic Management solution- WashKaro.	Dataset- 400 WHO articles.	Personal hygiene alertness in the native language of India.	WashKaro is a Bluetooth based Contact Tracer, delivering information in Hindi.
(May 10, 2020) [12]	Designed a prediction model based on the XG-Boost ML algorithm.	Dataset- 2,799 patient's electronic records, Tongji Hospital. Period- 10/01/2020 to 18/02/2020.	Early identification.	From more than 300 features, the proposed model recognized 3 key medical characteristics; lactic dehydrogenise (LDH); lymphocyte; high-sensitivity C-reactive protein (hs-CRP).
(April 24, 2020) [9]	Proposed a method for genome analyses combining supervised ML with digital signal processing (MLDSP).	Dataset-5000 genomic sequences Period- virus progressions accessible till January 27, 2020	Classification of critical periods of novel viral outbreaks.	This study suggests that during novel viral outbreaks, timely classification is required at critical periods.
(April 6, 2020) [13]	Presented a data-driven ML analysis of the COVID-19 pandemic.	Dataset- daily confirmed COVID-19 cases in the USA. Period- 21/01/2020 to 14/03/2020	Efficient, robust, and general models for predicting the virus.	The study confirms that the infectious force is strapping with 0.14 percent transition from mild to serious infection.
(April 3, 2020) [15]	Proposed SIR model along with ML tools to analyze the COVID-19 in the actual world.	Dataset- Pandemic data available online. Period- 21/10/2020 To 02/04/2020	Helpful in predicting the initial point and probable ending time for the pandemic.	The study based on the public data, the designed model was able to probably ending time for the pandemic, especially for Senegal.
(March 23, 2020) [10]	Developed Vaxign-ML. (the tool to predict COVID-19 vaccine)	Dataset- ClinicalTrials.gov database along with PubMed literature Period- by March 17, 2020	Predicted potential vaccine measures for efficient and secure COVID-19 vaccine development.	The study proposed that an "Sp/Nsp cocktail vaccine" having a structural protein(s) (Sp) and a non-structural protein(s) (Nsp) will help in successfully arising immune responses.
(March 2, 2020) [16]	Provided assay designs and experimental resources, which can be used through CRISPR-based nucleic acid detection.		Helping in tracking the curve of COVID-19 outrage.	The authors experimentally screened 4 SARS-CoV-2 designs with a CRISPR-Cas13 detection system and expansively tested the highest-performing SARS-CoV-2 assay.
(February 25, 2020) [11]	Proposed that using ML algorithm and mobile phone-based web survey,		Assisting diagnosis with decision-making in treatment.	The proposed modeling method could aid in recognizing plus controlling COVID-19 in populations in quarantine.

	identification of the COVID-19 case can be performed more quickly.			

To treat rapidly growing COVID-19 patients worldwide an efficient and healing approach is immediately required. As there has been not any medicine confirmed to treat COVID-19 patients, it is essential to design a well-organized approach to re-purpose clinically permitted drugs otherwise propose new drugs in opposition to SARS-CoV-2. Swift progress in automatic structures which are based on AI as well as ML be able to not only chip in boosting diagnostic accuracy and speed will moreover keep healthcare employees safe by diminishing their contact with COVID-19 patients. Many ML-based algorithms and models (as discussed in Table 1) have been proposed which can help in several ways in opposition to the COVID-19 crisis.

As AI and ML scientists have been fervently searching as well as waiting for real-time data which is produced by this deadly disease around the world because well-timed deliverance of COVID-19 patient data, such as a therapeutic result of COVID-19 patients and physiological characteristics of patients followed via consequent data alteration for trouble-free access is very important, however challenging. This factor is currently limiting the function of ML and AI towards combating COVID-19.

III. The Contribution of DL in Opposition to COVID-19

Over the last 5 years, the developments in DL applications appear to arrive at an accurate time period. DL is a combination of ML techniques mainly focusing on automatic feature extraction and classification from images.

Dl mostly refers to a method in which deep convolutional neural networks are used for automatic mass facet mining, which is attained through a process known as convolution. The layers in this process, access the nonlinear information [18]. Alteration of the data into an advanced as well as more intangible level involves each layer. The deeper we go into the network, more we learn about information extraction complexity and accuracy. Higher layers of interpretation help in enhancing the accuracy of extracted information which is important for smother segregation of insignificant attributes.

Generally, DL refers to further deep networks than the classic ML ones, which utilize big data. DL applications that are generally used are object detection tasks and medical field image classification tasks. Recently, immense achievement has been achieved in the medical imaging domain using DL technology owing to its high ability of feature extraction [24]. In the present time, DL is being applied to detect and differentiate bacterial and viral pneumonia in pediatric chest radiographs [12]. Many successful attempts have also been made to identify a variety of imaging features of chest CT. Table 2 demonstrates some of the recent researches performed using DL to battle in opposition to COVID-19.

TABLE 2
THE CONTRIBUTION OF DL IN OPPOSITION TO COVID-19

Publishing Date	**Studied/used already existing methods**	**Proposed algorithm/ technique/ device**	**Dataset**	**Contribution of research in battling in opposition to Covid-19**	**Concluding the research findings**
(May 18, 2020) [29]	Studied AI using DL technology.	Developed COVID-19 detection neural network (COVNet).	Dataset- 4356 chest CT images of 3,322 patients.	An automatic framework to identify COVID-19 utilizing chest CT.	Developed model distinguished COVID-19 from pneumonia as well as other non- pneumonic lung diseases using chest CT.
(May 17, 2020) [31]	Studied CheXNet. CheXNet is trained on ChestX-ray14	Presented CovidAID: COVID-19 AI Detector.	Dataset- 112,120 front-view chest X-Ray images.	Using modern AI techniques to detect the COVID-19 patients using X-Ray images.	The proposed model gives 90.5 percent accuracy with 100% sensitivity for the COVID-19 infection.

(May 16, 2020). [26]	Studied different Convolutional Neural Network-based models.	Proposed two models: i)InceptionV3 ii)Inception-ResNetV2	Dataset- 100 X-ray descriptions Description- consisting of 50 COVID-19 patients and 50 normal people	Implementing an automatic revealing method as a swift the substitute option to prevent COVID-19 spread.	The pre-trained ResNet50 model provides the highest 98 percent accuracy among the other two proposed models.
(May 10, 2020) [36]	Studied 7 DL classifiers; VGG19, DenseNet121, ResNetV2, InceptionV3, InceptionResNetV2, Xception, and MobileNetV2	Proposed a CVOIDX-Net framework to automatically identify and confirm COVID-19 in 2-D X-ray images.	Dataset- 50 Chest X-ray descriptions.	Identify COVID-19 in X-ray images.	The results proposed that DL classifiers, the VGG19 and DenseNet201models performed best and verified COVIDX-Net.
(May 7, 2020). [37]	Studied ResNet-50 architecture	This work presented a 3-step technique named COVID-ResNet.	Dataset- COVIDx	Early screening of COVID-19 cases.	The presented model classified COVID-19 from other infections with 99.9 percent accuracy.
(May 6, 2020) [40]	Deep convolutional neural networks (DCNN).	Proposed a DCNN based transfer learning model, Inception-V3.	Dataset- 3550 X-ray images. Description- 864 COVID-19, 1345 viral pneumonia and 1341 normal chest x-ray images.	Automatically detect COVID-19 pneumonia patients using digital chest x-ray images.	The proposed model attained more than 96per cent accuracy.
(May 5, 2020). [30]		Proposed DCNN model- CoroNet.	Dataset- 1300 images. Description- 1203 normal, 660 bacterial Pneumonia, and 931 viral Pneumonia	Automatically screen Covid-19 from chest X-ray images using DCNN.	The proposed model achieved an accuracy of 97 percent for Covid-19 cases.

			cases.		
(April 22, 2020) [33]	Studied multiple CNN models to categorize CT samples with COVID-19, Influenza viral pneumonia, or no infection.	Used ResNet in extracting features from CT images with a location-attention mechanism model.	Dataset- 618 CT samples.	Deep learning system to screen COVID-19.	Distinguished COVID-19 cases with an 86.7 percent accuracy rate.
(April 20, 2020) [39]	Three deep transfer models Alexnet, Googlenet, and Restnet18 are selected in this research for examination.	Presented a GAN with deep transfer learning for COVID-19 detection in chest X-ray images.	Dataset- 307 images.	Early detection.	Googlenet was selected as the main deep transfer model with 100 percent testing accuracy and 99.9 percent validation accuracy.
(April 15, 2020). [24]		Designed a DCNN-COVID-Net	Dataset- COVIDx, 13,800 CXR images of 13,725 cases.	Predicting risk status of patients.	Highly accurate and practical DL solutions for detecting Covid-19 will be accelerated by the proposed open-access COVID-Net.
(March 30, 2020) [25]	Transfer Learning was studied and adopted.	Proposed a CNN	Dataset- 2,870 X-ray images Description- 448 X-ray images of confirmed cases of COVID-19	Diagnosis and prognosis.	The proposed CN showed the best accuracy- 96.78 percent, sensitivity- 98.66 percent, and specificity- 96.46 percent.
(March 29, 2020) [34]		Proposed an automated DL method that uses a serial CT scan.	Dataset- 126 patients from 01/01/2020 to 03/02/2020	Evaluating lung troubles in patients with COVID-19.	This DL method could identify differences in the lung opacity burden on CTs from COVID-19, although the current version still needs radiologists' supervision.
(March 27, 2020). [35]		Proposed a DL model to identify COVID-19	Dataset- 1531 chest X-ray Source-	Screening of COVID-19 on chest X-ray images using DL.	The model developed when tested on 1531 X-ray images detected 96 percent COVID-19 cases

		from non-COVID-19 cases.	Github repository1 and ChestX-ray14.		and 70.65 percent non-COVID-19 cases.
(March 14, 2020) [28]	Studied DCNN based models	Proposed an assisted detection test. (combining DL and molecular testing)	Dataset- 588 samples Dataset source- repository 2019 Novel Coronavirus resource.	To develop detection tests for SARS-CoV-2.	The proposed model identifies diverse corona viruses with 98.75 percent accuracy and SARS-CoV-2 with 98per cent accuracy.
(March 12, 2020) [27]	Studied Non-contrast thoracic computer tomography (CT). Used Resnet-50 - 2D architecture (50layers CNN)	Proposed an AI-based automated CT image analysis model.	Dataset- 6,150 CT slices cases	Detection of COVID-19 based on CT images.	The developed system classified COVID-19 vs. Non-COVID-19 cases per thoracic CT studies with 96 percent accuracy.
(February 25, 2020) [38]		Proposed a system named DeepPneumonia to identify patients with COVID-19.	Dataset- 275 chest CT scans. Patients Description- 88 COVID-19, 101 bacterial pneumonia, and 86 healthy persons.	Rapid and accurate identification of COVID-19 in human samples.	The proposed model can accurately identify COVID-19 patients from others with 99 percent accuracy.
(February 17, 2020) [32]	AI and DL methods	Developed a DL algorithm and constructed an Inception migration neuro network.	Dataset- 453 CT images.	Fast and alternative processes can be utilized by front-line health care individuals for quick and accurate diagnosis of the disease.	The DL-developed algorithm obtained 90 percent accuracy on the internal validation and 78 percent accuracy on the external validation.

These days, researchers from every corner of the globe, belonging to diverse fields are working day and night to battle in opposition to the epidemic. To design highly precise as well as dependable DL-based approaches, a huge number of researchers along with data scientists are working collectively to detect and manage Covid-19 disease. The researchers main focal point is to develop DL techniques to

spot the particular character of Covid-19 patients from chest radiography images [19].

Historically, DL has been very flourishing in a variety of visual tasks that contain medical image analysis as well. Table 2 discusses some recent DL-based approaches to spot Covid-19 infection from chest x-ray images. By precisely analyzing, recognizing, categorizing blueprints in medicinal images DL has transformed automatic disease analysis as well as an organization [20]. The main cause that resulted in such accomplishment in the field of DL is that the DL technique does not rely on instruction manual handcrafted characters, but these algorithms get trained on features automatically from data itself [21]. In bygone days, DL has had success in infection categorization through chest radiography images [22].

A deep neural network model known as ChexNet is utilized efficiently in detecting pneumonia from a chest x-ray image. Exceptional results have been attained by ChexNet, exceeding average radiologist performance. One more alike approach called ChestNet [23] is a deep neural network model that is considered to make a diagnosis of thorax diseases based on chest radiography images.

DL image investigation tools can probably be designed to support radiologists in quantification, triage, as well as drift examination of the data. AI results contain much potential in analyzing numerous cases in parallel to sense whether chest CT discloses some abnormalities in the lung. If software recommends that there has been a considerable increase in the probability of disease, the case can be flagged for further reconsideration by a radiologist or clinician for potential treatment/quarantine. Such classification, and dissimilarity thereof, once confirmed as well as tested, can develop into key contributors in the detection along with managing the increase in the number of infected patients with the virus.

IV. Conclusion

To control the rising infectious diseases such as the present COVID-19 timely diagnosis is very crucial. There is a vital necessitate to come across a swift alternative system because of the constraints of nucleic acid-based laboratory testing which can be utilized by front-line health care individuals for fast as well as precise diagnosis of the disease. As discussed in the above-mentioned studies, using standard ML and DL techniques as well as pioneer AI functions, with a recognized pulmonary CT detection stage, which is an efficient instrument and can be operated for the screening as well as in the early hour's recognition of patients who might have contracted the COVID-19 pathogen. Similar methodologies are capable of getting used inaccurate plus rapid assessment of disease succession; furthermore, help in directing the therapist and patient supervision staff in safe dealing of the patients who might have contracted the virus as well as have the pulmonary malfunctions linked with it.

After doing this rapid review, it is not wrong to mention that AI is not playing a noteworthy function in the battle opposite to COVID-19, in any case commencing the diagnostic, epidemiological, and pharmaceutical examination. The studies mentioned in this article highlighted the reason why AI has not yet succeeded in the case of COVID-19 is the lack of data. AI has the potential to analyze very large datasets and to detect patterns in data using ML algorithms and use DL algorithms to analyze images and detect variations that might suggest a COVID-19 related infection. However for those powerful algorithms to work, they need a large amount of good quality. There are limited numbers of CT scan images of the lungs of established cases of COVID-19 as many patients barely get a lung scan. Moreover, experts need to label the data to guide the algorithms in terms of what to look for in the scan. , AI's potential to help with this crisis is severely limited, as both data and the expertise to label the data are in short supply

Although, the rising amount in worldwide projects in this view is encouraging; but, there is a need to perform additional diagnostic testing. Not simply for providing training data for AI models efficient operation; however also for efficient management of the pandemic crisis as well as dropping its rate in terms of human lives plus economic dent. Undoubtedly, data is a vital factor to decide whether AI will be a useful tool in opposition to future epidemics as well as pandemics. Another fear which is about the increase in the requirement of relevant data is that the public health alarm might trump data privacy issues. Governments possibly will be continuing the extraordinary surveillance of their citizens long after the pandemic is over for future predictions which might result in arising questions on the data security systems. Thus, concerns about the erosion of data privacy are justified.

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Modified Particle Swarm Optimization Algorithm Proposed for Augmenting Makespan

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Abstract – IT industry is mounting each day and so is the necessity for computing and storage resources. Huge quantities of data are produced and swapped over the network which further requires the prerequisite of more and more computing resources. Organizations, to better exploit their asset, are opening their infrastructure to newfound virtualization technologies like Cloud computing. Cloud Load balancing is the procedure of allocating loads and computing resources across one or more servers. This kind of distribution guarantees maximum throughput in minimum response time. To get the best out of cloud service, the optimized utilization of available cloud resources is a must. The research paper particularizes the importance of load balancing. The load balancing factor is responsible to keep a check on the appropriate utilization of available servers. Load balancing is a method for reassigning the entire workload to available nodes for a group of systems, to utilize resources effectively and efficiently. The primary aim of performing load balancing is to evenly distribute the load to be processed among available processing nodes to avoid any kind of overutilization or underutilization. The research paper proposes a modified PSO (Particle Swarm Optimization) technique intending to minimize the makespan in a virtual cloud environment. The utilization of VM explains how well accessible resources can be utilized in cloud computing. The objective of the task scheduling algorithm is to schedule the tasks in such a manner that makespan gets minimized and the utilization of VM gets maximized. The emphasis has been laid on the effective use of load balancers to achieve the desired task. The research paper elaborates on the proposed technique via an algorithm, flowchart, and implementation.

Keywords **–** Cloud Computing, Load Balancing, Makespan, PSO, Virtual Machines.

I. INTRODUCTION

Cloud computing is a development of parallel, distributed, cluster, and grid computing. In parallel computing, all processors share the memory to exchange information between processors. In distributed system components resides on computers on different networks. Each system has possessed its memory and it may be at the same or different location. It transfers and synchronizes by passing messages. In cluster computing groups of different distributed or parallel systems reside in the same area and are interconnected with a high-speed network to solve a problem [1, 2]. Grid computing is geographically spread and the clusters at the same or different locations are connected through the internet. The large tasks are fragmented into small sections and are executed on different machines. The cloud host is categorized into three main categories as public clouds, private clouds, and hybrid clouds. In public clouds, cloud resources are possessed and activated by CSP (Cloud Service Provider). For example, Microsoft Azure, Amazon Web Services, and Google Cloud Platform. Public clouds provide and charge cloud services to users over the Internet. Public clouds deal with the service market rather than specific enterprises. On the contrary, private clouds are built for specific organizations and are maintained by professional parties. Private clouds can only be accessed by members of the enterprise. For example, IBM, Cisco, and Sun. Private clouds also depend on public clouds to enhance their storage and computing capabilities. Hybrid clouds are a combination of public clouds and private clouds and are intended to improve scalability and efficiency. In a hybrid cloud, the scheduler regulates whether to admit or not to agree on the cloud user's request depending upon resource usage of public and private clouds [3, 4].

Some of the characteristics of cloud computing are mentioned as under [4, 5, 6].

- Virtualization–Virtualization is the idea of exploiting resources in a virtual environment, i.e. generating an environment that looks like the real environment. It delivers service to the user via virtualization technology. It distributes the accessible resources into manifold virtual machines and runs numerous operating systems and applications on the same machine.
- Large scale infrastructure - It offers extraordinary computing abilities to the user. There are numerous servers in millions in the cloud podium on Google and more than thousands in Amazon, IBM, Yahoo, Microsoft, and others.
- Low-cost - No need for mammoth investment while consuming its service. With the help of

Cloud Service Provider, users can pay as per their use.

- Scalability–Scalability denotes to how to handle the system with varying necessities of the user. Divergent categories of users access the similar service at the simultaneously from different places.
- Universal tolerability - Diverse types of managers can run a diversity of requests in a single platform rendering to the prerequisite of users. Cloud Service Platform allows internet workers can access requests, positions, and time.
- Quick Elasticity - Rendering to the environments of the number of users and application resources are vigorously extended or contract.

Load balancing in cloud computing refers to adjustments of workloads and properties related to computing. Load balancing enables organizations to manage workload demands or application demands by allocating available resources among several networks, servers, or computers [5, 6]. Load balancing comprises the circulation of workload traffic existing on the Internet. With the rapid increase in the growth of the internet and organizations adapting to the cloud environment, the need for load balancing has further gained importance [7, 8]. The primary purpose of load balancing is to keep a check and prevent the server from getting overloaded and facing possible break down. If efficiently implemented, the load balancing reduces the downtimes and hence enhances the service availability. End-user contentment and efficiency highly depend upon fast response time [9, 10].

The protuberant benefits of load balancing in the cloud environment are stated as under [5, 6, 11].

- Resource Optimization - Through load balancing, one can enhance how traffic is dispersed to the server cluster so, that it promises the best performance.
- Redundancy - It defines the process of running two or more processes on the multiple servers thus providing a certain event that one server becomes engaged.
- Scalability - Even though uncertain resource requirements are offered, scalability must always be measured for finding the correct host solution.
- Security – In security, only one IP is visible to the web with load balancing, which expressively decreases the number of breakpoints in instance of attack.

The performance measurement of the load balancing in the cloud environment is mentioned as under [6, 12].

- Throughput- Sum of the complete execution of a task is called throughput. So if throughput is high system will perform better.
- Migration Time- Time is taken by the tasks in transferring from one machine to another machine in the system. Migration time should be minimum for better performance.
- Overhead- During the execution of the load balancing algorithm, the amount of overhead is produced. So a successful implementation of the algorithm means minimum overhead.
- Fault Tolerance- At any arbitrary node working in the system. It is the way to perform uniformly even at any fault at any arbitrary node in the network system.
- Scalability- It depicts the capability of the system to complete the load balancing algorithm having less consumption of resources (processor or machine).
- Response Time-Minimum time that a Load balancing algorithm takes to respond in the distributed system.

The research work conducted in this paper is primarily focused to minimize the makespan via load balancing. Makespan is the total length of the time consumed until all the tasks have been processed. The optimization problem in cloud computing is to minimize the makespan. The utilization of VM defines how well the available resources can be utilized in cloud computing. The makespan and utilization rate are inversely proportional to each other [11, 12]. The objective of the task scheduling algorithm is to schedule the tasks in such a manner that makespan gets minimized and the utilization of VM gets maximized.

Particle Swarm Optimization look like Genetic Algorithms (GA) in many facets. The random solutions and searches are used to initialize targets via updating generations [13, 14]. PSO is free from evolution operators like transformation and crossover. Particles fly through the problem space by following the current optimum particles. Each particle moving in the solution space is fascinated by two poles, its past best position (solution) and the best position (solution) of the whole swarm (collection of particles). These poles are responsible for transforming the velocity vector of the particles at each iteration [15, 16, 17]. The implementation of PSO is comparatively easy as compared to Genetic algorithms.

II. MODIFIED PSO TASK SCHEDULING ALGORITHM

This section illustrates the proposed modified algorithm and flowchart of the PSO task scheduling algorithm intended to minimize the makespan.

Algorithm

- Initialize the CloudSim package. It should be called before creating any entities and initialize the CloudSim Library.
- Create Datacenters that would act as resource providers in CloudSim. At least one of the Datacenter needs to be running in CloudSim simulation.
- Create a list to store multiple machines. Each machine comprises multiple PEs (Processing Elements) or CPUs / Cores.

- A Machine contains one or more PEs or CPUs/Cores. Therefore, should generate a list to stock these PEs before constructing a Machine.
- Generate PEs and initiate adding up these into the list for a quad-core machine. PE id and MIPS (Million Instructions per second) rating should be stored.
- Generate Hosts along with their IDs and list of Processing Elements and including them in the list of machines.
- Create a Datacenter characteristics object for storing the properties of a data center like design, Operating System, list of Machines, and distribution policy.
- Thereafter, create a Power Datacenter object and a Broker followed by the creation of VMs and Cloudlets and direct them to the broker.
- Create a container to store VMs and cloudlets. VMs must have parameters like count of CPUs, name of Virtual Machines, image size in MegaBytes, memory size in MegaBytes, and MIPS. Cloudlets must comprise the parameters like length of filesize, output size, etc. This list is approved to the broker later.
- Start simulation.
- Print results when a simulation is over.

Fig. 1 shows the workflow of the proposed method in the form of a flowchart.

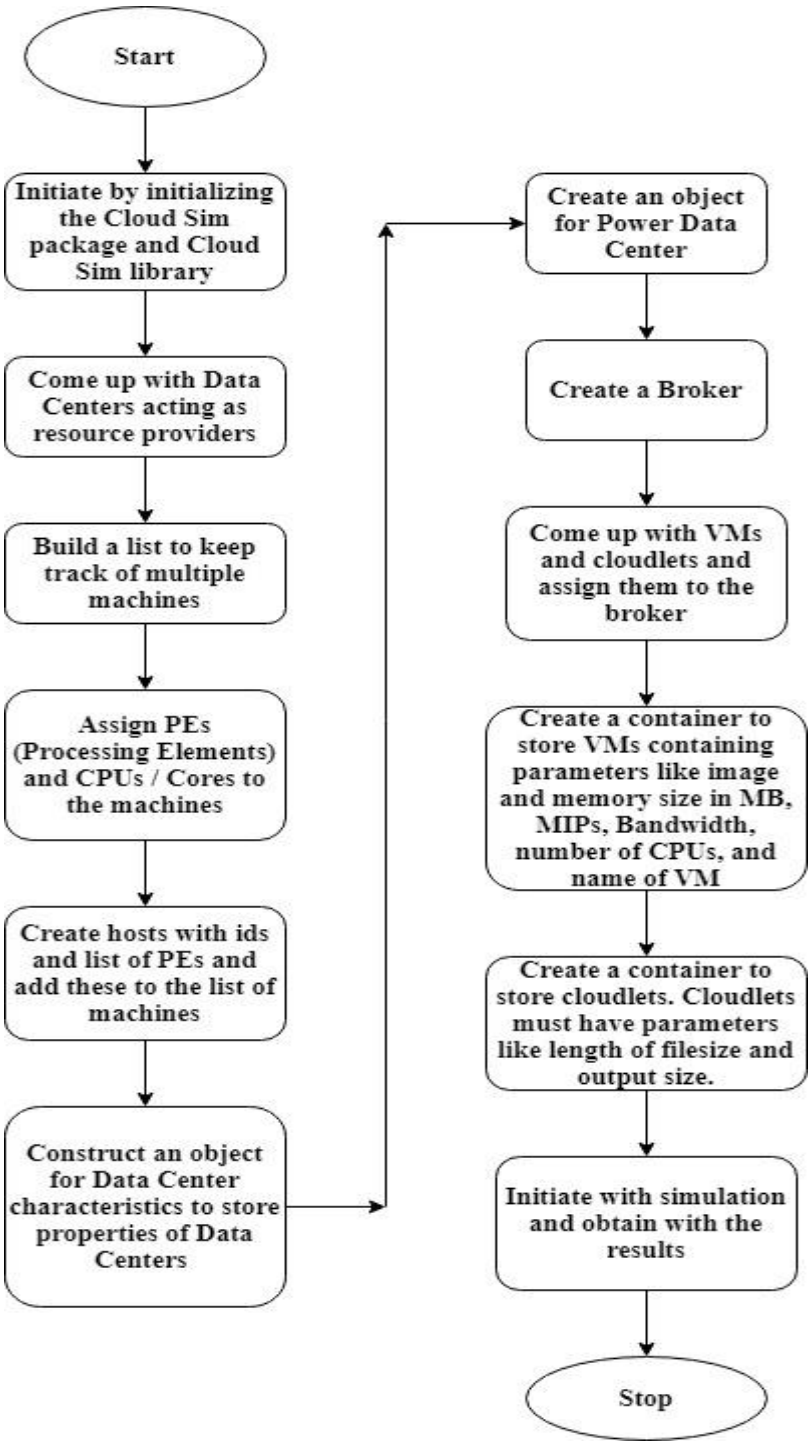

Fig. 1 Flowchart for modified PSO algorithm

III. RESULTS AND IMPLEMENTATIONS

This section demonstrates the implementation of the proposed technique via setting parameters to a fixed value except for the number of CPUs which varies.

Case 1:

The considered parameters along with allocated values for the accomplishment of the implementation are given below. Values assigned to the parameters with data types

- *long size* = 10000 (size of an image in MB)
- *int ram* = 2048 (memory allocated to Virtual Machine in MB)

- *int mips* = 250 (Number of million instructions per second)
- *long bw* = 1000 (bandwidth)
- *int pesNumber* = 1 (Number of participating CPUs)

Thirty cloudlets have been allocated to five virtual machines having VM_IDs as 02, 03, 04, 05, and 06. The status of executing iterations to find out the BFV (Best Fitness Value) is shown below.

Iteration No.	BFV
Iteration Number (0):	7078.035913
Iteration Number (10):	6001.581043
Iteration Number (20):	5685.997767
Iteration Number (30):	5377.083438
Iteration Number (40):	5313.230507
Iteration Number (50):	5313.230507
Iteration Number (60):	5313.230507
Iteration Number (70):	5313.230507
Iteration Number (80):	5313.230507
Iteration Number (90):	5313.230507
Iteration Number (100):	5313.230507
Iteration Number (110):	5313.230507
Iteration Number (120):	5313.230507
Iteration Number (130):	5313.230507
Iteration Number (140):	5313.230507
Iteration Number (150):	5313.230507
Iteration Number (160):	5313.230507
Iteration Number (170):	5313.230507
Iteration Number (180):	5313.230507
Iteration Number (190):	5313.230507
Iteration Number (200):	5313.230507
Iteration Number (210):	5313.230507
Iteration Number (220):	5313.230507
Iteration Number (230):	5313.230507
Iteration Number (240):	5313.230507
Iteration Number (250):	5313.230507
Iteration Number (260):	5313.230507
Iteration Number (270):	5313.230507
Iteration Number (280):	5313.230507
Iteration Number (290):	5313.230507
Iteration Number (300):	5313.230507
Iteration Number (310):	5313.230507
Iteration Number (320):	5313.230507
Iteration Number (330):	5313.230507
Iteration Number (340):	5313.230507
Iteration Number (350):	5313.230507
Iteration Number (360):	5313.230507

Iteration Number (370): 5313.230507
Iteration Number (380): 5313.230507
Iteration Number (390): 5313.230507
Iteration Number (400): 5313.230507
Iteration Number (410): 5313.230507
Iteration Number (420): 5313.230507
Iteration Number (430): 5313.230507
Iteration Number (440): 5313.230507
Iteration Number (450): 5313.230507
Iteration Number (460): 5313.230507
Iteration Number (470): 5313.230507
Iteration Number (480): 5313.230507
Iteration Number (490): 5313.230507

The number and sequence of cloudlets allocated to available data centers as best solution are (6 16 18 25 26 27 29), (5 9 10 12 17 23 28), (7 11 14 15 19 20), (1 2 8 21), and (0 3 4 13 22 24). The comprehensive status of the accomplishment of assigned tasks is shown below in Table I.

Table I. Table shows the execution of PSO as per readings of Case 1

CloudletID	STATUS	Data_center_ID	VM_ID	Time	Start_Time	Finish_Time
0	SUCCEEDED	2	2	621.46	0.1	621.56
1	SUCCEEDED	3	3	900.68	0.1	900.78
7	SUCCEEDED	6	6	960.61	0.1	960.71
3	SUCCEEDED	2	2	525.76	621.56	1147.32
11	SUCCEEDED	6	6	879.92	960.71	1840.64
5	SUCCEEDED	4	4	1988.31	0.1	1988.41
6	SUCCEEDED	5	5	2247.86	0.1	2247.96
2	SUCCEEDED	3	3	1418.9	900.78	2319.69
8	SUCCEEDED	3	3	478.9	2319.69	2798.59
4	SUCCEEDED	2	2	1844.32	1147.32	2991.64
9	SUCCEEDED	4	4	1443.17	1988.41	3431.58
16	SUCCEEDED	5	5	1457.4	2247.96	3705.36
14	SUCCEEDED	6	6	1966.06	1840.64	3806.7
21	SUCCEEDED	3	3	1120.96	2798.59	3919.56
18	SUCCEEDED	5	5	328.8	3705.36	4034.16
10	SUCCEEDED	4	4	611.3	3431.58	4042.88
13	SUCCEEDED	2	2	1319.69	2991.64	4311.33
15	SUCCEEDED	6	6	1668.02	3806.7	5474.72
25	SUCCEEDED	5	5	2620.08	4034.16	6654.24
12	SUCCEEDED	4	4	2640.24	4042.88	6683.12
22	SUCCEEDED	2	2	2758.13	4311.33	7069.46
19	SUCCEEDED	6	6	1694.36	5474.72	7169.07
17	SUCCEEDED	4	4	1409.67	6683.12	8092.79
26	SUCCEEDED	5	5	1741.58	6654.24	8395.81
23	SUCCEEDED	4	4	1013.08	8092.79	9105.87
20	SUCCEEDED	6	6	2145.86	7169.07	9314.94
24	SUCCEEDED	2	2	2415.06	7069.46	9484.52
27	SUCCEEDED	5	5	2261.71	8395.81	10657.52
28	SUCCEEDED	4	4	1892.69	9105.87	10998.56
29	SUCCEEDED	5	5	497.12	10657.52	11154.64

The best fitness value achieved is 5313.230507345577 and the makespan is 2782.6384127689835.

Case 2:

The considered parameters along with assigned values for performing the implementation are given below.
Values assigned to the parameters with data types

- *long size* = 10000 (size of an image in MB)

- *int ram* = 2048 (memory allocated to Virtual Machine in MB)
- *int mips* = 250 (Number of million instructions per second)
- *long bw* = 1000 (bandwidth)
- *int pesNumber* = 2 (Number of participating CPUs)

Iteration No. BFV
Iteration Number (0): 8238.091436
Iteration Number (10): 6817.418662
Iteration Number (20): 6108.189052
Iteration Number (30): 5458.987011
Iteration Number (40): 5013.728819
Iteration Number (50): 4992.544666
Iteration Number (60): 4992.544666
Iteration Number (70): 4992.544666
Iteration Number (80): 4992.544666
Iteration Number (90): 4992.544666
Iteration Number (100): 4992.544666
Iteration Number (110): 4992.544666
Iteration Number (120): 4992.544666
Iteration Number (130): 4992.544666
Iteration Number (140): 4992.544666
Iteration Number (150): 4992.544666
Iteration Number (160): 4992.544666
Iteration Number (170): 4992.544666
Iteration Number (180): 4992.544666
Iteration Number (190): 4992.544666
Iteration Number (200): 4992.544666
Iteration Number (210): 4992.544666
Iteration Number (220): 4992.544666
Iteration Number (230): 4992.544666
Iteration Number (240): 4992.544666
Iteration Number (250): 4992.544666
Iteration Number (260): 4992.544666
Iteration Number (270): 4992.544666
Iteration Number (280): 4992.544666
Iteration Number (290): 4992.544666
Iteration Number (300): 4992.544666
Iteration Number (310): 4992.544666
Iteration Number (320): 4992.544666
Iteration Number (330): 4992.544666
Iteration Number (340): 4992.544666
Iteration Number (350): 4992.544666
Iteration Number (360): 4992.544666

Thirty cloudlets have been allocated to five virtual machines having VM_IDs as 02, 03, 04, 05, and 06. The status of executing iterations to find out the BFV (Best Fitness Value) is shown below.

Iteration Number (370): 4992.544666
Iteration Number (380): 4992.544666
Iteration Number (390): 4992.544666
Iteration Number (400): 4992.544666
Iteration Number (410): 4992.544666
Iteration Number (420): 4992.544666
Iteration Number (430): 4992.544666
Iteration Number (440): 4992.544666
Iteration Number (450): 4992.544666
Iteration Number (460): 4992.544666
Iteration Number (470): 4992.544666
Iteration Number (480): 4992.544666
Iteration Number (490): 4992.544666

The number and sequence of cloudlets assigned to available data centers as best solution are (7 12 16 18 19 29), (4 6 9 10 17 21 23), (5 11 13 14 22 28), (0 1 2 15 25 27), and (3 8 20 24 26). The detailed status of the execution of allocated tasks is shown below in Table II.

Table II. Table shows the execution of PSO as per readings of Case 2

Cloudlet_ID	STATUS	Data_Center_ID	VM_ID	Time	Start_Time	Finish_Time
3	SUCCEEDED	3	3	525.76	0.1	525.86
0	SUCCEEDED	2	2	772.13	0.1	772.23
11	SUCCEEDED	5	5	879.92	0.1	880.02
1	SUCCEEDED	2	2	900.68	0.1	900.78
6	SUCCEEDED	4	4	1082.14	0.1	1082.24
5	SUCCEEDED	5	5	1897.2	0.1	1897.3
15	SUCCEEDED	2	2	1095.35	900.78	1996.14
4	SUCCEEDED	4	4	2001.84	0.1	2001.94
8	SUCCEEDED	3	3	2172.34	0.1	2172.44
13	SUCCEEDED	5	5	1301.06	880.02	2181.08
2	SUCCEEDED	2	2	1418.9	772.23	2191.13
12	SUCCEEDED	6	6	2348.43	0.1	2348.53
9	SUCCEEDED	4	4	1443.17	1082.24	2525.41
10	SUCCEEDED	4	4	611.3	2001.94	2613.24
20	SUCCEEDED	3	3	2106.3	525.86	2632.16
7	SUCCEEDED	6	6	2753.5	0.1	2753.6
18	SUCCEEDED	6	6	328.8	2753.6	3082.4
22	SUCCEEDED	5	5	1248.36	2181.08	3429.44
27	SUCCEEDED	2	2	1267.24	2191.13	3458.37
16	SUCCEEDED	6	6	1457.4	2348.53	3805.93
25	SUCCEEDED	2	2	1857.82	1996.14	3853.96
14	SUCCEEDED	5	5	1966.06	1897.3	3863.36
17	SUCCEEDED	4	4	1409.67	2525.41	3935.08
21	SUCCEEDED	4	4	1556.73	2613.24	4169.97
29	SUCCEEDED	6	6	497.12	3805.93	4303.04
26	SUCCEEDED	3	3	1840.58	2632.16	4472.74
24	SUCCEEDED	3	3	2415.06	2172.44	4587.5
23	SUCCEEDED	4	4	1013.08	3935.08	4948.16
28	SUCCEEDED	5	5	1803.36	3429.44	5232.8
19	SUCCEEDED	6	6	2223.09	3082.4	5305.49

The best fitness value achieved is 4992.544665557023 and the makespan is 2397.0862791338564.

Case 3:

The considered parameters along with assigned values for performing the implementation are given below.
Values assigned to the parameters with data types

- *long size* = 10000 (size of an image in MB)

- *int ram* = 2048 (memory allocated to Virtual Machine in MB)
- *int mips* = 250 (Number of million instructions per second)
- *long bw* = 1000 (bandwidth)
- *int pesNumber* = 3 (Number of participating CPUs)

Iteration No. BFV
Iteration Number (0): 8477.748501
Iteration Number (10): 6166.514727
Iteration Number (20): 6027.380268
Iteration Number (30): 5871.049399
Iteration Number (40): 5295.155011
Iteration Number (50): 5118.678478
Iteration Number (60): 4921.491504
Iteration Number (70): 4921.491504
Iteration Number (80): 4921.491504
Iteration Number (90): 4921.491504
Iteration Number (100): 4921.491504
Iteration Number (110): 4921.491504
Iteration Number (120): 4921.491504
Iteration Number (130): 4921.491504
Iteration Number (140): 4921.491504
Iteration Number (150): 4921.491504
Iteration Number (160): 4921.491504
Iteration Number (170): 4921.491504
Iteration Number (180): 4921.491504
Iteration Number (190): 4921.491504
Iteration Number (200): 4921.491504
Iteration Number (210): 4921.491504
Iteration Number (220): 4921.491504
Iteration Number (230): 4921.491504
Iteration Number (240): 4921.491504
Iteration Number (250): 4921.491504
Iteration Number (260): 4921.491504
Iteration Number (270): 4921.491504
Iteration Number (280): 4921.491504
Iteration Number (290): 4921.491504
Iteration Number (300): 4921.491504
Iteration Number (310): 4921.491504
Iteration Number (320): 4921.491504
Iteration Number (330): 4921.491504
Iteration Number (340): 4921.491504
Iteration Number (350): 4921.491504
Iteration Number (360): 4921.491504

Thirty cloudlets have been allocated to five virtual machines having VM_IDs as 02, 03, 04, 05, and 06. The status of executing iterations to find out the BFV (Best Fitness Value) is shown below.

Iteration Number (370): 4921.491504
Iteration Number (380): 4921.491504
Iteration Number (390): 4921.491504
Iteration Number (400): 4921.491504
Iteration Number (410): 4921.491504
Iteration Number (420): 4921.491504
Iteration Number (430): 4921.491504
Iteration Number (440): 4921.491504
Iteration Number (450): 4921.491504
Iteration Number (460): 4921.491504
Iteration Number (470): 4921.491504
Iteration Number (480): 4921.491504
Iteration Number (490): 4921.491504

The number and sequence of cloudlets assigned to available data centers as best solution are (3 16 18 19 24 29), (0 5 6 9 10 17 23), (7 11 13 14 20 28), (1 2 8 15 21 25 27), and (4 12 22 26). The detailed status of the execution of allocated tasks is shown below in Table III.

Table III. Table shows the execution of PSO as per readings of Case 3

Cloudlet_ID	STATUS	Data_Center_ID	VM_ID	Time	Start_Time	Finish_Time
18	SUCCEEDED	4	4	328.8	0.1	328.9
8	SUCCEEDED	3	3	478.9	0.1	479
11	SUCCEEDED	6	6	879.92	0.1	880.02
1	SUCCEEDED	3	3	900.68	0.1	900.78
7	SUCCEEDED	6	6	960.61	0.1	960.71
6	SUCCEEDED	2	2	1082.14	0.1	1082.24
13	SUCCEEDED	6	6	1301.06	0.1	1301.16
2	SUCCEEDED	3	3	1418.9	0.1	1419
0	SUCCEEDED	2	2	1429.76	0.1	1429.86
16	SUCCEEDED	4	4	1457.4	0.1	1457.5
15	SUCCEEDED	3	3	1095.35	479	1574.36
4	SUCCEEDED	5	5	1844.32	0.1	1844.42
5	SUCCEEDED	2	2	1988.31	0.1	1988.41
21	SUCCEEDED	3	3	1120.96	900.78	2021.75
10	SUCCEEDED	2	2	611.3	1429.86	2041.17
3	SUCCEEDED	4	4	2451.76	0.1	2451.86
12	SUCCEEDED	5	5	2512.96	0.1	2513.06
9	SUCCEEDED	2	2	1443.17	1082.24	2525.41
19	SUCCEEDED	4	4	2223.09	328.9	2551.98
22	SUCCEEDED	5	5	2758.13	0.1	2758.23
27	SUCCEEDED	3	3	1267.24	1574.36	2841.6
14	SUCCEEDED	6	6	1966.06	880.02	2846.08
29	SUCCEEDED	4	4	497.12	2451.86	2948.97
23	SUCCEEDED	2	2	1013.08	2041.17	3054.25
28	SUCCEEDED	6	6	1803.36	1301.16	3104.52
20	SUCCEEDED	6	6	2145.86	960.71	3106.58
25	SUCCEEDED	3	3	1857.82	1419	3276.83
17	SUCCEEDED	2	2	1409.67	1988.41	3398.08
24	SUCCEEDED	4	4	2202.73	1457.5	3660.23
26	SUCCEEDED	5	5	1840.58	1844.42	3685

The best fitness value achieved is 4921.491503710873 and the makespan is 2285.224391203073. Table IV shows the values of the best fitness and makespan obtained after executing the three cases mentioned above.

Table IV. Table shows the readings of Best Fitness and Makespan of executed three cases

Case	Number of CPUs	Best Fitness	Makespan
Case 1	1	5313.230507345577	2782.6384127689835
Case 2	2	4992.544665557023	2397.0862791338564
Case 3	3	4921.491503710873	2285.224391203073

Fig. 2 shows the graphical representation of the values obtained in Table 4.

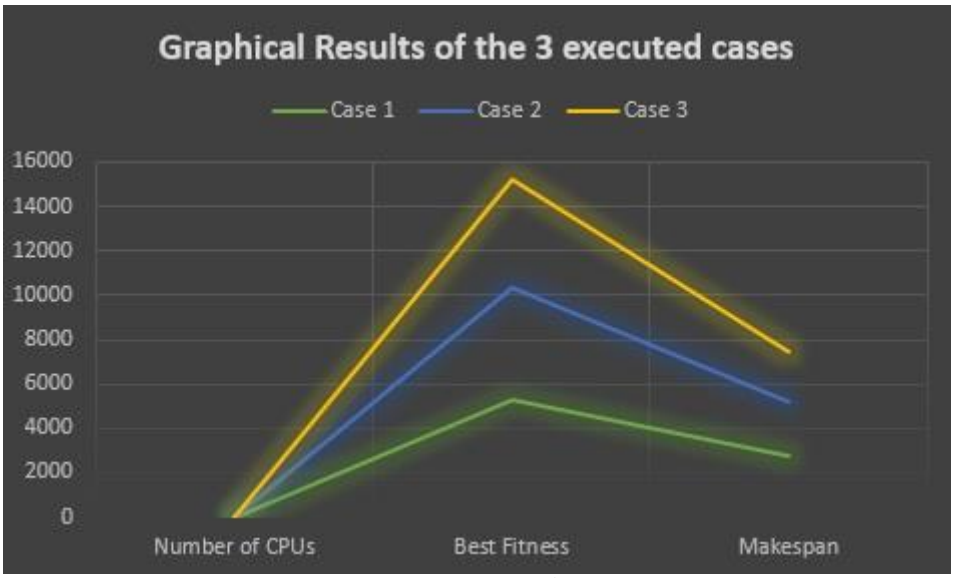

Fig. 2 Graphical representation of executed cases

IV. CONCLUSION

The expectations from cloud computing are very high and so are the challenges. Load unbalancing is a multi-optional and multi-limitation problem responsible for the poor performance of resources in cloud computing. With time, improvement is needed to enhance the general system performance. The modified PSO technique proposed in the research paper has minimized the makespan. From the output of the three cases executed, it can be concluded that as the number of CPUs increases, the best fitness and makespan value keeps on decreasing. The minimum is the makespan, more effective is the load balancing.

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Castigation of Cyberbullying in Relevance with Law Enforcement

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Abstract **-** Although most young people have positive experiences using technology, on the other hand, bullying or cyberbullying by electronic means is becoming a serious issue nowadays. Not only does this have a particularly disruptive effect on the educational environment, but it can also have serious physical and psychological consequences for victims. In this article, by reviewing the most relevant empirical studies, the authors present an integrated definition of cyberbullying, methods that lead to cyberbullying, and common platforms used by cyberbullies. Also, they talk about rules and regulations with educational heads and, respective order regulation which allows them to put a hold on cyberbullying cases, and list some of the harmful effects of cyberbullying. Finally, some strategies for dealing with cyberbullying are described**.**

Keywords **-** Cyberbullying, Bullying, Traditional bullying, Cybersecurity, Cyberlaw

I. Defining Cyberbullying in an Integrated Way

Bullying is a unique type of personal assault that involves deliberate, pessimistic, and repetitive activities to involve the imbalance of power between the offenders and the victims [2]. Negative actions such as verbal (naming and threatening), physical (kicking, hitting, and damaging the property of the victim), or related/social (rumor or social exclusion) [3] [9] [27]. Overall, the above-mentioned kinds of natures are frequently called the same as “conventional” kinds of harassment [43].

Bullying is performed by creating disparity of the authority which is in many cases might be derived commencing the substantial benefit described; like size, maturity as well as vigor, communal strength inside numbers (group targeting a single person) [67] or prominence inside the crowd i.e. well-liked vs. unpopular. The power of imbalance can be achieved by knowing the source of a person's susceptibility such as look, education status, people's condition, and, using facts that results in the suffering. Bullying in the description is habitual and, employing repetitive occurrences, the power is consolidated; the power of bully improves as the power of the person being bullied weakens. Due to these reasons, adolescents who are bullied may find it difficult to respond or solve the problem themselves [9].

In a similar seam, Stephensonn and Smiths, (1990) posit that a requirement for creating an event as bullying is to add violent conduct, which causes significant stress to the bully person. Conventional bullying and, cyber bullying consist of significant common characteristics in their main motivations, in many ways. People who make others cyberbullies want to harm their goals and put into practice a sequence of designed conducts to affect them with anguish.

Cyberbullying differs largely from conventional bullying into reaching criminals. Cyberbullies can extend bullying outside school premises, also, follow the victims until their houses [17]. Cyberbullying can also be stated as an umbrella phrase as it is associated with comparable constructions of electronic bullying, online bullying along cyber nuisance. Quite a lot of cyberbullying descriptions are provided within the literature, a lot of which is derived commencing definition of conventional bullying.

Cyberbullying is usually described as a kind of harassment that involves the usage of online included with computer added communications like Facebook, Twitter and, SMS application [34] [37]. Cyberbullying examples comprise of transfer of abusive and bullying texts, dissemination of rumors, disclose of privacy, upsetting images, and not including others in online interactions [48]. The key elements of this definition are that aggressive action must be deliberate, recurring, and power imbalanced. Belseyy, (2019) elaborated on cyberbullying - ‘‘usage of personal information with technologies to promote intentional, recurring and, aggressive nature via a person and crowd which is planned to hurt someone’’ [10].

The number of children and teens that use internet connections in their houses is growing swiftly. Currently, more than 69% of 4^{th}- 9^{th} class students can stay online from the ease of these places. Kids may get engaged in several internet-based actions for example; online games, searching for info as well as chatting with contacts [89]. However, the galaxy of advantages has recently been eclipsed by some cases of adverse communal impacts of the Internet, which come into sight in scholarly literature and style media. Reasonable consideration has been paid to cybercrimes, including cyber-stalking, sexual predation [15] and

cyberbullying [7] [13]. It brings together the security of kids and adults using the internet.

II. Methods Used to in act Cyberbullying

Cyberbullying is as easy as sending out harassing text messages or emails to someone who said they didn't want to communicate further with the correspondent. This includes a series of threats, sexual comments, false labels (ie hate speech) or false accusations, public activities such as harassing a victim by mocking a person on hacking, online forums or vandalizing a site, posting bogus statements, in person, or insulting the target person [27]. The subsequent are several caution signs that a child is being cyberbullied or is cyberbullying other:

- Significant increase or decrease in child's usage of a mobile, laptop, or tablet
- Demonstrate emotional responses such as sadness, anger, or happiness to the activities on their device
- The propensity to stay away from conversation concentrating their online activities
- Hiding device screen when others are close by
- Unconcern to public activities and gatherings as well as outdoor activities
- Sudden deactivation of their social media accounts or opening of new ones
- Becoming unhappy and reserved

Cyberbullying may be restricted to posting rumors about a person, bringing disgust to the minds of others, or relying on others who do not want or refuse a goal online. It may go so far as to personally identify victims of crime and to publish derogatory or offensive material [11]. Cyberbullies may reveal the victim's data as in; actual person's name, the house adds. and, administrative center/educational center over the online sites/ firms known as docking, or using imitation, create false profiles, remarks or websites posturing their objective intended for the publishing of data in their name to de-fame, dis-credits and make them feel ridiculous [20]. It may be seen that a cyberbully is usually a person with a fake id, which makes it quite tricky to get them and punish them on behalf of their conduct, though not every cyberbully maintains a name. A user of unauthorized chatting sites is at a particularly soaring threat of cyberbullying because cyber-bully is anonymous in these shops [56]. Message and e-mail amongst associates be capable of also cyberbullying; if what is held is harmful.

A. Platforms with the prevalence of cyberbullying

1) *Social media:* Over the past decade, cyberbullying and bullying have been seen throughout the usage of electronic communiqué technology also known as e-mail, social media, instant messaging, online games, digital messages or images sent on a cellular phone [39].

2) *Gaming:* Of those who become a victim of online nuisance in the Phew Study polling, 17 percent stated that the majority of the current event took place in online gaming [47]. A study by the Nationwide Sun Yatt-Sen Uni. explained that kids who experienced aggressive video games be considerably more probable to be responsible for cyberbullying [48]. Another study discussing the direct link between the emergence of violent gaming and cyberbullying also take in-to explanation special factor; period of playing games online, consumption of alcohol past 3 months, drunken parenting, annoyance, unfriendliness, ADHD, and not able to feel the nous of belonging" [29] as potential contributing factors of cyberbullying. Some game developers suffer bullying and death threats from players who are offended by a game's changes or the developer's online policies [66]. Nuisance too occurs inside response to critics mostly known as Jack Thompson and Anitta Sarkesian, as a few fans witness this as intimidation to the cyberbullying middling [15]. Lots of persons are stressed interlinked among the gamergate argument [87]. Gaming-related harassment is not significantly different or scarce compared to online stalking triggered with former cultures and backing matters. This disrupts is one of the most frequent crude funding campaigns for gaming-related projects [33]. Some examples of delivering a bow to someone in online games such as 'call of duty and 'league of legends' resulted in law enforcement by S.W.A.T units called onto person's houses as a part of pranks. On December 28, 2017, Wichita, Kansas police officials killed Andrew Finch at his Kansas residence in a reported swatting trick [39].

3) *Search engines*: Information cascades occur when users begin to pass on information that they think is right but are not known as a right supported by the fact that what former customers are undertaking. This could be increased by using searching engine rank equipment and propensity on the way to deliver results that are related to the customer's prior comfort. These sorts of info are difficult to disseminate. Info via communal medium and the internet is safe and can have real information [19]. The bully's using Google Bombs which is a terminology appropriate to several search engines; [60] headed for increasing the importance of their favorite station species with the mainly trending seeks, as often as possible by connecting to these posts through numerous web pages. The instance of propaganda for the neologism of "Santorum" prepared by the L.G.B.T. lobby states that the

Google bombs can handle the searching platforms of the Internet, even though how reliable the platforms are, there is always a way to deal with this kind of maneuvering [4].

III. Harmful Effects of Cyberbullying

Instability in someone is associated with cyberbullying which can series from mild depression in addition to aggravation on the way to solemn psychological with wellbeing troubles. Many of the unenthusiastic circumstances planned as the effects of cyberbullying depend on the occurrence, time-span, and, intensity of malicious acts. Rarely does cyberbully have the prospective reason for long-standing troubles rather than a persistent nuisance [46, 70].

The ill-treatment might relate as well to emotional disorder. The vulnerability may also be associated with affective disorders. Cyberbullying and emotional distress over anger, anger, and sadness are associations of victimization. Exploited people additionally build up a large group of social issues including separation, externalized threatening vibe, and misconduct. The unenthusiastic results of cyberbullying split numerous likenesses employing conventional bullying to happen in educational centers [80, 81].

A few examinations examine the connection between exploitation and a recognizable drop in scholarly execution in addition to the nature of relations connections [21] at the same time as a different study examining the growth of psychosocial nuisance and emotional disorder [25] [79]. Sufferers continue to account for educational difficulties inside engaging in cyberbullying occurrences.

Apprentice account for a hasty crash in the marks [5], amplified nonattendance in addition to absenteeism [46] and, building perception in the education sector is not a secure place. The former solemn educational problem such as confinement, cutting class, postponement, and delivery of arms into university grounds are too accounted for [83]. The decrement in the educational presentation may subsist attributed in the direction of the poor attentiveness of victims and a greater degree of aggravation through the bully as well as the situation [54]. Additionally, $1/4^{th}$ of the sufferers think that their home livings have been significantly affected by cyber threats [49].

When someone says the worst thing that healthy can drain it, they can set as a barrier linking them in addition to their self-esteem. Except psychologically ill persons don't contain the power or self-confidence in the direction of doing it, disconnect it, as a result, it compiles the whole thing. For those, this is an utter fact-no riddle, negative blocking. That human being's resolve acquires it and gets it for granted. Communal medium has authorized harassers to separate as of the collision they can have on others [75].

A. Harmful effects explained, taking age as a factor

Children account for pessimistic online conduct happening from the second class. According to the study, males start pessimistic online action in comparison to females. Though, in high school, females are probable to employ in cyberbullying more than males [81]. The point is deliberately to humiliate, annoy, scare, or make bullying online, whether the bully is male or female.

Lower success scores are often accounted for in kids who are bullied than folks who are not [33]. Furthermore, alteration troubles come into view as of come across using usual bullying with kids [49]. Sufferers do not have the opportunity to engage in pro-social activities and conduct to internalize problems and show their unhappiness.

Researches on psychosocial special adverse effects of cyber-space have started to observe the influences of cyberbullying happening to victims. Effects of cyberbullying are multifaceted which can concern online and offline conduct. Studies on teenagers suggest that alteration in the conduct of sufferers as a result of cyberbullying may be encouraging. Sufferers developed a cognitive form of bullying, in turn, enabled them to identify violent groups [63].

Psychological troubles and unenthusiastic temper are as well noticed inside people who are susceptible to cyberbullying. For example, depression-related through which persons witness cyberbullying[34] [71]. Furthermore, psycho-social struggles such as communal nervousness [39] and depreciate elevation of confidence have been recognized in sufferers of cyberbullying [51].

B. Effects such as intimidation, emotional damage, and suicide

Cyberbullying is a serious kind of emotional mistreatment, and its fatalities are twofold as probably to go through cerebral illness as compare to usual bullying [7].

Research has demonstrated several serious consequences for the vulnerability of cyberbullying. Victims may have various types of emotional responses, including low self-respect, increased suicidal ideation, and fear, frustration, anger, and depression [31, 56, 61]. Cyberbullying might be extra damaging as compared to conventional; common bullying as there is no escaping from it. The most detrimental consequence be that fatality starts staying away from near and dear ones, which is especially the main purpose of the bully [71].

The negative consequence of harassment happening over the health of kids and adults is broadly documented. Sufferers of bullying testimony, weak peer-to-peer

relationship, isolation, low self-worth [23][41], an indication of sadness plus nervousness, societal extraction, in addition to with nothing to live for belief [59]. Bullies report high levels of aggression, innocence, and violation of rules along with the material used. Bullies and sufferers (bully-victims) are in danger of developing communal and psychological healthiness troubles [79].

Cyberbullying campaigns can sometimes cause victims to commit suicide. Readily available four cases of the United States inside which cyberbullying is related to the suicidal attempt of adolescents [3]. Megan Myer's suicide is one example, which leads to the certainty of a grown-up convict in an assault. Holy Grogan committed suicide by jumping off the 30-foot bridge near Gloucester, England. Additionally noted that many of her classmates posted many odious messages on her Facebook page [13].

Young people's reluctance towards a person who has authority over cyberbullying has led to deadly consequences. According to a report by the USA Today and the Baltimore Examiner, 3 kids between 12 and 13 years have committed suicide owed to cyberbullying. These comprise the suicide of Ryaan Haligan and the suicide Megaan Myeer, resulting in America's W. Lorii Drrew. Teenage suicidal attempts associated with cyberbullying have turn out to be increasing. Rebeca Aan Sedgwick committed suicide following a threat by mobile phone applications like As-FM, Kik Messenger and Voxxer [26].

C. Effects on youth and teenagers

The consequences of cyberbullying differ, but the study shows that cyberbullying has an effect on adolescents which is worse than on adults. Young people are more likely to experience as they grow more mentally and physically [18], Jenifer M., an authorized family physician. As Cattle states, “bullying children be more probably results in nervousness, despair, aloneness, misery in addition to deprived sleep” [38]. According to Lucy Rusell, leader of the crusade, strategy, and, partaking within young psychological fitness, immature individuals with psychological mess are cyberbullying because sometimes they are not able to wave it off.

The cyber threat often gets ignored as a younger age group veil their maltreatment from anybody, which helps cannot prevent and just worsens bullying. Among 10% and 30% of teenagers being exposed to cyberbullying internationally. Young people gradually modify conduct and performance as a result of that they withdraw in addition to calm down, other than this might not depart unobserved because the transformation is restrained. Cyberbullying will eventually turn out to be a crucial crisis in the upcoming years due to an increase in the use of the Internet and mobile phone use among young people [17].

Juvenile citizens appear mainly susceptible to the side effects of cyberbullying from side to side unspecified societal medium, as teenagers are paying attention to the sites as a way of looking for verification from their peers. Unless preventive measures are taken against cyberbullying, teenagers in addition to teens will experience significant changes in their diet and sleep patterns and may become more lonely and depressed if they lose concern in their normal activities. These changes affect their growth and development as they age [74].

Kids and adolescents are 76 percent possible to exhibit suicidal thoughts, additionally also at risk for former issues, like; psychological vigor, dwelling mind, and, relations among erstwhile. When victims have no support from anyone in their lives, the danger of suicide rises from 37 percent to 47 percent and exacerbates the cyber threat situation [9].

Violence over sites, like Ask@fm, Yiik Yaak, and Sarah, may be mainly felt in youth, most important are the problems leading to low self-confidence [14]. Around a large number of suicides connected with bullying over the online platforms in the U.S [5] and Britain [19].

IV. Law Enforcement Around the World

Most of the countries have rules that incorporate electronic kinds of communiqué into hacking and aggravation law. Many a law regulating agency has the cyber-cell unit, and the pursuit of the Internet is considered more serious than reports of physical predators. You can search for help or resources by state or region [43, 45, 47, 53, 81].

A. At educational centers

The protections of online seclusion matters in schools are rapidly attracting the spotlight of state legislative activity. Between 2006 and 2010 there was a raise in the law that enacted cyberbullying [25]. Fundamentals and set of courses required are in the U.K (Ofsted eSafety Guidance) and Australia (Overall Learning Outcome 13).

In 2012, a bunch of teenagers at the design class made an app to help fight against bullying, the "Back of the Bully" (B.O.B). When someone testifies; becomes the prey of bullying, he/she can instantly send a report about the mishappening. Application questions regarding the site, timing, in what manner bullying has happened and, provides helpful action and empowerment concerning the incident. Reported info directly sent to a database, from where officers can analyze. General texts are found, so someone else can interfere and help break the bully's chain (CD teens create bullying applications, keeping active colleagues) [16]. "Back of the bully" measured as benchmark functioning method in school crosswise Connecticut, at the same time as fresh research amongst 66 mid-school educators has

highlighted that impediment programs have been unsuccessful to date [61].

Not only the students but the educator can moreover be cyberbullied by students, [73] and close relatives and other school workers. There is a requirement for suitable law practices for everyone [45].

B. Protection providing laws

The law which tackles only online nuisance of kids, laws focusing on adolescent abusers, and laws protecting mature cyber aggravation sufferers, victim any epoch. At present, there are 45 cyber irritation (and linked) rules in the manuscript. Several sites focus on the law that defends people 19 years older.

Functioning towards stopping online mistreatment is an auxiliary reserve that contains a catalog of the present in addition to awaiting cyber nuisance connected to United States federal and communal law. It furthermore lists that state that does not yet contain laws and linked laws as of other countries [36]. Global Cyber Law Database (GCLT) aims to turn out to be the most inclusive, reliable cause of internet law of all countries [29].

States, like Florida, California and, Missouri encompassed many communal rules and regulations in regards to cyberbullying. This is a secure place to study in California, there is a law that says, "One can be scared of their lives because they use an electronic device," which could result in a misdemeanor, which carries a sentence of up to one year. In Florida, “Jeffrey Johnson Stands Up to All Students” prohibits any bullying and addresses cyberbullying. In Missouri, anyone who aggressively threatens somebody at communal media can be the convict of a Class B misdemeanor, other than if the sufferer is seventeen years old or older, they may be a prisoner of a Class D felony [47].

C. Laws to prevent cyber-stalking in case of adults

Cyberstalking can be an additional room for corporeal backlash and might have an illegal penalty. The goal of perceptive why cyber stalking is happening can help resolve and secure action. Factors that motivate followers include jealousy, pathological aggression, redundancy and stoppage in one's labor and living, and craving to frighten, make others sense substandard. A follower might believe the illusion; they “know” the goal. A person may be afraid to validate their position and consider they could escape from the deeds [86].

United States central cyberstalking rules and regulations are intended to punish peers for using electronic means to repetitively pursue and to intimidate somebody online [62]. There is readily available evidence devoted to serving mature sufferers to handle cyberbullies lawfully and efficiently. Recommended footstep is to prove the whole thing and make contact with the police force [49].

V. Government Framework for Cyber Security in India

Cyberbullying in India has raised its ugly head in more than one way and it is only reaching worse heights with each passing day. Though, it is appalling that there are no special Anti-Cyber Bullying Laws in India yet. Following are some of the cyber laws though that cover some of the acts classified as cyberbullying in India [49].

At present, the Information Technology Act, 2000 is the primary law for dealing with cybercrime and digital commerce in the country. The Act was first formulated in 2000, and then was revised in 2008 and came into force a year late. The Information Technology (Amendment) Bill, 2008 amended several sections that were related to digital data, electronic devices and cybercrimes.

- In the Information Technology Amendment Act, 2008, cybersecurity is exercised under the following sections:
  - Sec. 43 (data protection),
  - Sec. 66 (hacking),
  - Sec. 66A (measures against sending offensive messages),
  - Sec. 66B (punishment for illegally possessing stolen computer resources or communication devices),
  - Sec. 66C (identity theft)
  - Sec. 66D (cheating by personation by using the computer resource)
  - Sec. 66E (violation of privacy)
  - Sec. 67 (protection against unauthorized access to data),
  - Sec. 67B (punishment for publishing or transmitting of material depicting children in any sexually explicit act, etc. in electronic form)
  - Sec. 69 (cyberterrorism),
  - Sec. 70 (securing access or attempting to secure access to a protected system)
  - Sec. 72 (privacy and confidentiality)

University Grant Commission (UGC) regulations on shortening the threat of ragging in higher education institutions 2009 were passed by the government of India as a special regulation to control bullying at higher education institutions which enforced that even students may have accountability under different sections under Indian Penal Code. Indian Penal Code provides a solution in opposition to an offensive act or an act offending the modesty of the women. The amendment of the Act in 2013 introduced other offenses and also made cyberstalking an offense.

- In the Indian Penal Code (IPC), cyber bullying is exercised under following sections:

- Sec. 292A (printing, selling, advertising matter intended for blackmail)
- Sec. 354A (guilty of the offence of sexual harassment)
- Sec. 354C (taking pictures of someone without the persons consent and publishing same)
- Sec. 354D (stalking and contacting, or attempting to contact a woman)
- Sec. 499 (sending defamatory messages through email)
- Sec. 500 (email abuse)
- Sec. 503 (sending threatening messages through email)
- Sec. 507 (criminal intimidation by an anonymous communication)
- Sec. 509 (word, gesture or act intended to insult the modesty of a women)

Government permitted a structure for improving protection in cyberspace for cyber security in the Indian cyberspace, with the National Security Council Secretariat (NSCS) as nodal energy. National Technical Research Organisation (NTRO) has been elected as the nodal agency for intriguing all methods for the protection of national critical infrastructure and to grip cyber security happening in critical sectors.

Further, Indian Computer Emergency Response Team (CERT-In) is elected as the national organization for incident retort together with analysis, forecast in addition to alerts on cyber security contravene. It is under MeitY, Government of India. The Cyber and Information Security (C&IS) Division under the Ministry of Home Affairs, deal with matters describing cyber security, cybercrime, National Information Security Policy & Guidelines (NISPG) and execution of NISPG, NATGRID etc. It is implementing the 'Cyber Crime Prevention against Women & Children' scheme with the aim of managing concerns of cyber bullying against women and children.

VI. Dealing with Cyberbullying – Some Strategies

Numerous ways of managing the adverse effect of cyberbullying experience have been acknowledged in many pieces of literature. Studies point out with the aim of technological managing practices are generally utilized by cyberbullying victims to avoid future peace. Cases of technology handling schemes involve the establishment of firm confidentiality systems in web-based platforms like messengers and e-mails, plus, altering user names as well as e-mail addresses [39]. Using firm confidential set else altering on-line characteristics be seem interesting to them, who are cyberbullied, effective to note that on the whole efficiency of the schemes in discomforting upcoming damaging conducts remnants anonymous [61].

Technical managing policies, though, being utilized by significant efficiency besides other online offenses like online abusive relative interruption; another kind of cyber-stalking[19]. Inactive schemes are seldom engaged over managing issues with cyberbullying. On the subject of it, only 24 percent of the sufferers reviewed stated that they do not anything as a reply to moral victimization [29]. The proportion that Patchinn and Hindujaa (2017) reported might be inflated as it only comprises lone episodal cases; still, these additions are in opposition to the hypothetical meaning it provides.

If events are Limited to individual events, ignoring encounters with cyber threats is a viable option. Significant differences in the exploit of coping strategies may appear as the incidence and threat of harm increase. Former researchers pointing out to the sufferers are looking for lively plans to stop upcoming cyber threats stumble upon. Approximately 14-34 percent of young people face cyberbullies [58].

Notifying cyberbullies in the direction of ending violent as well as injurious conducts be frequently accompanied by threats that tell the grown-up if conduct persists. Though intimidations telling an adult are reported in the direction of performer, inside fact, kids seldom report merely to father-mother also grown regarding the victim. The majority of researches account that fatalities of cyberbullying informed the father-mother are 1-9 percent in the recorder time [23, 63].

The sufferers hardly ever account for incidents relative to cyberbullying to grown-ups due to many causes. Numerous kids consider the knowledge of efficient managing the issues, emanating exploit of communiqué expertise be very essential. Going towards father-mother assist be considered as conduct only found in children [50].

Furthermore, victims believe that their independence might get questioned if they share it with their family members. Kids, as well as youth, are reluctant to inform their elders in fear of losing technical facilities. Personal management of victims is measured as minute price in comparison to remunerations of being online [13]. Hereby not telling family about it, cyberbullying sufferers discuss with associates to obtain hold and suggestion [39][47][4], thinking that communal hold up given via associates might assist in decreasing a bit of anxiety [8, 36, 42, 90].

VII. Conclusion

Cyberbullying states consists of violent conduct that will be directed through electronic media. Comparatively this recent kind of bullying is gaining interest among researchers and is a growing topic in literature. Several facets of cyberbullying remain relatively unknown, like, magnitude present in the differences between cyberbullying motivations and goals, a long-standing shock given by cyberbullying, and, cyberbullying versus in-person bullying. Consecutively, it is not easy to build up intercession to tackle the particular ill-manner among undergraduates as

most kids are scared to share the incidents openly and stay mute in swear cases.

Cyberbullying is one of the offenses which can take an ugly shape in the future and needs to be addressed soon. In making the cyberbullying law, lawmakers should take the opinion of the psychiatrist since such an offense affects the psyche of a child very much. The law should be made considering the psychology of the people involved and the legal expertise of law enforcement. If the law is not made, many cyberbullies will be left open and victims will have to suffer the consequences and defeating the concept of justice.

To date, however, little is known about the hypothetical framework regarding cyberbullying, and, as if the use of an online medium in getting involved with aggressive harassment is equivalent to involvement as in-person communications. Provided that a major scale cyber threat be message based it might not be clear about the process of this information being used as a threat and how it is different from the normal information processing which is happening on the internet during concurrent communal communications. Rising accessibility, ease-of-use of with dependence over electric gadgets, problems summarized above might turn out to be a most concerning issue along with deserving greater understanding. Cyberbullying chapters need more in-depth research on power, motivation, and recurring issues.

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Mining Data Relevant to Bollywood using Hadoop based Hortonworks Sandbox

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Abstract – The research paper focuses on mining the data related to movies released in Indian cinema. The movies covered in the research work are Bollywood movies along with regional movies like Tamil, Telugu, Punjabi, etc. The aim of the research work conducted in the research paper is to provide one common platform to the movie watchers to analyze the different aspects of the movies like the star cast and director of the movie, the public reviews, and reactions to the movies, the critic's ratings, the time duration of the movie, etc. The research work would prove helpful for the people who are crazy about watching cinema and have a deep interest in analyzing the different aspects of the movies like the impact made by movies on society, the message conveyed by the movies, and the impact of movies on different age groups people.

Keywords – *Big Data, data mining, Hadoop, Hortonworks, Indian Cinema, movies.*

I. INTRODUCTION

In this jet-set age, the amount of data has been increasing with time at an unbridled pace. This happened because of the growth of sophisticated technology. Big data is a thriving technology that deals with different kinds of data. The term data not only include text and numbers, but it also consists of pictures, audio, and video. In other words, it can be said that big data handles the massive amount of data involving complex relationships and garnered from multiple heterogeneous platforms [1, 2]. The growth rate of data is increasing and would remain increasing in the upcoming years. The term big data came into emergence when conventional data processing systems become less adequate and inefficient to extract and analyze the data due to exponential growth in the amount of data. The colossal amount of data hinders traditional technologies to work properly [3, 4]. The data is divided into three major categories mentioned below.

- Structured Data - The data which is easily segregated and scrutinized into different categories is called structured data. It is mainly in a row and column layout fitted into a standard relational schema. The primary source of this data is network sensors, GPS, etc. Sale statistics and transactional data also come under the category of structured data. Due to its simple format and consistency, it provides a high-speed mode to respond to user-submitted queries to access information that is pertinent for the organization [5, 6, 7].
- Semi-Structured Data is structured data but with one constraint that it does not meet the requirements of a fixed-format schema. It has self-described nature along with tags and markers to implement a hierarchy of records of data. Examples of semi-structured data cover the following: weblogs and social media feeds [8, 9].
- Unstructured Data - The data which is not easily divided into rows and column occupies the name unstructured data. It is not easily accessible and analyzed [10]. This data has a complex nature along with complicated relationships. Examples of unstructured data are pictures and audio, videos, etc [11, 12].

Data mining technique helps companies to get knowledge-based information.

- Data mining helps organizations to make cost-effective modifications in operation and production.
- It is an economical and well-organized solution compared to other statistical data applications.
- Data mining helps with the decision-making process.
- Enables automated prediction of drifts and performances as well as the automated discovery of hidden patterns.
- It can be applied in new systems as well as prevailing platforms
- It is an immediate process that makes it easy for the users to examine a huge amount of data in less time.

II. RESEARCH METHODOLOGY

The primary concern of the research work conducted in the research paper is to provide a common platform to the cinema-loving people to extract information relevant to Indian cinema (Bollywood and Regional cinemas) concerning actors, actresses, directors, music directors, and so on. Currently, there is no such available source that provides elaborated details relevant to movies under one roof. The research work is an attempt to provide one such common platform for the public interested in movies irrespective of their geographical location and language. The research work would help out those people who rarely get time to watch movies and are confused about which movie to watch whenever they get time. The research work would guide such people to decide for the best option as per

their interests after analyzing the ratings, likes, and dislikes enjoyed by movies and make the best utilization of their precious time. This section elaborates on the adopted research procedure via the flow chart shown in Fig. 1.

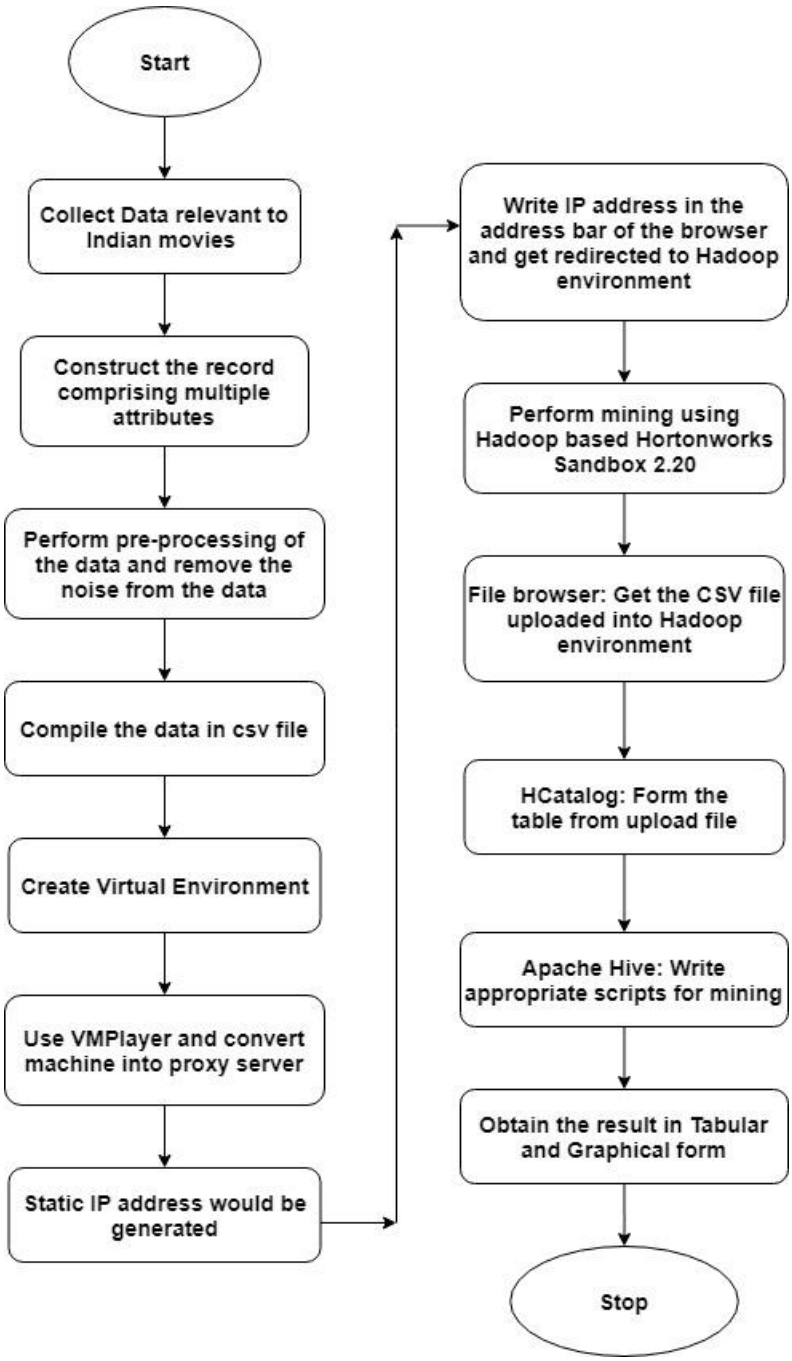


Fig. 1. Flowchart illustrating the adopted workflow of the research

III. CONTRIBUTION AND IMPLEMENTATION

The database has been constructed comprising attributes detailing different Bollywood movies and regional movies. The database comprises 15 attributes mentioned as under.

Movie_Name – Denotes name of the movie
Year_of_Release – Refers to a year of release
Language – Refers to the language of the movie
Director – Name of the director of the movie

No_of_Males – Denotes the number of the male star cast in the movie
No_of_Females - Denotes the number of the female star cast in the movie
No_of_Awards – Number of awards won by a movie
Name_of_Awards – Name of the awards won by the movie
M1 – Refers to Male star cast one
M2 - Refers to Male star cast two
M3 - Refers to Male star cast three
M4 - Refers to Male star cast four
F1 - Refers to Female star cast one
F2 - Refers to Female star cast two
F3 - Refers to Female star cast three
F4 - Refers to Female star cast four
Critic_Ratings – Refers to ratings given by critics out of 5
No_of_Likes – Denotes the number of likes received by movies
No_of_Dislikes - Denotes the number of dislikes received by movies
Views - Denotes the number of views received by movies
Comments - Denotes the number of comments received by movies
No_of_Songs - Denotes the number of songs in the movie
Duration_of_Movie_in_Minutes - Denotes total length of the movie in minutes

Query 1

The below-mentioned query is intended to create three tables titled "*bachchan*", "*akshay*", and "*devgn*" from the main table titled "*movies2*". All three tables comprise the attributes *movie_name, year_of_release, genre, director, critic_ratings, no_of_likes, and no_of_dislikes*. Only those records from table "*movies2*" will be extracted to table "*bachchan*" where "*Amitabh Bachchan*" acted in any four of the attributes referring to the male star cast (*m1, m2, m3,* and *m4*). Only those records from table "*movies2*" will be extracted to table "*akshay*" where "*Akshay Kumar*" acted in any four of the attributes referring to the male star cast (*m1, m2, m3,* and *m4*). Only those records from table "*movies2*" will be extracted to table "*devgn*" where "*Ajay Devgn*" acted in any four of the attributes referring to the male star cast (*m1, m2, m3,* and *m4*).

```
drop table if exists bachchan;
create table bachchan as select
movie_name,
year_of_release,
genre,
director,
critic_ratings,
no_of_likes,
no_of_dislikes
from movies2
where
m1='Amitabh Bachchan'
or m2='Amitabh Bachchan'
or m3='Amitabh Bachchan'
or m4='Amitabh Bachchan';
drop table if exists akshay;
create table akshay as select
movie_name,
year_of_release,
genre,
director,
critic_ratings,
no_of_likes,
no_of_dislikes
from movies2
where
m1='Akshay Kumar'
or m2='Akshay Kumar'
or m3='Akshay Kumar'
or m4='Akshay Kumar';
drop table if exists devgn;
create table devgn as select
movie_name,
year_of_release,
genre,
director,
critic_ratings,
no_of_likes,
no_of_dislikes
from movies2
where
m1='Ajay Devgn'
or m2='Ajay Devgn'
or m3='Ajay Devgn'
or m4='Ajay Devgn';
```

Fig. 2 shows the three newly constructed tables *"bachchan", "akashay",* and *"devgn"* in the table list of HCatalog.

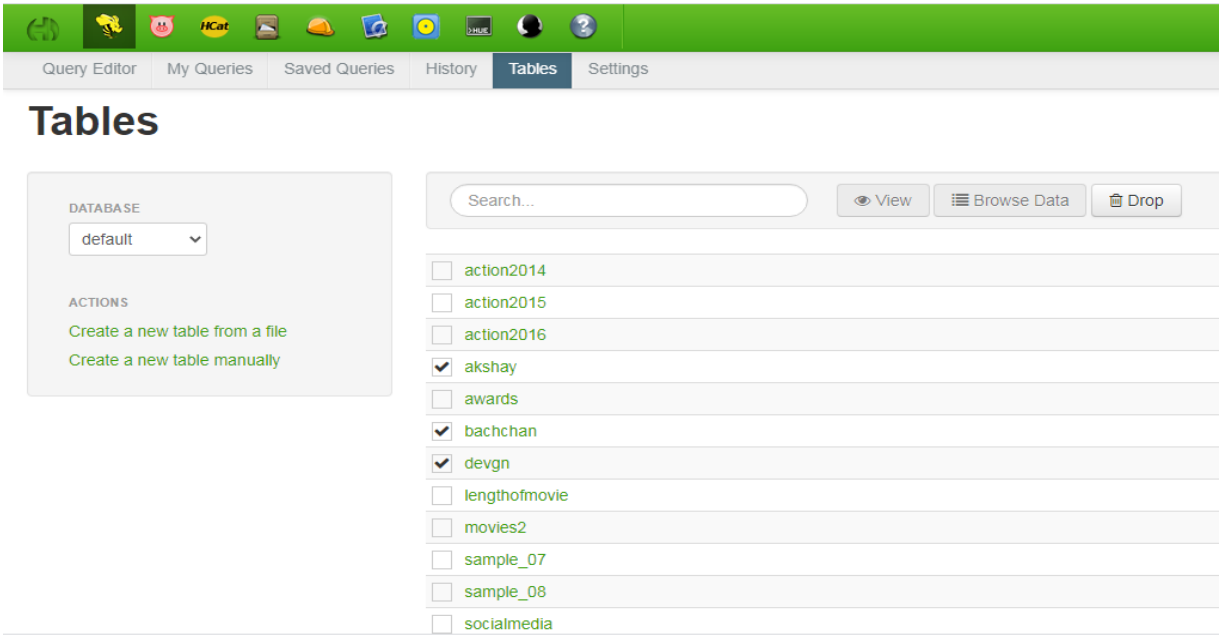


Fig. 2 Figure shows the three newly constricted tables *"bachchan", "akashay",* and *"devgn"* in the table list of HCatalog

Fig. 3 shows the records fetched in the table "*bachchan*" from the primary table "*movies2*" as per Query 1.

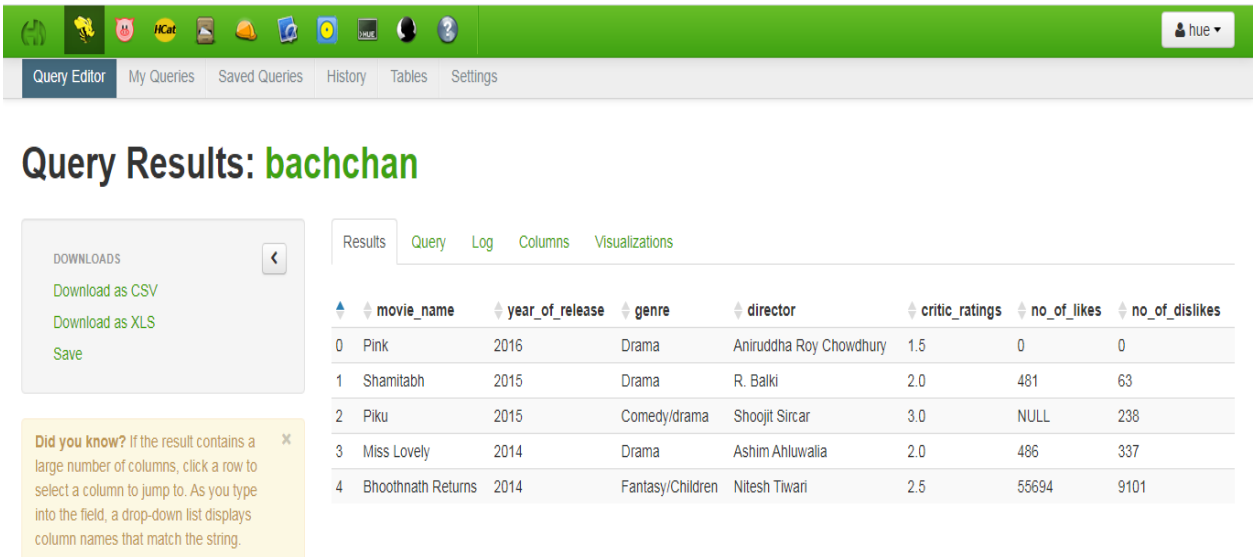


Fig. 3 Figure shows the records fetched in the table "*bachchan*" from the primary table "*movies2*" as per Query 1

Table I shows the records fetched in table "*bachchan*".

Table I Table illustrates the records included in the table "*bachchan*" as per Query 1

movie_name	year_of_release	genre	director	critic_ratings	no_of_likes	no_of_dislikes
Pink	2016	Drama	Aniruddha Roy Chowdhury	1.5	0	0
Shamitabh	2015	Drama	R. Balki	2	481	63
Piku	2015	Comedy/drama	Shoojit Sircar	3	NULL	238

Miss Lovely	2014	Drama	Ashim Ahluwalia	2	486	337
Bhoothnath Returns	2014	Fantasy/Children	Nitesh Tiwari	2.5	55694	9101

Fig. 4 shows the graphical representation of the records included in table "*bachchan*". Red-colored bars in the figure denote the *year_of_release* (the year of release of the movie) and green-colored bars denote *no_of_dislikes* (dislkes received by the movie) against Y-axis and X-axis denotes the *movie_name* (the name of the movie).

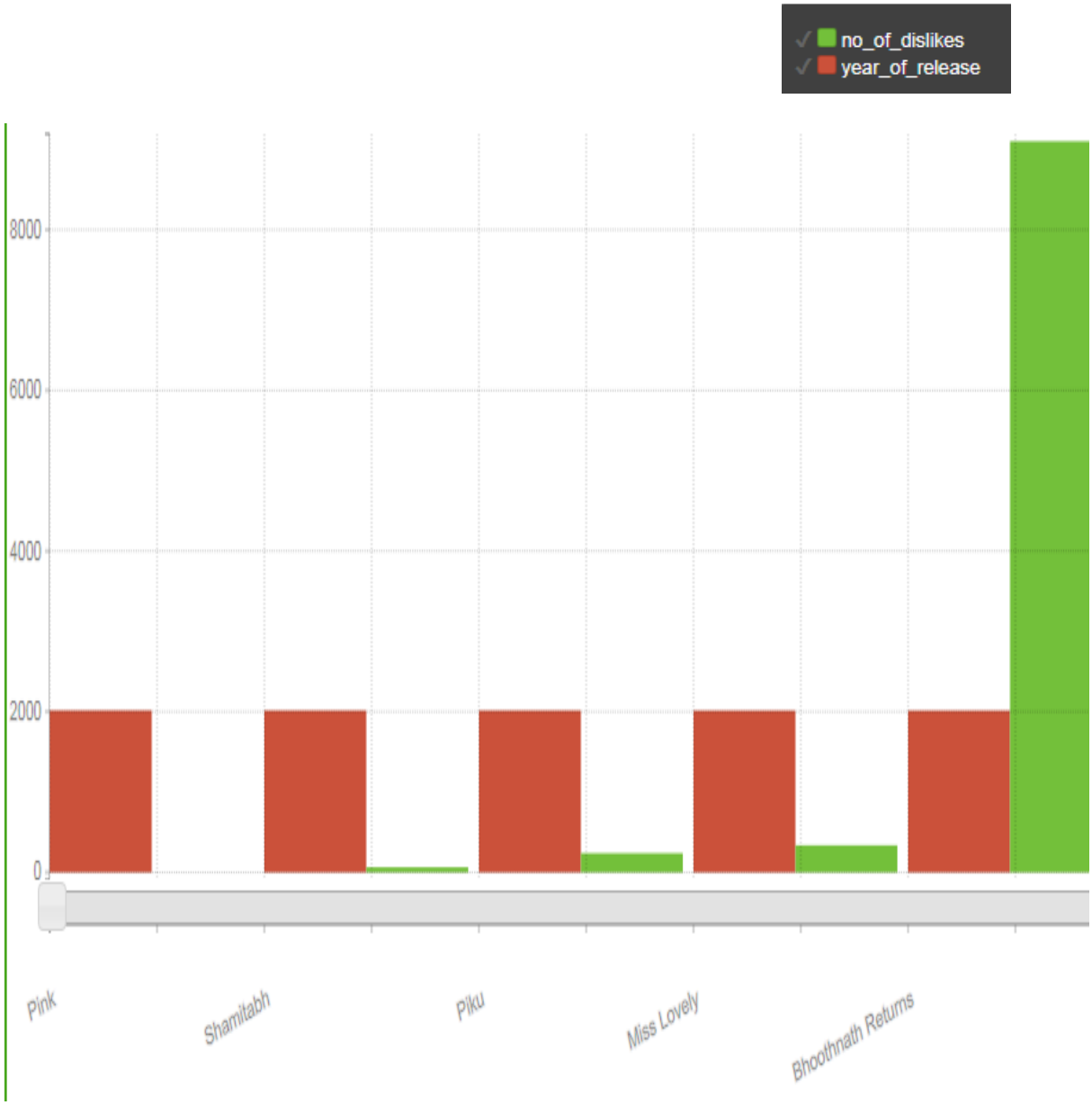


Fig. 4 Figure shows the red colored bars denoting the year_of_release (the year of release of the movie) and green colored bars denoting no_of_dislikes (dislkes received by the movie) against Y-axis and X-axis denotes the movie_name (the name of the movie)

Fig. 5 shows the graphical representation of the records included in table "*bachchan*". Red-colored dots in the figure denotes the *critic_ratings* (ratings received by a movie given by movie critics) against Y-axis and X-axis denotes the *movie_name* (the name of the movie).

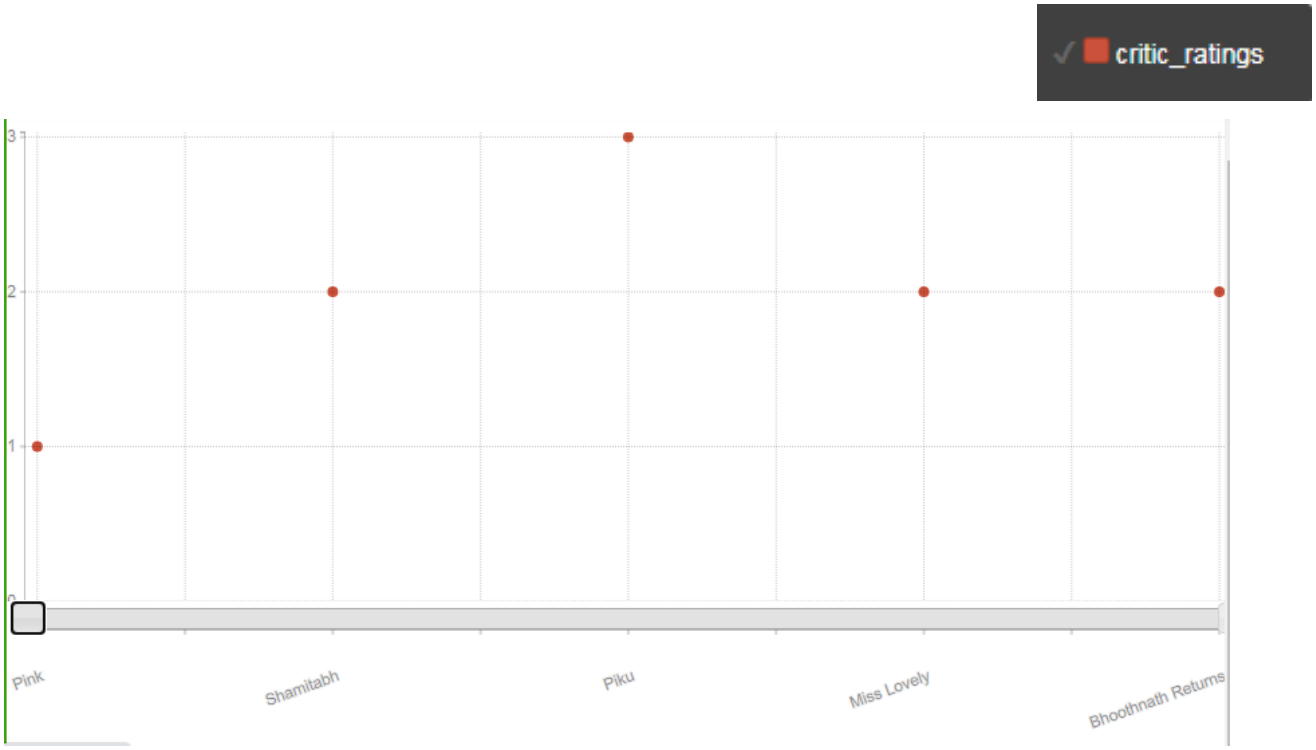
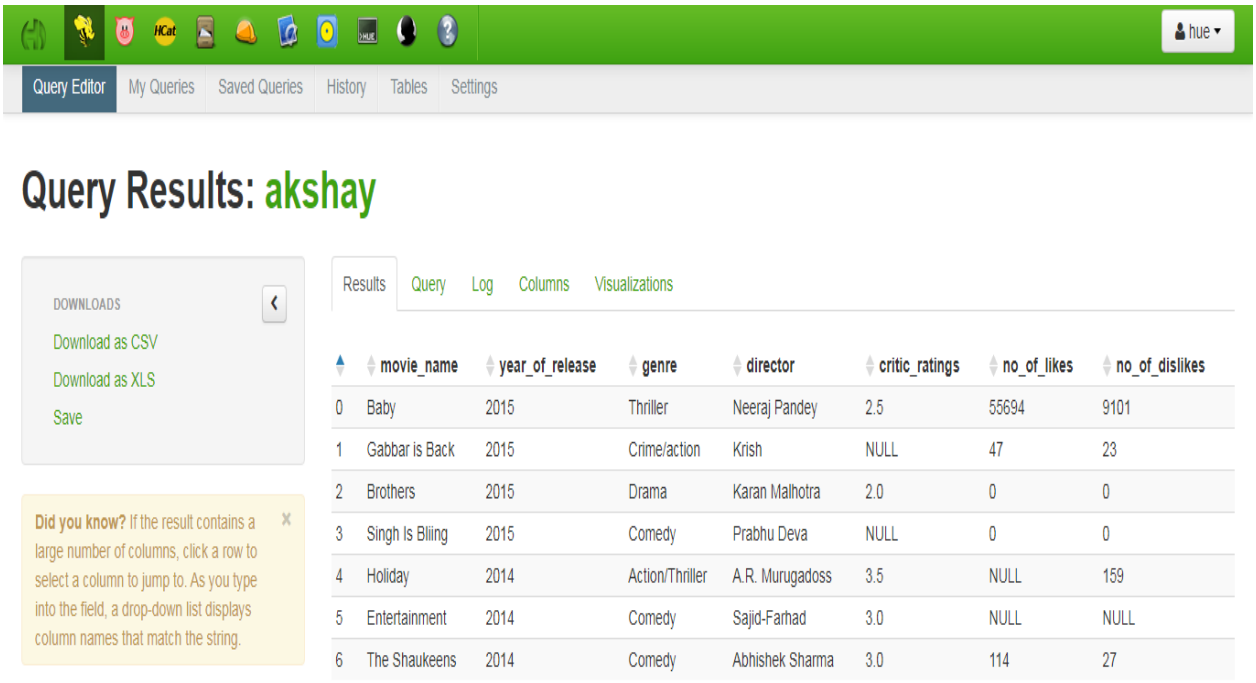


Fig. 5 Figure shows the red colored dots denoting the *critic_ratings* (ratings received by movie given by movie critics) against Y-axis and X-axis denotes the *movie_name* (the name of the movie)

Fig. 6 shows the records fetched in the table *"akshay"* from the primary table *"movies2"* as per Query 1.



	movie_name	year_of_release	genre	director	critic_ratings	no_of_likes	no_of_dislikes
0	Baby	2015	Thriller	Neeraj Pandey	2.5	55694	9101
1	Gabbar is Back	2015	Crime/action	Krish	NULL	47	23
2	Brothers	2015	Drama	Karan Malhotra	2.0	0	0
3	Singh Is Bliing	2015	Comedy	Prabhu Deva	NULL	0	0
4	Holiday	2014	Action/Thriller	A.R. Murugadoss	3.5	NULL	159
5	Entertainment	2014	Comedy	Sajid-Farhad	3.0	NULL	NULL
6	The Shaukeens	2014	Comedy	Abhishek Sharma	3.0	114	27

Fig. 6 Figure shows the records fetched in the table *"akshay"* from the primary table *"movies2"* as per Query 1

Table II shows the records fetched in table "*akshay*".

Table II. Table illustrates the records included in the table "*akshay*" as per Query 7

movie_name	year_of_release	genre	director	critic_ratings	no_of_likes	no_of_dislikes
Baby	2015	Thriller	Neeraj Pandey	2.5	55694	9101
Gabbar is Back	2015	Crime/action	Krish	NULL	47	23
Brothers	2015	Drama	Karan Malhotra	2	0	0
Singh Is Bliing	2015	Comedy	Prabhu Deva	NULL	0	0
Holiday	2014	Action/Thriller	A.R. Murugadoss	3.5	NULL	159
Entertainment	2014	Comedy	Sajid-Farhad	3	NULL	NULL
The Shaukeens	2014	Comedy	Abhishek Sharma	3	114	27

Fig. 7 shows the graphical representation of the records included in table "*akshay*". Red-colored bars in the figure denotes the *year_of_release* (the year of release of the movie), green-colored bars denote *no_of_likes* (likes received by the movie), and light blue color represents the *no_of_dislikes* (number of dislikes received by the movie) against the Y-axis and X-axis denotes the *movie_name* (the name of the movie).

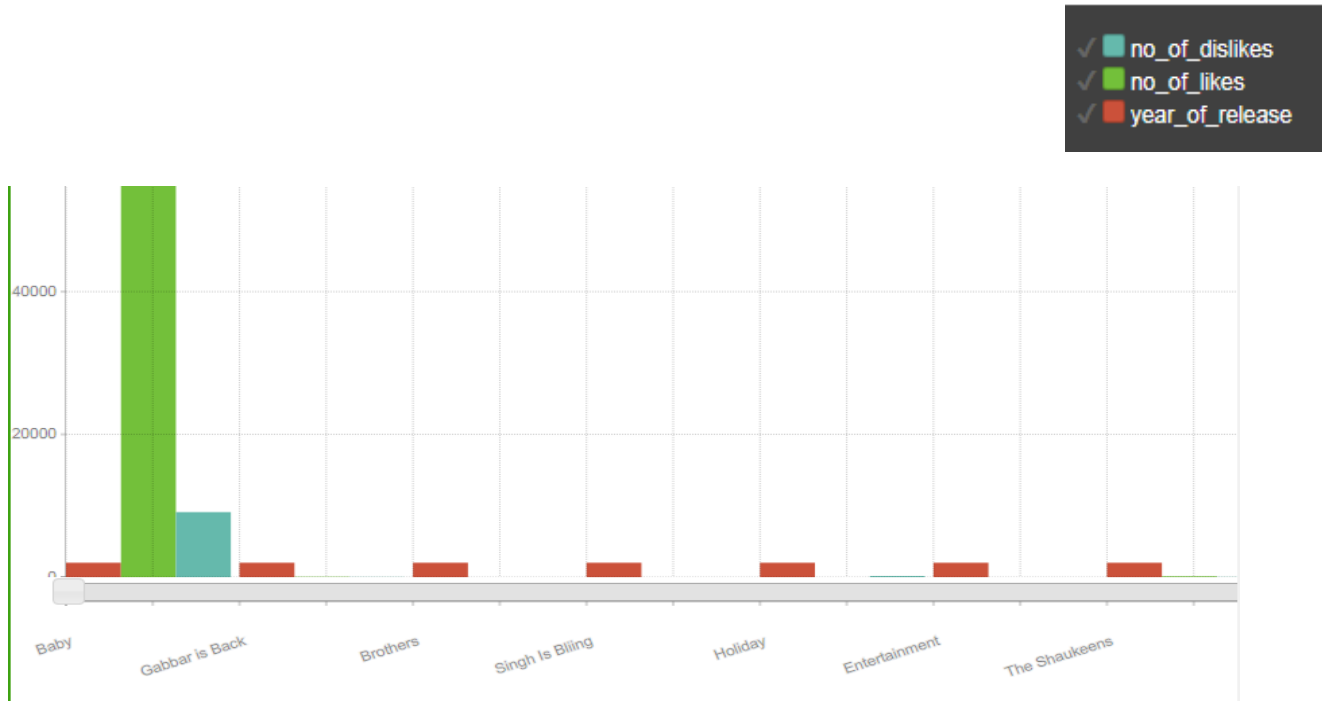


Fig. 7 Figure shows the red colored bars denoting the *year_of_release* (the year of release of the movie), green-colored bars denoting *no_of_likes* (likes received by the movie), and light blue color representing the *no_of_dislikes* (number of dislikes received by the movie) against Y-axis and X-axis denotes the *movie_name* (the name of the movie)

Fig. 8 shows the graphical representation of the records included in table "*akshay*".The pie chart on the left denotes the *no_of_likes* and the one on the right denotes the *no_of_dislikes*. The pie charts show different colors representing different movies.

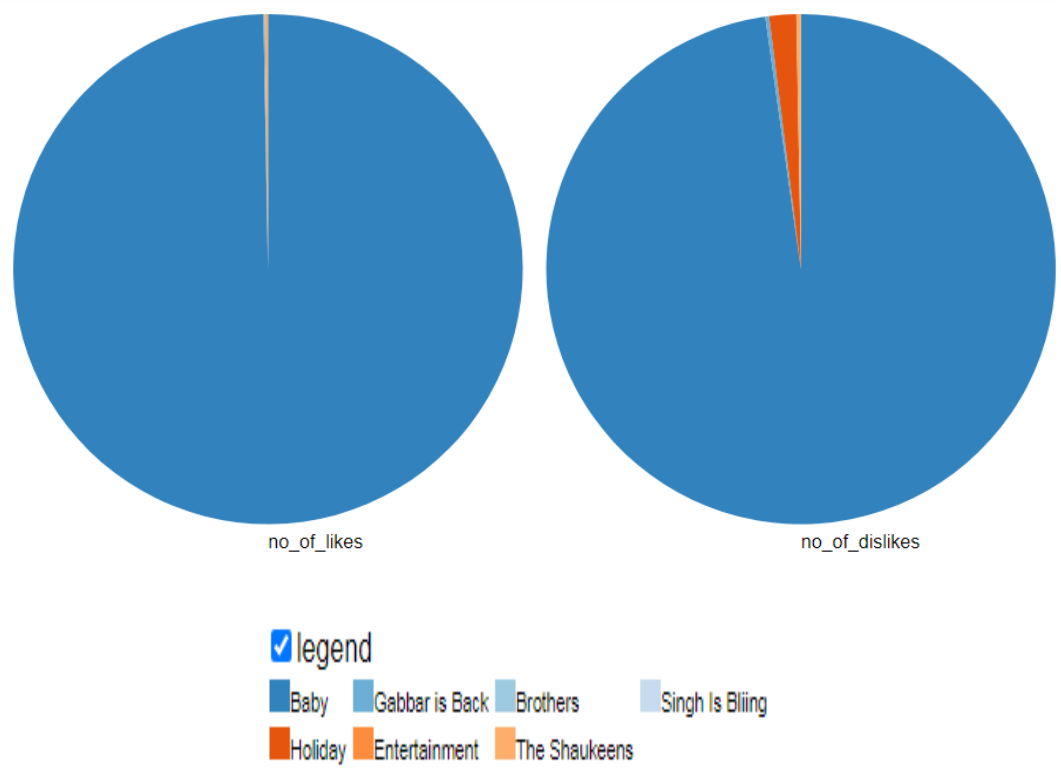


Fig. 8 Figure shows the graphical representation of the records included in table "*akshay*".The pie chart on the left denotes the *no_of_likes* and the one on the right denotes the *no_of_dislikes*. The pie charts show different colors representing different movies

Fig. 9 shows the records fetched in the table "*devgn*" from the primary table "*movies2*" as per Query 1.

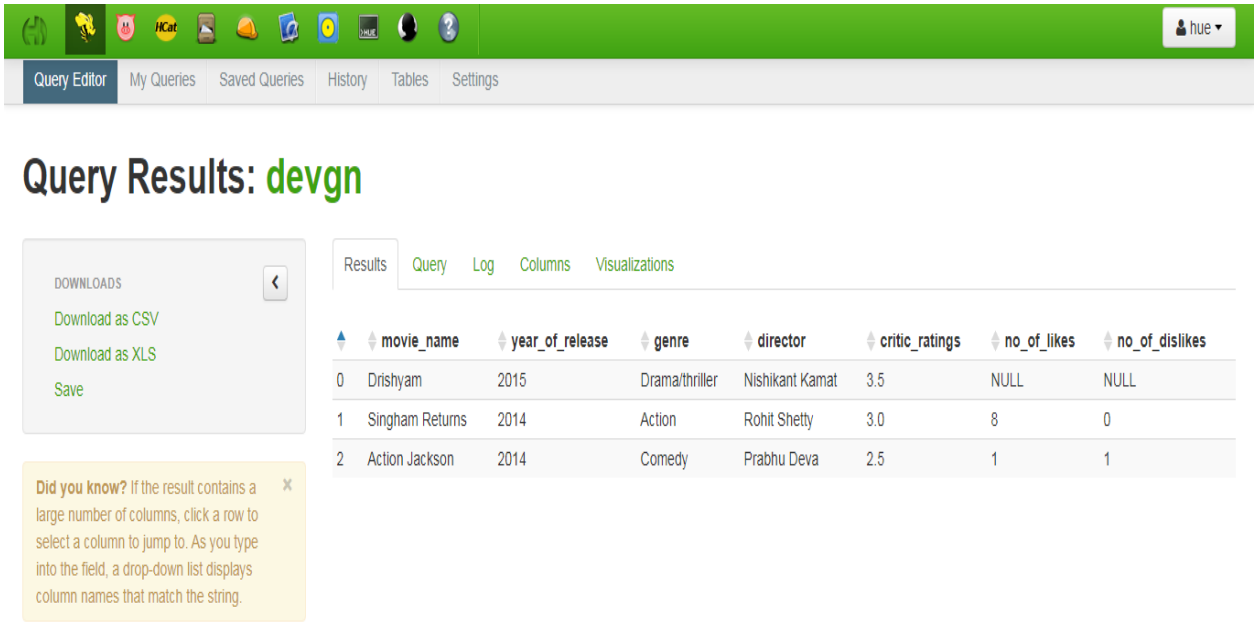


Fig. 9 Figure shows the records fetched in the table "*devgn*" from the primary table "*movies2*" as per Query 1

Table III show the records fetched in table "*devgn*".

Table III. Table illustrates the records included in the table "devgn" as per Query 7

movie_name	year_of_release	genre	director	critic_ratings	no_of_likes	no_of_dislikes
Drishyam	2015	Drama/thriller	Nishikant Kamat	3.5	NULL	NULL
Singham Returns	2014	Action	Rohit Shetty	3	8	0
Action Jackson	2014	Comedy	Prabhu Deva	2.5	1	1

Fig. 10 shows the graphical representation of the records included in table "*devgn*".The pie chart denotes the *critic_ratings* received by different movies of "*Ajay Devgn*". The pie charts show different colors representing different movies.

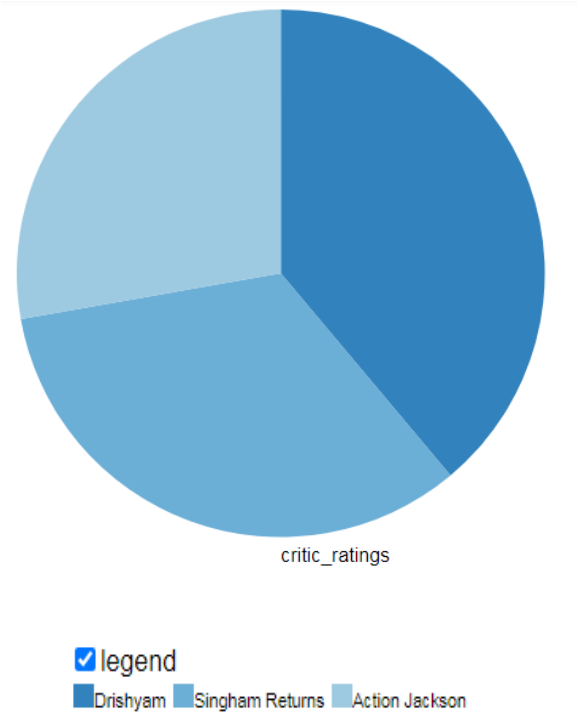


Fig. 10 Figure shows the pie chart denoting the *critic_ratings* received by different movies of "*Ajay Devgn*". The pie charts show different colors representing different movies

IV. CONCLUSION AND FUTURE SCOPE

Today the box-office collection of a movie is synonymous with its success. This trend strongly began recently with movies earning over 200 crores in profit. And thus began the trend of the 200-Crore-Club, 300-Crore-Club, and so on. With the increasing focus on digitization and data-driven marketing, there has been a revolution in the media industry on how it uses data and analytics. The future of the industry is dependent on the amalgamation of both digital and analytical solutions. Enterprises are eager more than ever before to transform media platforms to provide more personalized content for their audiences. There is no doubt about the amount of data that media and entertainment companies gather on an everyday basis and there is a huge scope of use the data to understand the demand of the genre of shows, music, content for a given age group on different given channels.

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Reconnoitering and Accomplishing Sentiment Analysis in Cricket

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***Abstract* –** The popularity and dependence on social media in the past decade have led to the exponential growth of data. Every sector today generates and needs the data. Data is new money. The research paper elaborates on the role played by sentiment analysis in sports science. An enormous amount of data is been generated each day, on-field and off-field. This data is highly valuable for the team management and the coaches for the selection of the best players to form the best team. The research work conducted in the paper focuses on mining sentiments related to cricket. The paper illustrates and details the proposed technology via flowchart, algorithm, and appropriate examples related to sentiment analysis. Twitter API has been used to collect the tweets related to the latest events from cricket and has been analyzed and implemented using Java programming to reach a definite conclusion that whether the majority of the sentiments were positive or negative.

***Keywords* –** Big Data, cricket, negative sentiments, positive sentiments, sentiment analysis, tweets.

I. INTRODUCTION

The data have undergone many changes the way it was a decade ago. The shape and size of data have witnessed a huge change. Today the data has turned out to be the power of different organizations to harvest their overall earnings. The need for the hour is to make optimize the use of the data to increase customer satisfaction and the organization's revenues. Such data having multiple forms, huge size, and generating at a high speed is referred to as Big Data. Big Data multiplies each day exponentially. Several web portals are created each day. Millions of photos, audio, and video content are uploaded on social media and popular websites like YouTube [1, 2]. The data should accomplish the purpose of description and prediction. A description is confined to analyzing and mining if data for extracting the latest information as per requirement and prediction, on the other hand, is responsible for providing solutions to the upcoming problems based on previously generated records and reports [3, 4].

The other prominent names for sentiment analysis are subjectivity analysis, opinion extraction, or opinion mining [5, 6]. The sentiments find their applications in several areas like writing reviews for the newly released movies, for newly launched mobile phone by the company, for any new policy launched by the government, for food items served in a restaurant, for any appliances or clothes bought online, etc. The primary purpose of conducting the public sentiment is to have an insight into the opinion public carries in relevance with any particular event, product, service, etc. The sentiments can be classified into different categories like Emotions (happy, sad, angry, sorrow, etc), Mood (gloomy, depressed, cheerful, etc.), Attitudes (liking, loving, hating, etc), Interpersonal stances (supportive, friendly, hatred, etc.) and Personal traits (jealously, anxiety, nervousness, etc.) [7, 8]. Sentiment analysis can be referred to as attitude towards a person or an object which is permanent [9, 10]. In the case of an attitude of a person, sentiment analysis is measured as polarity which can be either on a positive or negative side or maybe neutral [11, 12]. In the case of documents, the sentiment analysis can be conducted on the document as a whole or any specific paragraph or sentence [13, 14].

The generalized steps to be followed in sentiment analysis are depicted in the flowchart shown in Fig. 1.

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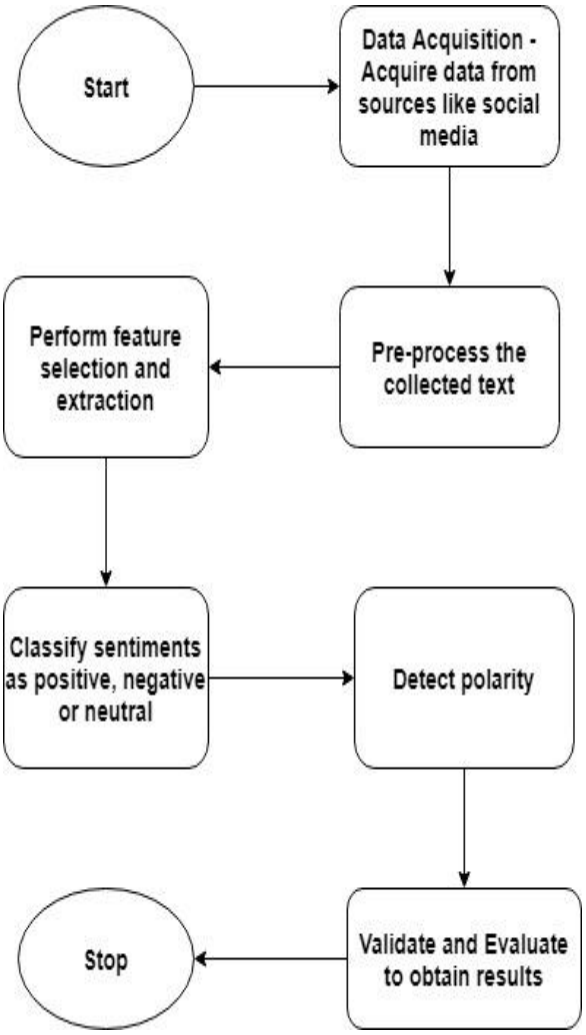

Fig. 1. Generalized flowchart for performing sentiment analysis

II. PROPOSED FLOWCHART AND ALGORITHM FOR SENTIMENT ANALYSIS

The proposed algorithm for performing sentiment analysis is mentioned below.

- Initiate with accumulating texts, tweets, posts, and comments from different social media platforms.
- Remove noise like grammatical errors from the unstructured data.
- Identify the sentiments.
- Construct separate dictionaries with positive words and negative words.
- Feature selection takes place and starts performing scaling of attributes.
- Select the appropriate classification method and perform the training of the model.
- Evaluate the model and conduct testing on it.
- Finally, Obtain and analyze the results.

The flowchart of the proposed algorithm is shown in Fig. 2.

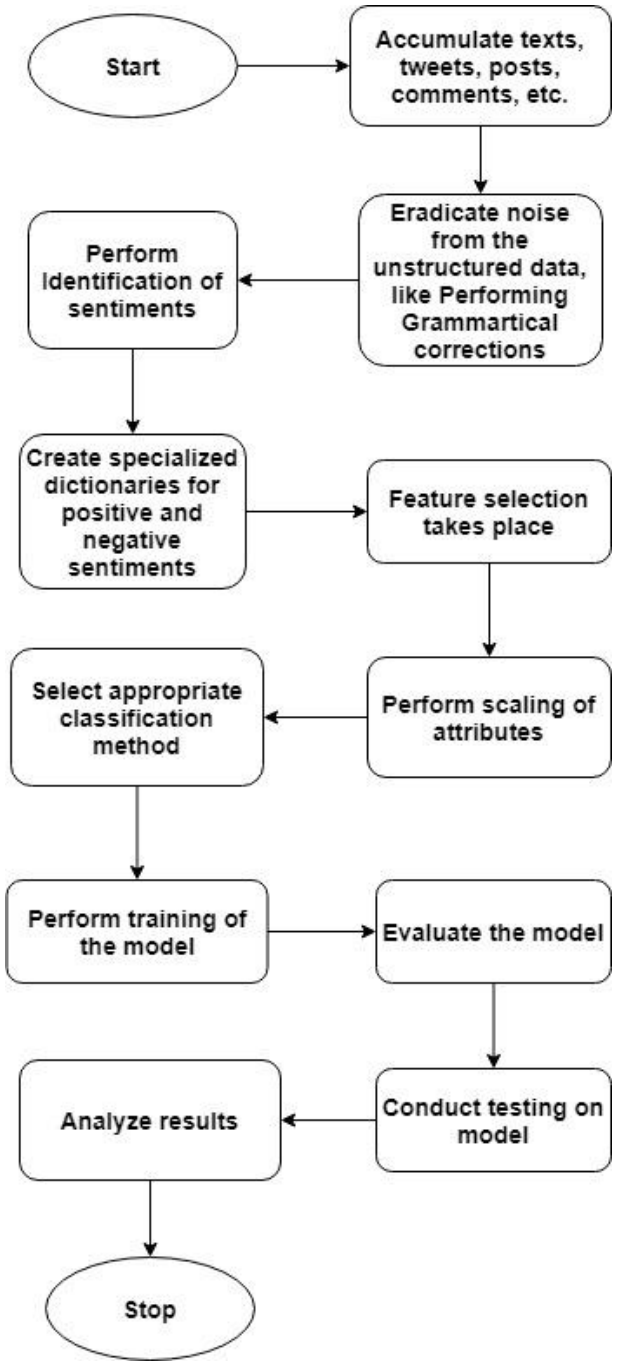

Fig. 2. Flowchart of the proposed technique for sentiment analysis

III. IMPLEMENTATION AND RESULTS

For performing the sentiment analysis on the tweets, two dictionaries have been created, one comprising of positive words and another comprising of negative tweets. Each word is accompanied by the numerical figure which has been allotted to the word based on the effective intensity of the word. The list of some positive words is shown below.

adorable 2 adore 1 adored 2 adorer 2 adoring 1 adoringly 2 adroit 3 adroitly 2 adulate 2 adulation 1 adulatory 3 advanced 1 advantage 1 advantageous 3 advantageously 3 advantages 2 adventuresome 3 adventurous 2 advocate 1 advocated 2 advocates 1 affability 2 affable 1 affably 2 affectation 3 affection 2 affectionate 2 affinity 2 affirm 1 affirmation 3 affirmative 3 affluence 2 affluent 1 afford 1 affordable 2 affordably 3 affordable 2 agile 1 agilely 2 agility 2 agreeable 1 agreeableness 3 agreeably 3 all-around 2 alluring 2 alluringly 1 altruistic 3 altruistically 3 amaze 1 amazed 1 amazement 2 amazes 3 amazing 1 amazingly 2

ambitious 2 ambitiously 2 ameliorate 3 amenable 3 amenity 3 amiability 3 amiably 3 amiable 2 amicability 2 amicable 2 amicably 2 amity 1 ample 1 amply 2 amuse 3 amusing 2 amusingly 1

The list of few negative words is mentioned below.

allegation -2 allegations -1 allege -2 allergic -3 allergies -2 allergy -1 aloof -2 altercation -2 ambiguity -2 ambiguous -2 ambivalence -3 ambivalent -1 ambush -2 amiss -2 amputate -3 anarchism -3 anarchist -2 anarchistic -2 anarchy -1 anemic -2 anger -1 angrily -1 angriness -2 angry -1 anguish -2 animosity -2 annihilate -3 annihilation -2 annoy -1 annoyance -2 annoyances -2 annoyed -1 annoying -2 annoyingly -2 annoys -1 anomalous -2 anomaly -1 antagonism -2 antagonist -1 antagonistic -2 antagonize -1 anti-1 anti-american -2 anti-israeli -2 anti-occupation -2 anti-proliferation -3 anti-semites -2 anti-social -2 anti-us -1 anti-white -1 antipathy -2 antiquated -3 antithetical -3 anxieties -2 anxiety -1 anxious -1 anxiously -1 anxiousness -2 apathetic -2 apathetically -3 apathy -2 apocalypse -3 apocalyptic -3 apologist -2 apologists -2 appal -1 appall -1 appalled -2 appalling -2 appallingly -2 apprehension -2 apprehensions -2 apprehensive -1 apprehensively -1 arbitrary -1 arcane -2

After constructing the two dictionaries the Java program is executed. Each tweet is analyzed when read. Each tweet's score is calculated on reading that particular tweet and based on the existence of positive and negative words in it. This individual tweet score is summed up after reading each tweet and the final score is obtained after running the entire file in which tweets are placed. The overall score decides the overall sentiment. If the score ends up as a positive value, it can be concluded that people's sentiments are on the positive side and if the final score comes out to be less than 0, then it means that the public sentiment is on the negative side.

{INDIAN CRICKET TEAM=0.0}
Current Counter score=0.0
{=0.0}
Current Counter score=0.0
{RT @JhaSanjay: Manish Tewari and I highlighted this in our piece yesterday. The #NamasteTrump event in a 100,000 seater cricket stadium tha…=0.0}
Current Counter score=0.0
{Sentiment(polarity=0.0, subjectivity=0.0)=0.0}
Current Counter score=0.0
{=0.0}
Current Counter score=0.0
{=0.0}
Current Counter score=0.0
{@CricketopiaCom They were legends! They brought game of Cricket to every home in India. People used to crowd around… https://t.co/Sye2wQ9Bi0=0.0}
Current Counter score=0.0
{Sentiment(polarity=-0.4, subjectivity=0.4)=0.0}
Current Counter score=0.0
{=0.0}
Current Counter score=0.0
{RT @navkrish55: @bhogleharsha's commentary for those 5 mins after @sachin_rt's last test was a masterpiece in cricket broadcasting! @alanwi…=4.0}
Current Counter score=4.0
{Sentiment(polarity=0.0, subjectivity=0.06666666666666667)=0.0}
Current Counter score=4.0
{=0.0}
Current Counter score=4.0
{=0.0}
Current Counter score=4.0
{Manish Tewari and I highlighted this in our piece yesterday. The #NamasteTrump event in a 100,000 seater cricket st… https://t.co/TQxzbHOUK8=0.0}
Current Counter score=4.0
{Sentiment(polarity=0.0, subjectivity=0.0)=0.0}
Current Counter score=4.0

{=0.0}
Current Counter score=4.0
{RT @kaustats: Douglas Marillier's 56(24) after coming to bat in the 45th over of an ODI and as a no.10 batsman - single handedly chased 65…=0.0}*
Current Counter score=4.0
{Sentiment(polarity=-0.07142857142857142, subjectivity=0.21428571428571427)=0.0}
.

.

Current Counter score=181.0
{RT @cricbuzz: "Virat's passion and drive to score runs is different to what Steve's would be"=0.0}
Current Counter score=181.0
{=0.0}
Current Counter score=181.0
{https://t.co/EtcNaTw3ys=0.0}
Current Counter score=181.0
{Sentiment(polarity=0.0, subjectivity=0.6)=0.0}
Current Counter score=181.0
{=0.0}
Current Counter score=181.0
{=0.0}
Current Counter score=181.0
{RT @republic: Rohit Sharma reveals personal reason that made #IPL 2019 win 'most special' for him #MumbaiIndians #RohitSharma https://t.co/…=4.0}
Current Counter score=185.0
{Sentiment(polarity=0.4142857142857143, subjectivity=0.44285714285714284)=0.0}
Current Counter score=185.0
{=0.0}
Current Counter score=185.0
{=0.0}
Current Counter score=185.0
{Rohit Sharma reveals personal reason that made #IPL 2019 win 'most special' for him #MumbaiIndians #RohitSharma https://t.co/R3Enx13am8=4.0}
Current Counter score=189.0
{Sentiment(polarity=0.4142857142857143, subjectivity=0.44285714285714284)=0.0}
Current Counter score=189.0
{=0.0}
Current Counter score=189.0
{=0.0}
Current Counter score=189.0
{@ESPNcricinfo 1999 Cricket betting scandal where Hansie Cronje was involved. I still pray that news somehow get del… https://t.co/LIeoRMRGh2=-2.0}
Current Counter score=187.0
{Sentiment(polarity=0.0, subjectivity=0.0)=0.0}
Current Counter score=187.0

Final Counter score=187.0

Sentiment Analysis ended on a positive note

Fig. 2 shows the image depicting the names of players from different countries generated using a Word Cloud. The larger is the name of the player, the more popular he is on social media, and the frequency of occurrence of his name is more as compared to other players.

Fig. 2 The figure shows the popularity of players using Word Cloud

IV. CONCLUSION

The paper discussed analyzing the sentiments related to cricket using the proposed technique. By obtaining a definite result, it becomes easier for the fans, coaches, and team management to predict the future of any upcoming event, the career of a particular player or team as a whole, the popularity of different organized series, etc. In the future, the analysis can be conducted with higher accuracy by adding new words to the dictionaries. The process of sentiment analysis can be executed on a greater number of tweets.

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Watt-less Magnetic Refrigeration (WMR) using Hybrid Nano-Fluid

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***Abstract*—** From past few decades, use of refrigerating system that are based on vapour-compression cycles and normally use R12, R22, R134a, etc. as refrigerants. For such a refrigeration system, heat transfer capacity of the refrigerant and power consumption by the system is of prime concern. A major breakthrough comes with this latest magnetic refrigeration technique which found feasible in room temperature devices. Magnetic refrigeration relies on magnetic substances called magneto-caloric materials, which thermally respond to changing magnetic field by manifesting a change in temperature. This magneto-thermodynamic phenomenon is called as magneto-caloric effect and is the main solitary concept behind magnetic refrigerating system. By the use of Nano-fluids, extraordinary thermodynamic and mechanical performance of the refrigerating fluids is achieved. While incorporating conventional heat transfer fluid with two different nanoparticles, a Hybrid Nano-fluids is produced a medium that offer better heat transfer and thermo-physical properties than convectional one. In WMR, with the use of hybrid Nano-fluid based on gadolinium (Gd) alloy that has strong magneto-caloric effect, results into the efficient performance. This paper use earth as the constant temperature sink incorporating with hybrid nano-material to achieve Wattless refrigeration. Hence, Magnetic refrigeration is big achievement in cooling technology which make us step forward to green-use and a Wattless performance of the refrigeration system for both domestic and industrial purposes.

***Keywords*—** Active magnetic refrigeration, magnetic fields, magnetic refrigeration, permanent magnets rare earth, Passive magnetic refrigeration, thermal conductivity, thermal expansion.

I. INTRODUCTION

Nowadays, our most common refrigerating system that are based on vapour-compression cycles and normally use R12, R22, R134a, etc. as refrigerants. For such a refrigeration system, heat transfer capacity of the refrigerant and power consumption by the system is of prime concern, hence very energy inefficient. More over these refrigerator systems are also undesirable for environmental reasons. And also it consists of compressor used to create pressure difference by compressing large volume of refrigerants consuming very high power. Hence in addition to lower COP along with lower cooling and environmental hazard, open up researchers to find some another way to fulfill this essential human need. However among different methodologies most promising is magnetic refrigeration, even the concept is still into research.

Magnetic refrigeration relies on magnetic substances called magneto-caloric materials, which thermally respond to changing magnetic field by manifesting a change in temperature. This magneto-thermodynamic phenomenon is called as magneto-caloric effect and is the main solitary concept behind magnetic refrigerating system. The study is based on a wattless use of magnetic refrigerator along with every detail to know about magnetic refrigeration and its alternative to the conventional refrigeration system, even in no power availability and uneven weather condition.[1,2]

Magnetic refrigeration is new refrigeration technology based on the magneto-caloric effect. This is very much analogous to refrigeration cycle. However in this magnetic refrigeration the desired cooling is produced with changing magnetic fields instead of changing pressure in Carnot refrigeration cycle. However depending upon requirement, different temperature can be achieved, while this technique can be used to attain extremely low temperatures. In the year 1881 German physicist Warburg very first observed this magneto-caloric effect. And in next few decades subsequently observed many French and Swiss physicist. While in the year 1926 the fundamental concept was suggested by the W. Giauque and P. Debye. And by the year 1933 the first working magnetic refrigerator also has been constructed. From the beginning, journey along with Magnetic refrigeration is full of achievements and it was the first to achieve cooling below about 0.3K [3].

II. FUNDAMENTAL CONCEPT

It's based on magneto-thermodynamic in which the sole functional unit is magneto-caloric effect. It is a thermodynamic system in which when a magnetic field sensitive material is exposed to changing magnetic field, temperature change up to desired value can be produced. This is an adiabatic process with corresponding effect on demagnetization hence also termed as adiabatic demagnetization. When such a technology is implemented in refrigeration process, with every change in magnetic field the material alter its orientation with corresponding change in thermal properties. In other words, when there is decrease in the magnetic field, instant disorientation leading to increase in temperature releasing energy in the form of thermal radiations present in the material is seen, at first place. It's the magneto-caloric material property to change its properties with respect to applied magnetic field. This magnetic refrigeration is very much similar to compressor based refrigeration system. Isolation is produced so that the system don't interact with the surroundings (adiabatic system) until it reach the cooling chamber where it get re-oriented to basic structure by absorbing the energy. The disorientation and reorientation

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fallows the similar fashion as in ferromagnetic material with corresponding Curie temperature [5,6,7].

However, in ferromagnetic material the dipoles are continuously developed overcoming the changing magnetic field causing no change in energy levels. Hence such type of materials are not used in magnetic refrigeration. Hence, in nutshell it consisting of four steps, first the heating of the material under magnetic field (1) fallowed by the cooling by expelling heat to the surroundings (2-4), caused by removal of magnetic field, as shown in figure below:

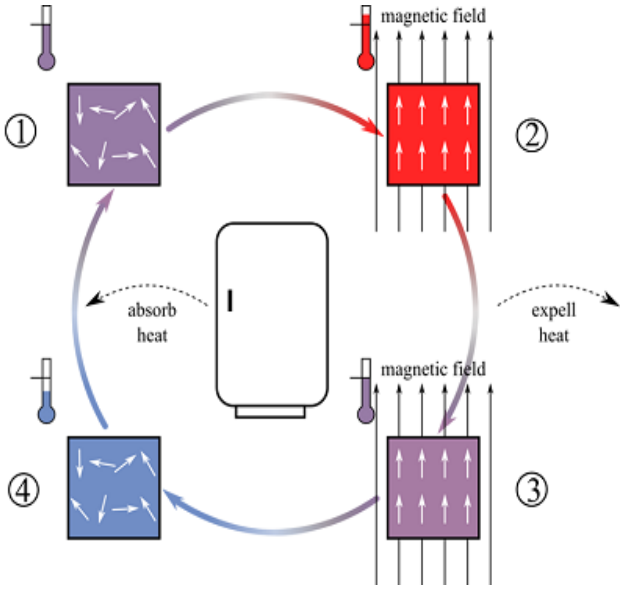

Figure: Shows magnetic refrigerator cooling cycle. Consisting of four steps, first the heating of the material under magnetic field(1) fallowed by the cooling by expelling heat to the surroundings(2-4), caused by removal of magnetic field.

The most commonly used magneto-caloric material is gadolinium along with its alloys. It is best of all due to high sensitivity to changing magnetic fields, producing the desirable temperature change. The most notable materials showing strong magneto-caloric gadolinium alloy (Gd5Si2Ge2). While other alloys like Praseodymium with nickel (PrNi5) also show good sensitivity with corresponding temperature change under changing magnetic field. The most notable example is Gd alloyed with Tb further achieve cooling capacity three times higher than other working fluids (refrigerants).[2]

On the other hand, Geothermal Temperature is the intermit temperature of earth crust. It is maintained at a temperature due to earth nature of acting as a heat source (winter) or as heat sink (summer). However temperature may vary depending on latitude, while the temperature beneath the surface, about 6 meters or 20 ft. is between 10 and 16 °C (50 and 60 °F). It remain undisturbed and always act as constant temperature heat sink/source [4].

III. RELATIONSHIP

Mathematically, the magneto-caloric effect can be formulated as:

$$\Delta T = -\int_{H0}^{H1} \left(\frac{T}{C(T,H)}\right)\left(\frac{\partial M(T,H)}{\partial T}\right) dH$$

Where: H is the applied magnetic field, C is the heat capacity of the working magnet (refrigerant), T is the temperature and M is the magnetization of the refrigerant.[10]

Taking the equation as reference, following points can be concluded:

- By applying a larger magnetic field, **magnetocaloric effect can be enhanced.**
- With a use of magnet with a small heat capacity, **magnetocaloric effect can be enhanced.**
- With more sensitive magneto-caloric material, there is larger change in temperature. Hence, **magnetocaloric effect can be enhanced.**

IV. REINFORCED NANOFLUID

At the beginning, the temperature variation rate of a pure Gd regenerator was higher. The equilibrium cold heat-exchanger temperature of a pure Gd regenerator is about 276.8K. Meanwhile, the equilibrium cold heat-exchanger temperature of a two-segment regenerator is found to be 4.6 K lower than that of the pure Gd regenerator. Studies tell us two-segment regenerators made of Gd-Tb alloys can achieve more than 2-time increase in cooling capacity.

However reinforced Gd alloyed with Tb further achieve cooling capacity three times higher, when two-segment regenerators are used, instead of pure Gd regenerator. The reinforced alloy composition was $\mathbf{Gd_xTb_{(1-x)}}$. Hence, it's a suitable material for use in room temperature condition and also show enhanced magneto-caloric effect.

V. THERMODYNAMIC CYCLE

The magnetic refrigeration cycle is very much analogous to refrigeration cycle. However in this magnetic refrigeration the desired cooling is produced with changing magnetic fields instead of changing pressure in Carnot refrigeration cycle. In simple words the process can be described as introducing working substance (magneto-caloric material) into a changing magnetic flux density with corresponding cooling effect [7,8,9].

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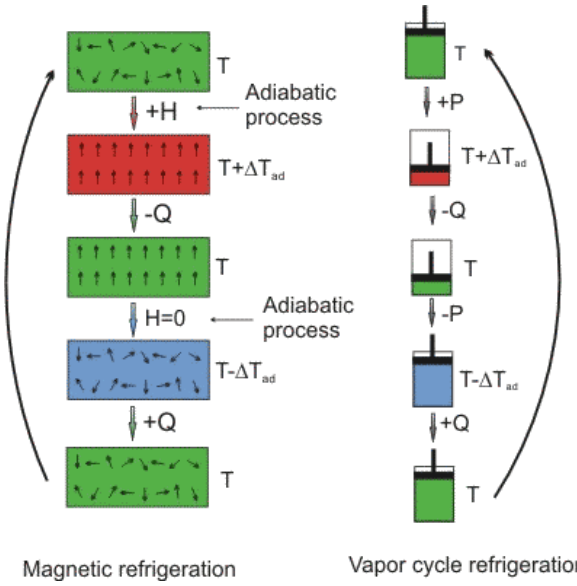

Figure: It shows the Analogy between conventional and magnetic refrigeration. **Where**: Q = quantity of heat; P = formed pressure; H = magnetic field applied externally; ΔTad = variation in temperature due to adiabatic change [15,16].

This refrigeration system consists of magneto-caloric material as the refrigerant (working material). Consisting of four steps, first the heating of the material under magnetic field fallowed by the cooling by expelling heat to the surroundings, caused by removal of magnetic field. Following are the different process involved in this magnetic refrigeration cycle:

- Adiabatic magnetization: The working material (magneto-caloric substance) is firstly transmitted to magnetic field chamber through an insulated passage. In the chamber it is placed in changing magnetic field, firstly increasing which allows magnetic dipoles to reorient into stable state, thereby tends to release heat energy with increasing temperature by decreasing the magnetic entropy along with its heat capacity. However the substance is kept to this state until it lose all of its energy due to magnetic heating of substance (T + ΔTad).

- Isomagnetic enthalpy transfer: After the adiabatic magnetization, now the substance release the heat energy due to temperature change. While during this the magnetic field is held constant at higher magnetic field so that the magneto-caloric material don't get realign and heat transfer to the source can be completed(-Q).

- Adiabatic demagnetization: The working material (magneto-caloric substance) is again return to magnetic field chamber through an insulated passage. In the chamber there is no magnetic field (H=0), which allows magnetic dipoles tend to reorient into previous state by absorbing the thermal energy, thereby increasing heat energy and relative cooling in the chamber i.e., change in thermal energy into magnetic entropy.

- Isomagnetic entropic transfer: After the adiabatic demagnetization, now the substance absorb the heat energy due the presence of thermal energy source. While during this the magnetic field is held constant at zero level magnetic field so that the magneto-caloric material don't get realign and heat can be absorbed into the working material (refrigerants). Because the refrigerant material is now tends to absorb energy to realign its magnetic dipoles. Hence the heat energy absorption can be seen (+Q), leading to desired cooling effect.

Once this process is complete the refrigerant and refrigerated environment are again available for next cycle until the thermal equilibrium is attained [10-24].

VI. PROPOSED METHODOLOGY

The need of electric power source is one of the drawback of conventional refrigerator but a major breakthrough comes with this latest magnetic refrigeration technique which found feasible in room temperature devices. As discussed before, Magnetic refrigeration relies on magnetic substances called magneto-caloric materials, which thermally respond to changing magnetic field by manifesting a change in temperature. This magneto-thermodynamic phenomenon is called as magneto-caloric effect and is the main solitary concept behind magnetic refrigerating system.

After this process is based on special type of working material (refrigerants), which should have high sensitivity to changing magnetic fields. Hence pure Gd can't be used alone, due to its weak nature. So, by the use of Nano-fluids, extraordinary thermodynamic and mechanical performance of the refrigerating fluids is achieved. While incorporating conventional heat transfer fluid with two different nanoparticles, a Hybrid Nano-fluids is produced a medium that offer better heat transfer and thermo-physical properties than convectional one. This paper use hybrid Nano-fluid based on gadolinium (Gd) alloy that has strong magneto-caloric effect required for the efficient performance. Most notable used refrigerants is reinforced Gd alloyed with Tb (with composition GdxTb(1-x)) further achieve higher cooling capacity.

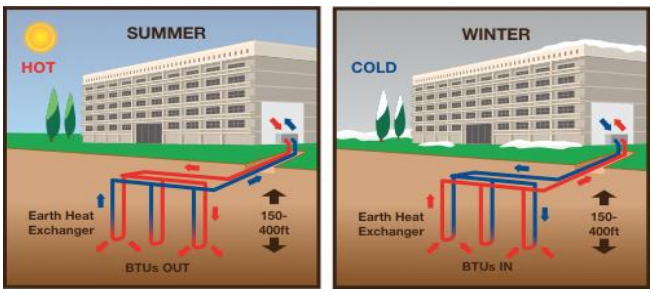

Figure: showing thermal energy exchange in both weather

Hence our proposed model consists of two parts. First is the system of working fluid to extract heat from the chamber and the second is the arrangement made to release the absorbed heat into the sink (intermit temperature earth crust). It is maintained at a temperature due to earth nature of acting as a heat source (winter) or as heat sink (summer). Hence, this methodology can get the desired effect in any weather condition.

The arrangement consists of the three basic elements i.e., the insulated tube passage, the magnetic chamber and the cooling chamber. The passage are made insulated so that there should be no interaction between the environment and the working substance (refrigerant). Next is the magnetic chamber where the working material is kept under adiabatic magnetization so that it can align it magnetic dipoles to release heat energy with increasing temperature by decreasing the magnetic entropy along with its heat capacity. The arrangement consist of the permanent magnet at the center, surrounded by the magneto-caloric refrigerants.

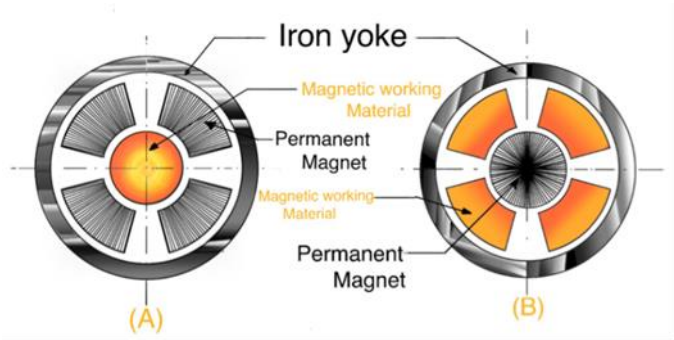

Figure: it shows the arrangement of magnetization chamber for adiabatic magnetization.

On the other side, it's the cooling chamber where the working material is exposed thermal energy source and under the change of magnetic field it tends to absorb energy to reorient itself to the previous orientation, producing the desired cooling effect.

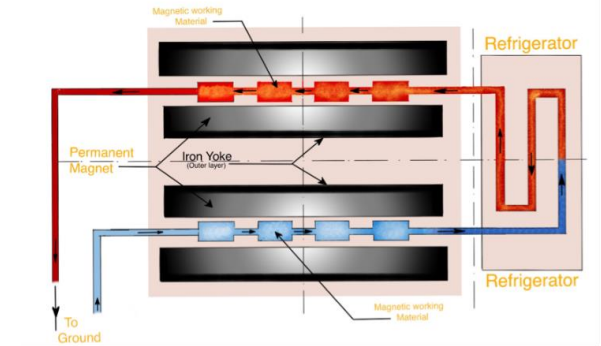

Figure: it shows the systematic arrangement of cooling chamber with the magnetic chamber for adiabatic magnetization

TABLE I
Temperature vs. mass flow rate observation table under steady magnetic field of 0.8T.

Magnetic field	Mass flow Rate	Temperature Span
Standard(0.8T)	zero	Start(18.3)
Standard(0.8T)	Low(0.75-2)	Very High(15-16)
Standard(0.8T)	Medium (3-3.5)	High(13-10)
Standard(0.8T)	High (4-6)	Good(8-7)
Standard(0.8T)	High (9-12)	Low(4-2)

VII. OBSERVATIONS AND RESULTS

At the beginning, the temperature variation rate of a pure Gd regenerator was higher. The equilibrium cold heat-exchanger temperature of a pure Gd regenerator is about 276.8K. Meanwhile, the equilibrium cold heat-exchanger temperature of a two-segment regenerator is found to be 4.6 K lower than that of the pure Gd regenerator. In our study of two-segment regenerators made of Gd-Tb alloys, the cold and hot heat-exchanger temperatures are fixed at 280 K and 298 K, respectively. Further, two-segment regenerators composed of GdxTb(1-x), where x is the composition, showed x about 0.83, which result in Curie temperatures close to the cold heat-exchanger temperature, have the highest cooling capacity ratios. The decrease of Gd composition below 0.83 is not able to further increase the cooling capacity ratio.

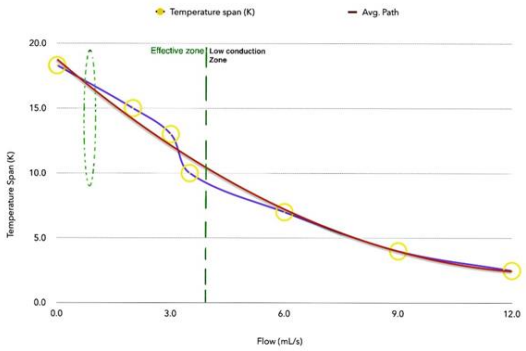

Figure: Temperature vs mass flow rate plot under steady magnetic field of 0.8T.

VIII. CONCLUSION AND FUTURE SCOPE

The described device and its associated test bench are simple and compact. The different parameters can be changed easily, such as the nature of the magnetocaloric material, the geometry of magnetocaloric material, the nature of exchange fluid, and the intensity of the magnetic field. The first results are promising although the bench can be improved without great difficulty. It will be used to evaluate the potential of different MCE materials and geometries. Geothermal energy utilization also has been increasing year by year. Solving the technical problems of geothermal energy utilization is the main aspect. The application of such a resource as a means refrigeration is very effective and it will be increasingly extensive application. Geothermal source/sink plays a big role in enhancing refrigeration effect. Hence, Magnetic refrigeration is big achievement in cooling technology which make us step forward to green-use and a wattless performance of the refrigeration system for both domestic and industrial purposes.

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New Development of Photovoltaic TiO2 Film as a Photocatalytic Removal of Micro-pollutants in Air

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***Abstract*—** From past few decades, the atmospheric deposition of different pollutants specially the micro-pollutants became the biggest setback for environmental governance making air quality bad to worst in cities. Moreover these micro-pollutants in air or when deposit is harmful as they cause breathing pathologies and in long term consumption cause cancer. On the other side, emerging Plug-in Electric Vehicle (PEV) technology given new edge to the world over diminishing petroleum-based fuel while with use of Photovoltaic TiO2 Film the capabilities are enhanced. However this TiO2 nanoparticles are also photocatalysts that can be used to remove these micro-pollutants under UV irradiation. In this study, the main objective is to use advanced Photovoltaic TiO2 Film with additional outermost nano-TiO2 coated layer for the removal of micro-pollutants. This purpose is detail studied and result showed us that photocatalytic reaction can be used for removal of micro-pollutants like NOx, SOx, NH3, CO, oil mist and other substances under appropriate irradiation, temperature, and O2 concentration. Considering the photovoltaic role of the film, optimum condition achieved at 8-9% loaded concentration of nano-TiO2 on outer layer, the removal efficiency was 40-50% for NOx, 60-70% for SOx and other be around 30-40%, under concentrated flow of these gases. Hence, Photovoltaic TiO2 Film with additional outermost nano-TiO2 coated layer can be used photocatalyst to remove the micro-pollutant and making this environment clean.

***Keywords*—** Micro-pollutants, NOx, SOx, formaldehyde removal, Nano-ToO2, Plug-in Electric Vehicle (PEV), Photocatalyst, Photovoltaic TiO2 Film.

I. INTRODUCTION

Nowadays, air pollution considered world biggest environmental problems. It's the main cause of imbalance and threatens all forms of life directly or indirectly. There are many causes of air pollution, while mostly Vehicle Exhaust and power plants working on fossil fuels and exhaust from industries cause air pollution by releasing micro-pollutant to the environment [6]. Among all micro-pollutants, NOx, SOx, NH3, CO, oil mist top the list with big health hazards. Hence, it's become our first priority to remove of these micro-pollutants. Nitrogen oxides (NOx) and Sulfur oxide (SO2) from fossil fuel combustion have brought great health hazards. The well-known desulfurization and denitrification are used to neutralize these micro-pollutant [2]. Formaldehyde, are also one of the biggest indoor pollutants.

Photocatalyst is a Nano-structured semiconductor known for its Photocatalytic reaction. It is very first reported by Nian Jhcyar, 1976, as a photocatalytic oxidation degradation of PCB. From past few decades, titanium dioxide (TiO2) used to reduce pollutant. However, it's tough when we talk about very small size of nano-TiO2, which cause difficulties of catalyst recovery. [3] Hence in order to use this, carbon or other carrier are used, in which catalyst not only can be used but when needed can be recycled. In this paper, nano-TiO2 catalyst with carbon carrier is prepared by hydrolysis using old two-step sol-gel process [9]. On the other side, emerging Plug-in Electric Vehicle (PEV) technology, given new edge to the world over diminishing petroleum-based fuel while with use of Photovoltaic TiO2 Film the capabilities are enhanced [1]. However this TiO2 nanoparticles are also photocatalysts that can be used to remove these micro-pollutants under UV irradiation making it more adaptive [10-19]. However, it is noted that NOx very effective removal efficiencies are produced when temperature is 250 °C–450 °C, otherwise at lower temp it's quite ineffective. So, with the help of TiO2 catalyst it was made possible to remove NOx under low-temperature condition [3, 4, 5].

II. ACTION MECHANISM OF TiO_2

Photocatalysis performed by nano-TiO_2 is a redox reaction. It initiated by absorption of light photon. Due to its semiconductor nature, there exist a band gap (lower than 3eV), with appropriate wavelength of UV light falls, it irradiates and the electrons jump from valence band to the conduction band generating the cavities/holes in valance band [2].

$$TiO2 + hv \longrightarrow ecb^- + hvb^+ \quad (1)$$

However in the case of liquid with catalyst, the electron jump to different position of the particle leading to participation of both sides and produce hydroxyl radical (•OH) as its product. Hydroxyl Radical (•OH) shows strong oxidation property and have high tendency to oxidize various micro-pollutants such as ammonia nitrogen [2, 7].

$$H2O+hvb^+ \longrightarrow •OH + H^+ \quad (2)$$
$$OH^- + hvb^+ \longrightarrow •OH \quad (3)$$
$$OH + \text{pollutants} \longrightarrow H2O + CO2 \quad (4)$$

Photocatalysis is same for any pollutants but the final product may very while catalyst remain unconsumed. (4)-shows the conversion of oil mist particle under same hydroxyl radicals. Here in this degradation, there is exchange of electron and holes between organic compounds and the hydroxyl radical (•OH), giving final products of reactions as CO2 and H2O [2].

III. Previous Work

Prabhjot Singh and Sanjeev Gupta [2019] [1]. This work is based on usage of nano-TiO_2 as a solar cells and its applications with PEV's to increase drive range. Stepping aside normal solar cell, the use nano-TiO2 in a polymer with silver wire immersed in it, produce efficient solar cell which can be used on a Plug-in Electric Vehicle (PEV) surface or colored body, without making changes in color of the object, due to its transparent nature. This concept is very useful in PEV's, giving them on an extra edge. This proposed project/concept was aimed to solve the limited energy storage problem also aims to solve the problem of energy consumption and also fulfill the future expectations. [1]

However, this paper depicts that with the addition of outermost nano-TiO_2 coated layer, the film is quite useful for the efficient removal of micro-pollutants present in air, due to is photocatalytic effect.

IV. Proposed Methedology

The study on nano-TiO_2 as a photocatalyst for removal of micro-pollutant is considered as a part of photovoltaic film previously developed. This reinforced Photovoltaic TiO_2 Film with additional outermost nano-TiO_2 coated layer for the removal of micro-pollutant given an extra edge for environment friendly use. However the size of the nano-TiO2 is very small and to be sure it don't get removed along with toxic micro-pollutants, the solid carrier is used all of these is detailed under this section including the possible composition for optimum condition.

4.1 Preparation of TiO_2 Photocatalyst Coating

The old two-stage sol-gel process is used to create TiO2/AC catalyst with drying and nano-scale precipitation at final stage. This process is divided into two stages, leading to final hydrolyzed solution of $Ti(OC_4H_9)_4$. First stage begin with slow intermixing of two solutions namely "A" and "B". In solution "A" there is $(Ti(OC_4H_9)_4$ with ethanol and Methyl cellulose (MC) and in solution "B" there is water and ethanol with small concentration of AC. This mixing continued slowly until desired amount is mixed and aggregated for at least 1hr. When first stage is completed, the second stage is started with addition of both the solution A and B into the previously prepared mixture and stirred for another hour, vigorously. Then this final extracted TiO_2/AC alcosols is impregnated for couple of hours, dried at water boiling temperature and at a temperature of 773K it is calcined for another 1-2 hours. Here we used a solid carbon carrier for binding of nano-TiO_2 while can also be achieved with the binders used in the photovoltaic film previously.

The finalized nano-TiO_2 outer coating layer was measured and reinforced to a film of with 20cm, while weight upto 7-8 g/m2 of area when covered. The whole process is done in standard room NTP condition with 50%RH humidity.

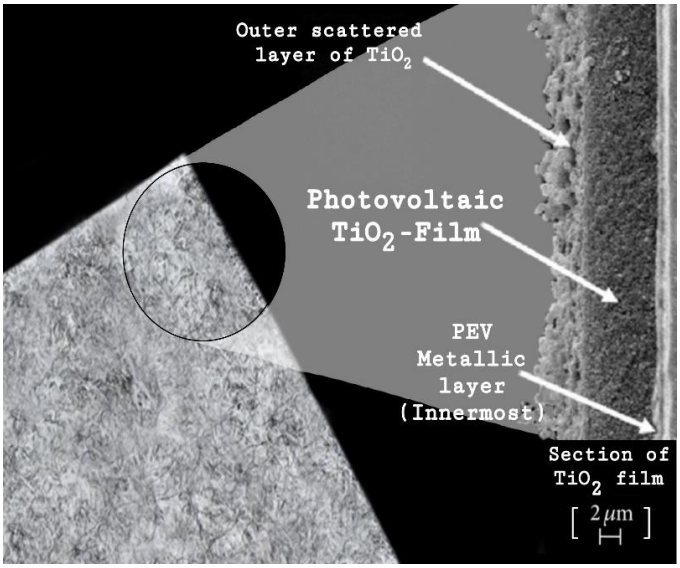

Fig. 1. Schematic overview of a photocatalystic nano-TiO2 Film

4.2 Removal of Micro-pollutants

Among all micro-pollutants, NO_x, SO_x, NH_3, CO, oil mist top the list with big health hazards. Hence, it's become our first priority to remove of these micro-pollutants. As the process is based on the photo-catalyst, we require an artificial UV lamp with (8W, λ=365 nm) configuration. The apparatus consist of a closed chamber in which normal air with fixed concentration of micro-pollutants (about 1-1.5 mg/L) was filled along with a 20cm×30cm nano-TiO_2 photocatalytic plate and UV lamp. The components remain intact for a period of 12-14 hr and after that the concentration of formaldehyde was measured. This procedure is used with all listed micro-pollutants and the observation and results are detailed next.

V. Result And Discussion

The whole process was repeated to test all different micro-pollutants with fixed concentration in the normal air. However the results showed variation when there is change in the concentration of nano-TiO_2 or when light intensity was increased or when the temperature was changed.

Let us consider a single sample of formaldehyde as a micro-pollutant and compare the outcome. So when air with 1-1.5 mg/L concentration was injected, with 1% nano-TiO_2 under constant UV radiation the removal efficiency was low but with the increase in the percentage of the nano-TiO_2, the efficiency increased. However the efficiency is found different for different micro-pollutants. Next is the graph showing variation of absorption efficiency for a fixed UV and air concentration

for an unchanged time of contact.

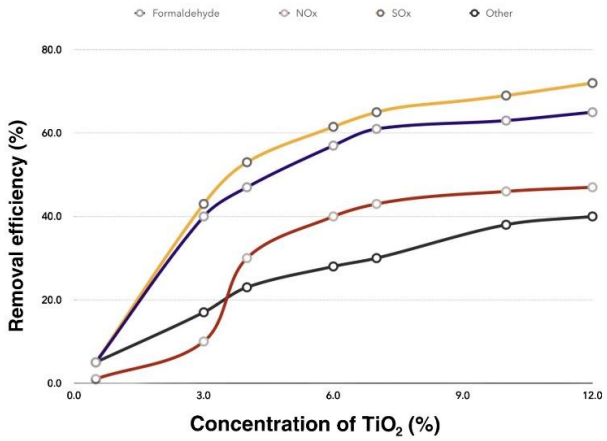

Fig. 2. Show graphical representation of removal efficiency(%) v/s %change in TiO_2

Now we can easily observe that when the loading % of nano-TiO_2 was 0-1% the efficiency was between 0-10% while when the concentration was increased to 11-12% the efficiency increased upto 50-70% for every micro-pollutant. Hence efficiency plays a vital role in removal of the micro-pollutants.

While on the other hand, when we consider the reaction/contact time as a factor, efficiency fall is observed with respect to the time and after a period it completely diminished. It can also be seen by the graphical comparison shown below.

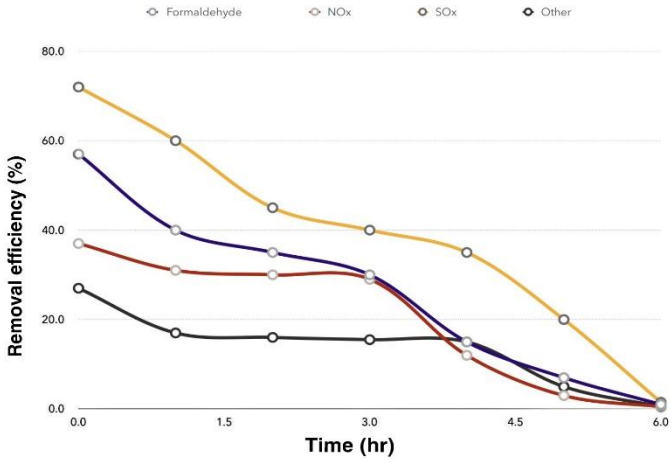

Fig. 3. Show graphical representation of removal efficiency (%) v/s contact/reaction time (hr)

Similarly, at the first instant of contact, the efficiency was maximum while by the time it decrease and after couple of hours it completely diminished or minimum. Efficiency at the start is different for different micro-pollutants. Hence it's also big factor to consider, however this fall in efficiency is due to the covering of surface by the settled down layer of the micro-pollutant and the process will restore as soon as we remove that layer.

TABLE I

I. EFFICIENCY DATA (IN %) FOR DIFFERENT MICRO-POLLUTANTS IN AIR

UV-Light intensity & % Loaded TiO_2	MICRO-POLLUTANTS	EFFICIENCY (%)
Standard & 11% fixed	NOx	40-50%
Standard & 11% fixed	SOx	70-80%
Standard & 11% fixed	Formaldehyde	60-70%

Hence, these two factors need to be considered while looking for the optimum solution. However other factors like temperature plays a big role when NO_x is priority because it is emission source is burning of fossil fuels and hence its production temperature is quite high. To naturalize this NOx, it is well needed to take this process at higher temperature and it is inefficient. So for such a pollutant the optimum efficiency is quite low. The following table shows us different optimum concentration for different micro-pollutants.

The catalyst reaction with the micro-pollutants decrease by the time and also when multiple micro-pollutants used at a time. For example when SO_2 is added to gas having the NO_x we found there is change in the absorption efficiency. The NO_x previously absorbed was 40-50% but when Sox was added its efficiency decreased to 17-19%. Similarly in case of SO_x, in which previous efficiency was up to 70% but when NO_x was added the efficiency dropped to 45% efficiency. However the overall efficiency was 58-60% and very much same in other micro-pollutants.

VI. CONCLUSION AND FUTURE SCOPE

Emerging Plug-in Electric Vehicle (PEV) technology given new edge to the world over diminishing petroleum-based fuel while with use of Photovoltaic TiO_2 Film the capabilities are enhanced. However, when additional outermost nano-TiO_2 coated layer is introduced, nano-TiO2 start acting as a photocatalysts and that can be used to remove these micro-pollutants under UV irradiation. The old established two stage sol-get technique was used with final stage drying and precipitation. We used $Ti(OC_4H_9)_4$ as its initial product. The average removal efficiency for NO_x, SO_x, formaldehyde and with other substances like oil mist it was found to be 40-50%, 60-70% and other be around 30-40% respectively, under steady NTP and at 50%RH humidity. However the nano-TiO_2 is need a solid carrier so that it is not removed along with the micro-pollutants and for this we use carbon carrier as a binding agent. Considering all, optimum condition was achieved when 11% of nano-TiO_2 is loaded AC

with around 6-8 hr of constant UV irradiation and contact/reaction time while the initial concentration was 1-1.5mg/L. Hence, this method are more advantageous as used along with photovoltaic TiO_2-film, as it shows efficient removal of Micro-pollutants. Therefore, this concept can be used in vehicles especially large size PEV and further improvement in micro-pollutant removing technology is very crucial with sound future-expectations.

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Contact and Consolidation Grouting Around Power Tunnel Lining

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***Abstract*—** In most of the hydroelectric projects, HRT'S pass through rock masses which contains discontinuities such as folds, faults ,joints, minor shear planes , fissures etc. These discontinuities further deteriorate during excavation by blasting and drilling techniques. Due to the presence of these continuities the rock mass does not behave monolithically. Proper grouting of the surrounding rock mass around the opening ensures the monolithic behavior of the rock mass. Grouting is primarily carried out to: Strengthen the surrounding rock mass around openings by filling shattered rock mass, joints etc. Fill voids and cavities between rock mass and concrete lining. To ensure no permeability in surrounding of the power tunnels. To reduce the drainage problem during tunnel driving. To reduce leakage of water from lining.

***Keywords*—** Grouting, Permeability, Usefulness, Tunnel.

I. INTRODUCTION

Grouting is primarily carried out for the purpose of improving impermeability of the rock-mass otherwise shattered due to bad rock quality and blasting during excavation. It also improves the rock strength by way of solidifying seamy but otherwise good rock (consolidation grouting) and to control leakage by way of introducing an impervious stratum and suitable drainage system (curtain grouting).

Grouting is also used to bring about, as nearly as possible a fully bonded contact between any concrete structure and adjacent rock by way of filling the gaps between structural surface and surrounding rock body by shear presence of shrinkage and/or construction defects otherwise. In Headrace Tunnel of Hydroelectric Project, in addition to contact grouting, consolidation grouting is carried out to improve the surrounding rock-mass and to provide pre-stressing at initial stages, to the concrete lining against internal hydrostatic pressure. This is considered to be a step forward in achieving economical solution for un-cracked, un-reinforced concrete lining in power tunnels. Power tunnels in hydroelectric projects are considered to be most sensitive part in determining the net head for available quantity of water thus, power to be generated. This is more relevant to projects containing long power tunnels, where maximum head loss (some times as high as 90%) is in headrace tunnels only .In case of power tunnels, grouting is required over various portions in following ways:

Contact Grouting: To fill large voids behind the steel and concrete liners which occur due to inadequate concreting, or due to air trapped during the concreting operation?

Embedment Grouting: To seal the gap between the steel liner and concrete which forms due to concrete shrinkage, due to plastic set in the rock during loading/unloading, and due to the temperature differential between the liner and the mass rock.

Consolidation Grouting: To consolidate blast damaged or relaxed rock and to reduce leakage. Consolidation grouting is the last step, and is done by the ring method, moving upstream and grouting through the same holes as the embedment grouting. With the packer attached to the steel liner, a second grouting of the gap as well as the fractured rock is done. It is advantageous to grout at the highest pressure possible, but without buckling the liner. Consolidation and contact grouting of tunnel lined only in concrete, is done to the same general criteria as a steel/concrete section. Thus, well-planned and staged consolidation grouting could result in a desired pre-stressing in concrete lining, at initial level, against internal hydrostatic pressure. This will reduce cracks in concrete lining due to internal hydrostatic pressure resulting lesser head loss and loss of water.

II. GROUTING AS LEAKAGE CONTROL MEASURE

Excessive leakage can occur from pressure tunnels in two ways. Firstly, by hydraulic jacking, and secondly if the rock is pervious and the internal pressure exceeds the external groundwater pressure. Some seepage loss may be allowed depending upon the quantity and value of available water and the probable effect of seepage on the stability of the terrain and its effect on the environment. Grouting to reduce permeability around a concrete lining can be successful provided carefully controlled techniques and pressures are used.

Grouting methods

Grouting technology is vast expanding and integral part of rock science. Depending upon state of the art and experience gained in a particular field different techniques are adopted for grouting. The best known and widely used grouting methods are as following;

- Stage Grouting
- Stop Grouting
- Series Grouting
- Circuit Grouting

- Ring grouting etc.

In all of these, the "split spacing" procedure of determining final hole spacing is followed, that is, the spacing of each succeeding set of holes is determined by splitting the interval between the holes of the previously completed sets. Holes for the initial or primary set are drilled at the maximum spacing (commonly 6.0 meters) and grouted, and the spacing of holes is reduced with each succeeding set until it becomes such that no appreciable quantity of grout can be injected at the maximum permissible pressure.

Stage grouting

Stage grouting, as the name implies, is a method of grouting whereby the work is accomplished in stages from top to down. Grouting in the upper part of the holes is accomplished before the lower parts are drilled. Its primary purpose is to give separate grouting treatment to cracks and other openings encountered in grout hole drilling that are of such size that separate treatment is desirable.

Some advantages of stage grouting are as following:

i. It excels all other methods for flexibility in meeting local conditions. It allows for separate treatment of each imperfection as encountered and, thus, permits the use of the grout mixes and the pressures that best meet each condition.
ii. It minimizes the problem of premature stoppage in the smaller seams or fractures because each seam encountered in drilling is subjected to additional grouting with each successive grouting stage.
iii. The first grouted upper sections of the holes are subjected to successively higher pressures as the holes are deepened and higher pressures are applied.
iv. The use of packers or expansion plugs is unnecessary in as much as washing, pressure washing, pressure testing, and grouting for all stages are accomplished from the top of hole.

A disadvantage of stage grouting is that the holes must be cleaned out after each stage. The cost of doing this is low, however, if it is done before the grout takes a hard set.

Stop grouting

Stop grouting is a method whereby packers or expansion plugs are used to block off pre-selected portions of the holes, while those portions are being grouted. Under this method the holes are drilled to their full depth and grouted in successive zones from the bottom up. Packers or expansion plugs are set in the holes at the top of the zone to be grouted, blocking off the higher portions of the holes, and the zone then pressure tested and grouted. The lower most zone is grouted first. Grouting in any particular zone is completed in all holes drilled through that zone before proceeding to the next higher zone. The packers are then raised to the top of the next higher zone and pressure-testing and grouting repeated. Some advantages of stop grouting are as following:

i. Imperfections disclosed by drilling operations, if so desired may be isolated by means of the expansion plug and given special treatment.
ii. Grout mixes can be varied so that mixes can be employed that are best suited for the conditions of each zone,
iii. Pressure washing and testing may be concentrated, if desired, to small segments of the holes by means of double expansion plugs, thereby improving the efficiency of these operations.
iv. Cleaning or drilling out holes after grouting is unnecessary.

Some disadvantages of stop grouting are as following:

i. Grout often bypasses the grout stops, or expansion plugs, through vertical or near vertical fractures or joints.
ii. A tight seal is difficult to obtain with expansion plugs in fractured or broken rock, and in cavernous or solution honey-combed rock.
iii. Leaks into nearby holes often cause difficulties and may plug fractures and seams and other imperfections in those holes above the zone being grouted.
iv. Sizes of holes that can be used for grouting are limited to the sizes of packers or expansion plugs obtainable.

Series grouting

Series grouting involves the drilling of a separate series of holes for each zone of grouting. Grouting of holes in all series is performed from top of hole. The series for the uppermost zone are drilled, pressure-tested, and grouted first starting with a primary set of holes on a wide spacing and reducing the hole spacing with succeeding sets by split-spacing method until the zone has been grouted to the satisfaction of the person in charge.

Some of the advantages of series grouting are as following:

i. Holes for the uppermost zone and possibly those for the next deeper zone may be drilled with percussion drills,which is less expensive than drilling with rotary drills.
ii. Cleaning of grout from the holes after grouting is not required.
iii. The use of packers or expansion plugs with their attendant problems is unnecessary, in as much as all washing, pressure-washing, pressure testing, and grouting are performed from the tops of the holes.

The series grouting method has two major disadvantages:

i. It requires an excessive amount of grout hole drilling.
ii. It lacks flexibility in meeting localized conditions.

Circuit grouting

In circuit grouting, an injection pipe is extended through a packing gland to the bottom of each hole for each specific zone or stage being grouted, and the grout is pumped through a complete circuit from the grout mixer or the sump through the injection pipe to the bottom of the hole and, thence, up the hole and back to the sump. Some advantages of circuit grouting are as following:

i. Grout is circulated constantly through the system and even in the case of relatively tight holes, the entire depth of hole is exposed to the circulating grout fluid.
ii. Periodic washing of the holes is facilitated.
iii. It is adaptable to the grouting of caving or revealing holes in that the injection pipe can be jetted to the bottoms of the holes and accretion material is removed by the rising column of grout.

The principal disadvantages of circuit grouting are as following:
i. More time is required to install and to remove the injection pipe than is required to make and to unmake hole connections by other grouting methods, especially if jointed pipe is used.
ii. The injection pipe may become grouted in holes that take grout so rapidly that no return flow is maintained in the circuit,
iii. The grout holes cannot be closed under pressure after completion of a grouting operation because of the removal of the injection pipe.

Ring grouting

This type of treatment is akin to curtain grouting under a dam in that it forms a grout barrier intended to reduce the possibility of water percolating from the reservoir along the tunnel bore. Stage-grouting method usually will produce the best results.

GROUTING MATERIAL

Followings are the main constituent of grouting material:

i. Portland Cement: OPC without air entraining agent is best. Use of proper water cement ratio is most important factor.
ii. Fillers: To reduce the relatively high cost use of fillers like sand, rock flour, stabilized clay, bentonite, straw, sawdust, grains and mica flakes etc. is recommended. If available at near source fly ash is considered to be good filler.
iii. Accelerators: Used to limit the extent of grout travel. Calcium chloride, high alumina cement and sodium carbonate.
iv. Retarders: Used to increase the set time, if required. Common retarders used for concrete will work.
v. Lubricants: Used to increase the flowability of the grout to have penetration in finer cracks. Fly ash and rock flour is used for this purpose.
vi. Non-shrinkage Agents: Powdered Aluminium is the agent most commonly used.

III. BRIEF LITERATURE SURVEY

Grouting is a widely used method for strengthening and sealing rock, soil and concrete. The possibilities for sealing structures are of great importance from both an economic and environmental point of view. The cost of grouting has in certain projects been as high as the cost of blasting and excavating the tunnel. To improve the technique for grouting with cement-based material, it is necessary to examine the properties of the grout mixture used.

In planning a grouting program for particular conditions, the engineer needs knowledge of the various types of grouts and their properties. The basic types of grouts now in use and their properties are discussed below. Types of admixtures and fillers used and their effects on the grout are also discussed. The most common types of grouts are Portland-cement, clay, chemical, and asphaltic grouts. No one grout is suitable for every situation. The properties of each specific grout make it desirable under certain circumstances. An important requirement for the selection of a grout is that its particles be substantially smaller than the voids to be filled. Figure 1 shows limiting grain sizes of materials that can be grouted by various types of grout. These data are based on experience and testing and should be used only as a guide. Another relationship can be determined by the groutability ratio, N, expressed by the equation N = D15/D85 where D15 is the 15 percent finer grain size of the medium to be grouted and D85 is the 85 percent finer grain size of the grout. N generally should be greater than 25 but in some cases may be as low as PORTLAND-CEMENT GROUT. Portland-cement grout is a mixture of portland cement, water, and, frequently, chemical and mineral additives. The properties of materials generally used in portland-cement grout are described below.

Portland-cements

Five types of Portland-cement, produced to conform to the specifications of ASTM Designation C 150, are used in cement grouts.

Type I is a general-purpose cement suitable for most cement grout jobs. It is used where the special properties of the other four types are not needed to meet job requirements.

Type II cement has improved resistance to sulfate attack, and its heat of hydration is less and develops at a slower rate than that of type I. It is often used interchangeably with type I cement in grouting and is suggested for use where precautions against moderate concentration of sulfate in groundwater are important.

Type III cement is used where early strength gains are required in grout within a period of 10 days or less. It may also be used in lieu of type I or type II in injection work because of its finer grind, which improves its injectability.

Type IV cement generates less heat than type II cement and develops strength at a very slow rate. It is rarely used in grouting.

Type V cement has a high resistance to sulfates. It is not often used in grouts, but its use is desirable if either the soil to be grouted or the groundwater at the jobsite has a high sulfate content.

Mixing Water. Generally, water suitable for drinking may be regarded as suitable for use in grout. Ordinarily the presence of harmful impurities (e. g., alkalies, organic and mineral acids, deleterious salts, or large quantities of silt) is known in local water sources. If there is reason to suspect a

water source, it should, be tested in accordance with CRD-C 400.

IV. Methodology/ Planning Of Work

The power tunnel is proposed to be grouted after laying the concrete lining, methodology and planning of both contact and consolidation grouting works is described as under:

Contact grouting shall provide an interface between the final rock support and lining and shall be carried out to fill all the voids between concrete and rock.

Consolidation Grouting shall prestress and strength the rock mass and provide the desired water tightness to the structure.

QUANTITIES OF EXPECTED GROUTING WORKS

CONTACT GROUTING / CONSOLIDATION GROUTING

1. Nos. of Profiles
2. Nos. of Holes per Profiles
3. Depth of Drilling
4. Total Length of Drilling
5. Total No. of Holes
6. Expected intake of cement in average

DRILLING FOR GROUTING

Drilling Equipment

Holes will be drilled using some standard drilling equipment.

GROUTING EQUIPMENT

Requirement to carry out work shall include Grout pump, grout mixer, agitator, packers, pipes and grout lines, fitting, pressure gauges, water meters, grout platforms and other miscellaneous Supplies. The equipment shall be capable of satisfactory mixing, stirring and supplying grout/mixes of various densities and viscosities at the required constant pressures provide a continuous circulation of grout and permit accurate volume and pressure control.

GROUTING MATERIAL

- The water used of drilling, washing, water testing and as grout ingredient shall be fresh, clean and free from deleterious silt, oil, grease and other impurities.
- The cement used in the grout shall conform to IS: 1489-1991. The fineness shall be greater than 350 m2/kg.

TESTING OF GROUTMIXES AND QUALITY CONTROL

Before starting of grouting works, each kind of grout mix which will be used during the grouting works will be tested for sp. gravity, viscosity, compressive strength and initial & final settings.

During the execution of grouting works, samples of each grouting mix shall be taken daily/weekly for testing.

GROUT LEAKAGES

If during the process of grouting any leakage is observed from the concrete joints, the same shall be repaired with mortar before the grouting is resumed again.

In case a leakage is observed from a grout hole already drilled in the vicinity the same shall be sealed with packer before grouting is resumed. Such problematic holes shall be re-drilled before grouting of these holes.

WATER PRESSURE TESTING (WPT)

Before the start first stage consolidation grouting two holes one in the crown and the other in the left or right side wall alternatively shall be checked to assess the rock permeability values. The pressure for WPT will not be more than those laid down for the grouting of particular stage.

FACILITIES REQUIRED FOR THE PROPOSED WORK

Besides the team of leading grouting specialist, civil engineer, Electrical Engineer, Mechanical Engineer, Quality Control Engineers and maintenance team like air supply maintenance, Pipe line & water maintenance etc. the following equipments are required at site:

1. Drilling Machine
2. Grouting pump
3. Agitator
4. Grouting Centrifugal pump
5. Packers
6. Pressure gauges
7. Water meters
8. Mixer & Recorder

V. Concluding Remarks

The paper finds its significance as the power tunnels of most of the Hydro Power Projects possess all or any few of the following properties along the entire length:

- Leakage of water causing loss of water.
- Formation of phreatic lines.
- Naturally fissured and cracked rocks.
- Damage to rocks (if any) caused by blasting carried out for construction activities.

FUTURE SCOPE:

- During construction of civil structures on geologically poor grounds this can be effectively used as a reference tool.
- It helps to take decision regarding whether the certain part of Head Race Tunnel needs to be re grouted.
- Sufficiently low permeability values in the grouted zones conclude that rock around power tunnels is sealed to a desired value.
- Closing of cracks, joints and other discontinuities helps in reducing the seepage of water from and to power tunnels.
- To save time and money decision about discarding of some holes can be taken.
- Can prove best as base/ reference for research and designs, advance studies and practical training of students.

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Fabrication of Smart Bandage Structure

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***Abstract*—** Microfluidic is the ongoing field finding its application in biomedical and pharmaceutical industries. A number of methods had been devised for the development of microfluidic structures. PDMS, paper are the flexible means for fabrication of microfluidic devices. PDMS is cheap, easy to work with, transparent and economical to use. Another cheap method of fabrication is by using Arc Sign. The scope of present research is to develop a structure for microfluidic smart bandage. In this paper, a smart bandage has been developed on hydrophobic paper and connections for the same are taken using copper paint.

***Keywords*—** smart bandage, microfluidics, micro drug chambers, microchannels.

I. INTRODUCTION

Microfluidics is the process of engineering manipulation of fluid at microlitre scale. It has revolutionized the way of analyzing samples and changes the way of modern biology. the Microelectronic devices form the basis of microfluidics where silicon was used as the substrate to fabricate microfluidic device [1][2]. The fabrication of microfluidic devices using silicon substrate is carried by cleaning substrate, photolithography, metal deposition and wet and dry etching [3] [4]. This is the conventional method of fabricating microchannels using glass or silicon which provides superior thermal conductivity, surface stability and the other class of materials used are Polymer materials which include polymethylmethacrylate (PMMA), polystyrene and the widely use material out of these is the PDMS as its flexible in moulding and stamping with optical transparency, and biocompatibility [4]– [6]. Paper, a biodegradable substance is also used now days for fabricating microfluidic devices it's useful only for some specified applications [7]. One of the method of fabricating microfluidic device is using lithography is discussed here. Lithographic techniques are used to fabricate the micro-channels of desired patterns on silicon (Si) substrate [3]. These substrates are cleaned and pre-baked for 5 min at 90 ºC for dehydration process. The substrate are then coated with SU-8 photoresist and exposed to UV light, creating patterns over the resist. The resist are developed for 15 min using MSDS SU8 developer. The patterns of SU-8 after examining under microscope are transferred over PDMS. Liquid PDMS is mixed with cross linker agent Siloxane in 1:10 ratio. Any increase in this ratio increases the rigidity of PDMS. All the air bubbles are carefully removed from the mixture and are poured over the substrate. After this the PDMS is dried and ready to peel and used for further processing [3]-[5] for carrying out the experiment.

A number of devices has been reported by the prevailing microfluidic technology. It is vastly used in testing and for the development of biomedical field and pharmaceutical industries. Development of smart bandage has been reported by different researchers worldwide using microfluidic technology. The conventional bandage is a medicated strip that becomes a breeding ground for bacteria on getting wet. Hardy [8] et al fabricated a bandage comprising of alternate gold strings for supplying voltage to the wound site. Fig. 1 shows the geometrical design of gold strings.

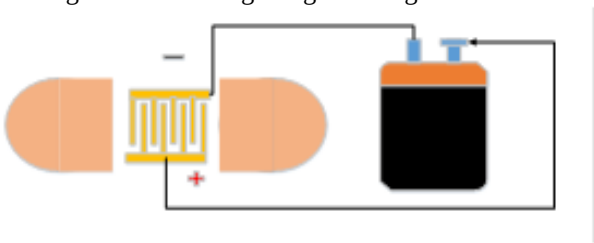

Fig. 1 Design of gold plated smart microfluidic bandage [8].

Lin [9] *et al* developed a temperature sensitive transparent, soft, durable, and flexible hydrogel bandage. Amount of drugs diffusion depends upon the temperature variation and the bandage is shown in Fig. 2 [9].

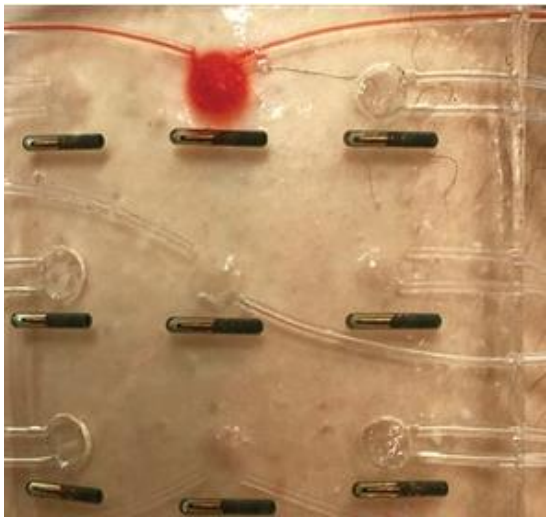

Fig. 2 A smart bandage designed by MIT researchers consisting of drug reservoirs, temperature sensors fabricated in a hydrogel matrix [9].

Mostafalu [10] et al reported a thread based encapsulation of drugs with independent addressing to release the medication (Fig. 3). The signals are sent wirelessly and the microcontroller release voltage signal to a specified fiber. It heats the gel enriched in infection fighting antibiotics.

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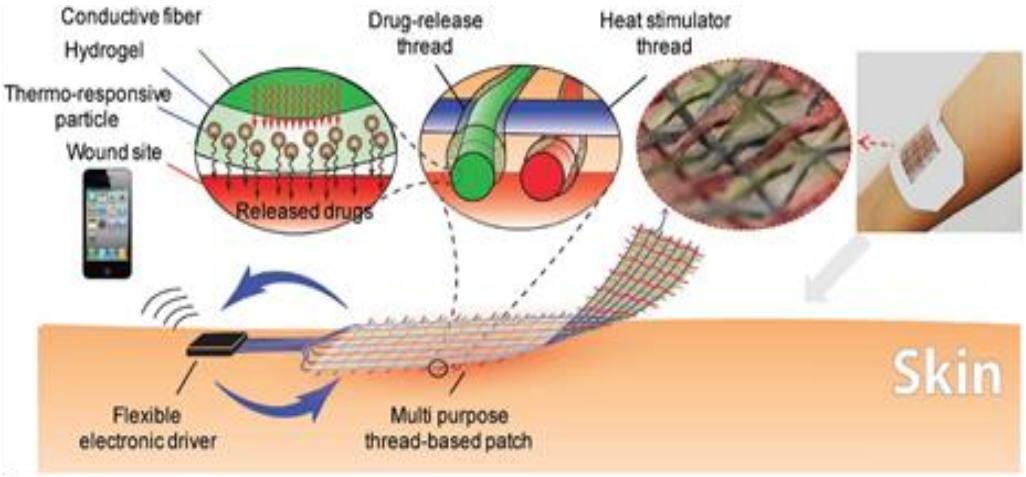

Fig. 3 A smart bandage fabricated with heaters that initiates drug release on the receipt of signal [10].

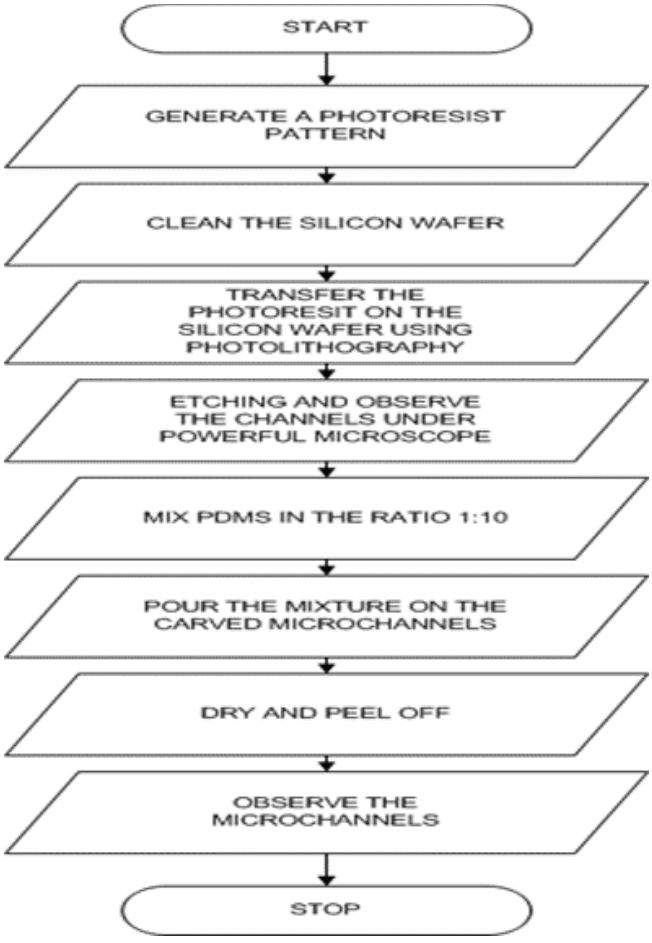

Fig. 4 Flowchart for fabrication of microfluidic structure using PDMS

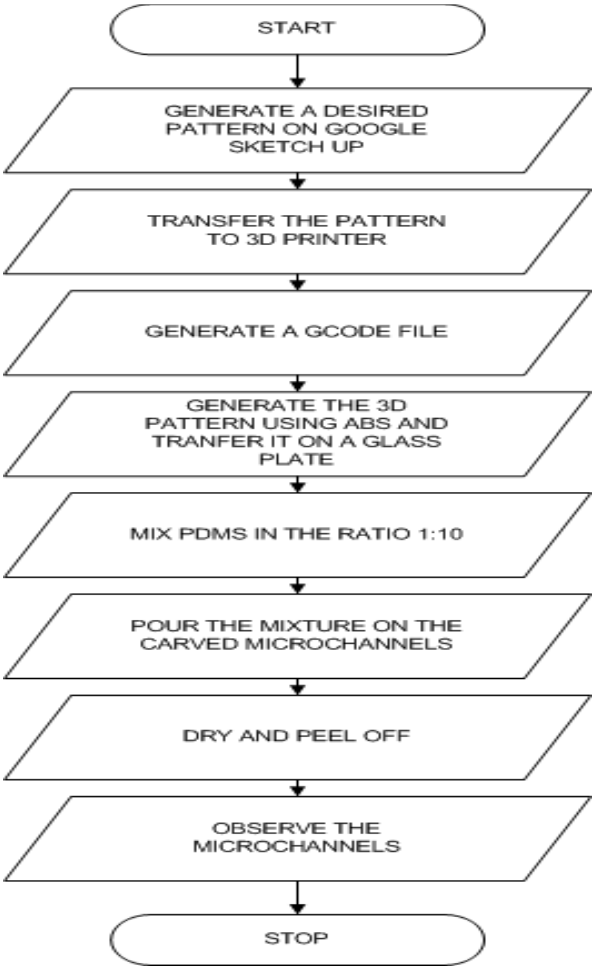

Fig. 5 Flow chart for fabrication of microfluidic structure using 3D printer.

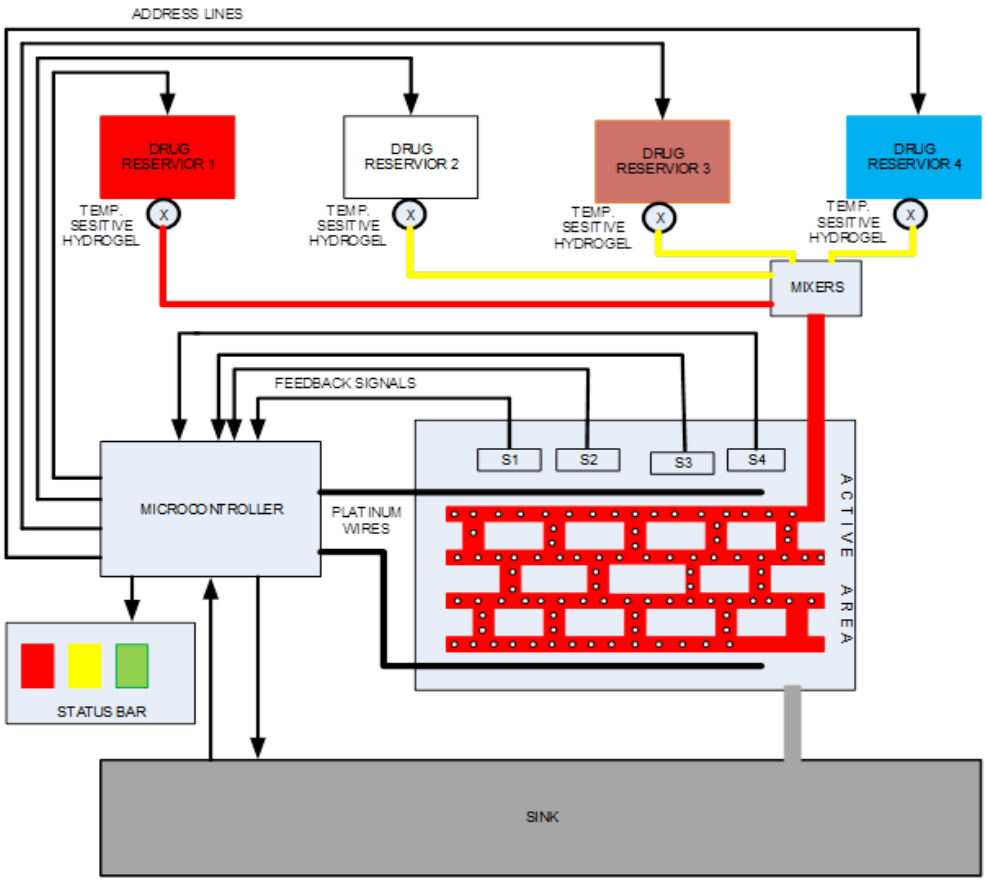

Fig. 6 Block Diagram of microfluidic bandage system.

Smart bandage is a relatively new and emerging concept in the present area of medicine & are rapidly finding opportunities in the health care industry especially area of chronic wound care. Not only do these smart bandages have the ability to save lives, but they also have the potential to reduce complications speedup the healing process & save time and money. The smart bandage is reliable, accurate, have a longer shelf life& ready to use. In most of the cases the smart bandage structures are fabricated using PDMS that are developed with the help of photolithography techniques. Fig. 4 and Fig. 5 shows the steps for fabrication of microfluidic structure using photolithography and 3D printing techniques.

Fig. 6 shows the proposed bandage consisting of active area, microcontroller, status bar, drug chambers, mixers. The microcontroller plays the lead role in the working of smart bandage. It releases drug as per the pH of the wound. A feedback system controlled by the microcontroller controls the flow of drugs. The drug chambers are cylindrical shaped structure wrapped with nichrome wires that are connected to dc voltages. The change in voltages controls the amount of drugs released from them. Three mixers are used to mix the drugs for uniform distribution of drugs on the active area. Waste are collected in the sink and status bar displays the status of different blocks of bandage. The drug chambers/ sink being empty or full is displayed on the status bar [11]. In this research paper, fabrication of microfluidic bandage is reported.

II. METHODOLOGY

The bandage to be fabricated consists of four inlet drug chambers, three mixer that feeds the drugs from four different inlets. The drugs after mixing are fed to the active area of bandage. A sink collects the waste of the smart bandage. The smart bandage is designed into the Arc Sign software. The object is sent for cutting on the hydrophobic flexible sheets. The connection channels for the same are also designed and developed using Arc Sign and finally taken off precisely.

III. RESULT

The width of flexible hydrophobic flexible sheets taken for fabricating the bandage is 18 microns. Fig. 7 shows the fabricated structure of smart bandage. The three circles shown are the mixers that are fed with the voltage signals as shown in Fig. 8. The colored connections shown on the transparent sheet are meant for supply voltages that in turn mix the drugs passing through mixers. Dimensions of small mixers i.e. small circles are 5.871mm for inner radius and 11.154 mm for outer radius. The bigger mixer/ circle in the middle of small mixers are having inner dimension of 7.936 and outer dimension of 15.872mm. The active area consists of 7 channels of dimensions 1mm height and width 40.632 mm. The width of channel connecting bigger mixer to the microfluidic channels of active area goes on decreasing from 3 mm to 1 mm.

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Fig. 7 Smart bandage designed and developed using Arc Sign software.

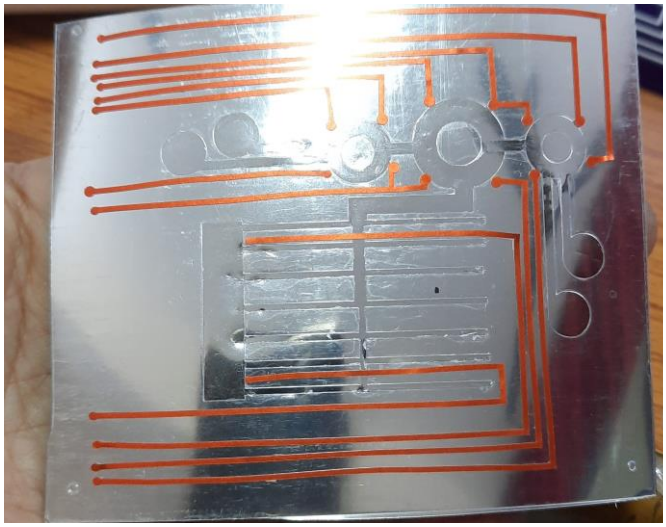

Fig. 8 Smart bandage developed on transparent flexible sheet attached with copper connections. .

IV. CONCLUSION

The microfluidic bandage can be fabricated using Arc Sign software and flexible sheets are economical as compared to fabrication techniques adopted by 3D printing and PDMS.

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New Development in Hydrogen Vehicle Fuel Cell Stack

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***Abstract*—** From past few decades, the combustion engine dominated our planet. However, this domination comes to end when world consider limited presence of fossil fuel reserves and also its role in increasing level of pollution from past few year due to high usage. Electric car are the very first thought which people get into their mind but found to be worthless, when people talk about long distance travel. Moreover take very long time to recharge. A major breakthrough comes with development of Hydrogen Fuel cell stack, which is suitable solution which can act as range extender and provide quick refill. Moreover, have zero emissions. Although, hydrogen vehicles given us extra edge but low efficiencies make them in ineffective and highly expensive, at first place. This paper conclude that with the use of maximized surface of contact (with membrane) by effective 45^0 inclination of fuel cell and the redesign of cathode side flow channels, leads us to improvement in the efficiency. With this design is more compact and optimized. This concept when used in hydrogen vehicle fuel cell stack, it not only make it compact and optimized but also increase its efficiency. Consideration the challenges and future expectations, compact and efficient Hydrogen vehicle is big positive.

***Keywords*—**Hydrogen vehicle; Hydrogen fuel cell stack; Fuel cell; cathode air and refrigerant channel redesign; Polymer Electrolyte Membrane Fuel Cells(PEMFCs); Reinforced stack Design.

I. INTRODUCTION

Nowadays, there is steep increase in demand of electric vehicle. Electric vehicle are known for their cheap and green use. However, lack behind when portrayed with long distance travel and recharge time. However, intimate use of electricity and fuel cell such as hydrogen is not only regarded as a promising solution but also environmental friendly by zero emissions. With these advantages, hydrogen vehicles based on hydrogen fuel cell stack is seeming to have strep increase in demand. This may be due to the gradually decreasing presence of fossil resources. Hence due to this reason, world is looking for evolutionary change and may lead to development hydrogen based vehicle technologies. However production of hydrogen and its efficient usage is now the key challenge. Hydrogen production very first initiated and produced by the companies Dornier System and Lurgi, a decade ago. They develop methodology to produce hydrogen by electrolysis of water, on a high temperature (900--1000°C). Their method is studied and modified for large and economic production of hydrogen and even now it seek more development [1,2].

Hydrogen fuel cell stack are also known by the term range extenders in electric vehicles. The basic function is to transform the energy present in chemical form to electrical energy.[4] As compared to batteries, these are power producing units not storing. In 1939, Fuel cell (FCs) was firstly discovered by Sir William R. Gove. FCs are subdivided into many types but among them, the high temperature Polymer Electrolyte Membrane Fuel Cells (HT-PEMFCs) is most widely used hydrogen fuel cell with better cooling behavior then others, due to its high heat dissipation tendency [3]. However, in start it need energy to reach out its operation point temperature. PEMFCs consist of polymer electrolyte membrane, which conduct proton, structurally sandwiched between bi-layer of electrodes. One electrode is provided with hydrogen which acts as fuel and other with oxygen. PEMFCs are known for their high efficiency range (50-80%) while change on variation of temperature [5,6,8].

II. FUNDAMENTAL CONCEPT

Most recent developed and used in vehicle Hydrogen fuel cell stack consists 350-400 equal dimension fuel cell. The basic function is to transform the energy present in chemical form to electrical energy. As the fuel is hydrogen, it is oxidized electro-chemically to water and the reaction is as follows:

$$H_2 + \frac{1}{2}O_2 \rightarrow H_2O$$

PEMFC consists of polymer electrolyte membrane, which conduct proton, structurally sandwiched between bi-layer of electrodes. One electrode is provided with hydrogen which act as fuel and other with oxygen.

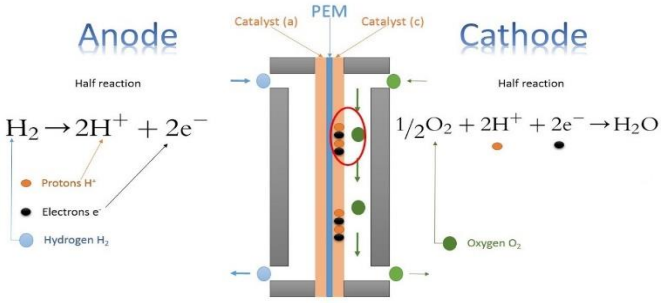

Figure 1: Outline of self-humidification concept by water content control

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The above overall reaction can be written after breakdown as follows:

$$2H_2 + \rightarrow 4H^+ + e^-$$

$$O_2 + 4H^+ \rightarrow 2H_2O$$

In this the Hydrogen which is present at anode diffuses into the catalytic layer present at anode on oxidation into proton and single electron. With addition of external circuit, these electron moves along the circuit and passes on to the cathode and this flow cause electricity and on the other side when photon reach cathode through PEM, and under the presence of that electron reduce oxygen to water.

While, in terms of working, the PEM fuel cell is having thermo-electric behavior. In other words the production of electricity depends upon the maintained temperature. An analysis is previously done, which says to get optimum working of PEM fuel cell, it is well needed to maintain a temperature of 55 °C. As the temperature rise by time with reaction and electricity generation due to non-uniformity in current density. With the use of air refrigeration, achievable temperature is 160 °C but after 65 °C the hydrogen cell stack is found to be unstable while stack performance is diminished due to evaporation of water and dehydration of membrane. Hence it's clearly seen that this low temperature can be achieved and maintained by a good refrigerant [8,9,10].

Humidification (liquid cooled only) is the latest technique used to prevent membrane dehydration. In this the cathode inlet flow is humidified using the cathode exit flow water content. However, this methodology is space consuming. Nowadays, big development in stack is taken place in which there is no need external mechanism for humidification.[7] Here, downstream water is returned to upstream inside cathode via internal circulation through anode, eliminating the need of humidifier[11], as shown below:

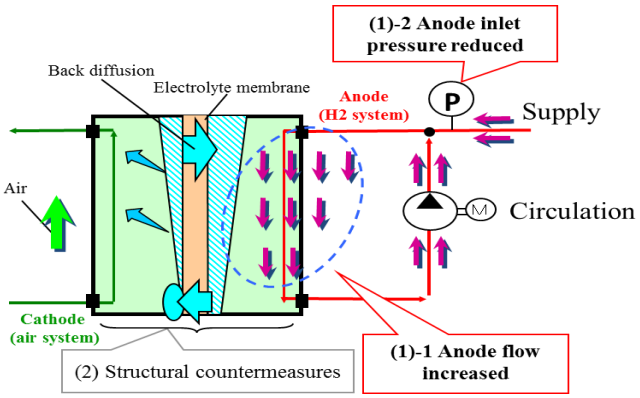

Figure 2: Outline of self-humidification concept by water content control

One of the practical example is Toyota FCs is the very first FC system in this world who adopted this technology and established a working hydrogen fuel cell stack which work without an external humidifier.

III. PROPOSED DESIGN

This study presents new development in design of hydrogen fuel cell stack, reinforcing it optimum working condition. The modification is in both the arrangement of individual fuel cell in hydrogen cell stack and in the air or refrigerant flow side (cathode side). Hence our proposed model consists of two parts. First is the system of working fluid to extract heat from fuel cell stack and the second is the arrangement made to give maximum area of contact under the same volume.

There are many possibilities of design can be considered for the optimized flow of air and refrigerant. While, among them a parallel channel flow is better due to its simple and maximum area of contact with the membrane. However, our design is not having the same area of correction inside a flow tube. In this design, the air channel inlet to outlet ratio is kept greater than 1 (most likely 2) and the refrigerant inlet to outlet is less than 1 (most likely half). This change in area act like diffuser and nozzle like structure and hence regulates the flow in our terms.

Here, the arrangement of the nozzle type air and refrigerant cannels in upstream direction while the hydrogen on the anode side have cross flow. This design is shown in figure below

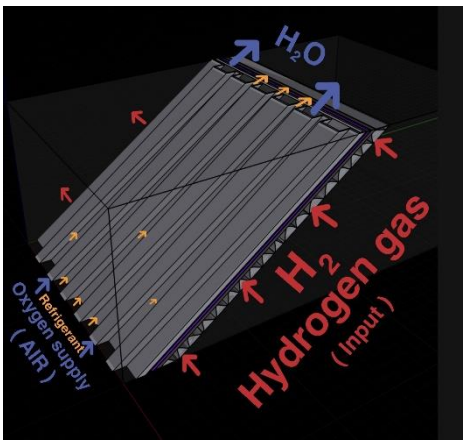

Figure 3: it shows the arrangement of magnetization chamber for adiabatic magnetization.

In this structure main change is in the area inside and outside along both reactant air and the Refrigerant/Coolant. As ratio of Refrigerant gas input and output is opposite to air input and output. All this is done in such a way that when refrigerant heat up, it's under thermal expansion, it is supported by increasing area, leading to better absorptive capacity. While, opposite in case of air, as along the path, air get absorbed and to maintain its given decreasing area, leading to higher proton transfer tendency. However, there are some other aspects playing key role, like flow velocity. In first case, when area decrease for the air, the velocity increase due to nozzle effect but when the density decrease along the flow due to the absorption of protons, this loss is nullify by this nozzle effect and opposites for the refrigerant (note, here no mass loss). So, in this way flow is

regulated and a constant temperature optimum condition is maintained. Both of this optimizes the reaction inside the hydrogen fuel cell.

On the other hand, in our proposed method, there is a change in design by giving inclination of 45 degree (vertically) to the fuel cell. This change is to optimize the area available per fuel cell and hence increase the productivity. The side view of the fuel cell stack is shown in the figure below:

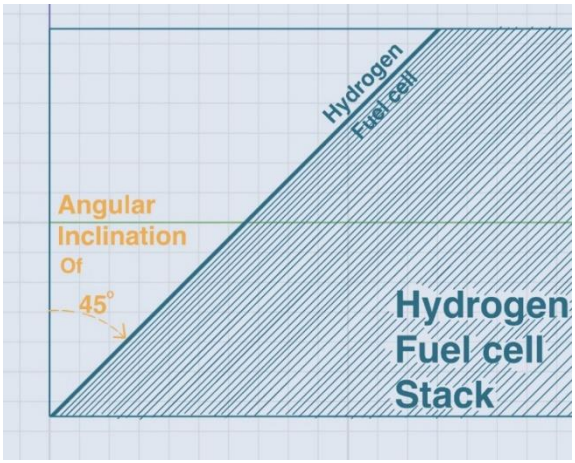

Figure 4: it shows side-view of 45^0 inclined fuel cell in a HFCS

However, for the sake of comparison and analysis, considered a newly adopted design of hydrogen fuel cell stack with 370 number of individual fuel cell and having dimensions 20x13x50 (breath x height x length), where (breath x height) represent previous individual fuel cell area, as shown below:

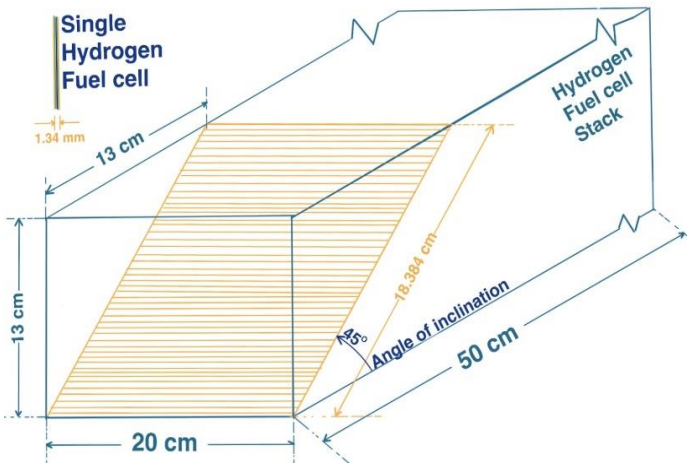

Figure 5: it shows 45^0 inclined fuel cell in a same dimension and volume HFCS

As per the most adopted size and structure of Hydrogen fuel cell stack, it consist as follows:

1. Number of fuel cell per each hydrogen fuel cell stack = 370 (reduced from 400)
2. Average area of single fuel cell = face area (truly vertical) = bxh = 255-260 cm^2
3. Volume occupied by hydrogen fuel cell = 13L
4. Thickness of each FCs = 1.34mm
5. Capacity of fuel cell per unit area = upto 120mW/cm^2
6. Therefore, avg. area of fuel cell stack = 95000 cm^2

By doing this, base remain the same 20 cm but the height of the fuel cell plate changed to 18.384cm from 13 cm, while other dimensions remain the same. Analysis of new structure are as follows:

1. Number of fuel cell per each hydrogen fuel cell stack = 275 (decreased by 95)
2. Average area of single fuel cell = bx(new height) = 20x18.384 = 367.69 cm^2 (increased by 110cm^2 per cell)
3. Volume occupied by hydrogen fuel cell = 13L(now 3.380L volume left empty in that box)
4. Thickness of each FCs = 1.34mm (negligible change)
5. Capacity of fuel cell per unit area = upto 120mW/cm^2 (not considering increased efficiency due to previous effect)
6. Therefore, avg. area of fuel cell stack =101000 cm^2 approx. (increased by 6000)

It can easily depicted that new design is more compact with a useful left over volume of 3.380 L and now can be used to install hydrogen and refrigerant/air input and output system inside the stack. Hence, it is the optimum utilization of space, in first place. However by inclination, there is reduction in the number of fuel cell plated while the area per plate and the average area of complete cell stack increased. This make this design produce more area of contact and make this fuel cell more efficient and if needed can produce high power at the same time. This is very compact design so far in which there is optimum usage of available volume.

IV. Observation and Results

Our study mainly focused on the optimum of working conditions and hence getting higher productivity. This new design delineate two things, beginning with the optimization of flow of air and refrigerant in which there is changed air channel inlet to outlet area ratio as greater than 1 (most likely 2) and the refrigerant inlet to outlet as less than 1 (most likely half). This change in area act as diffuser and nozzle like structure and hence regulates the flow in our terms. Actually

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this change optimized the design by putting a temperature drop of the fuel cell stack. All is due to the fact that refrigerant heat up, it's under thermal expansion, and itis supported by increasing area, leading to better absorptive capacity. While, opposite in case of air, as along the path, air get absorbed and to maintain its given decreasing area, leading to greater proton transfer tendency. However, there are some other aspects playing key role, like flow velocity. In first case, when area decrease for the air, the velocity increase due to nozzle effect but when the density decrease along the flow due to the absorption of protons, this loss is nullify by this nozzle effect and opposites for the refrigerant. All this represented on the temperature flow chart, which as follows:

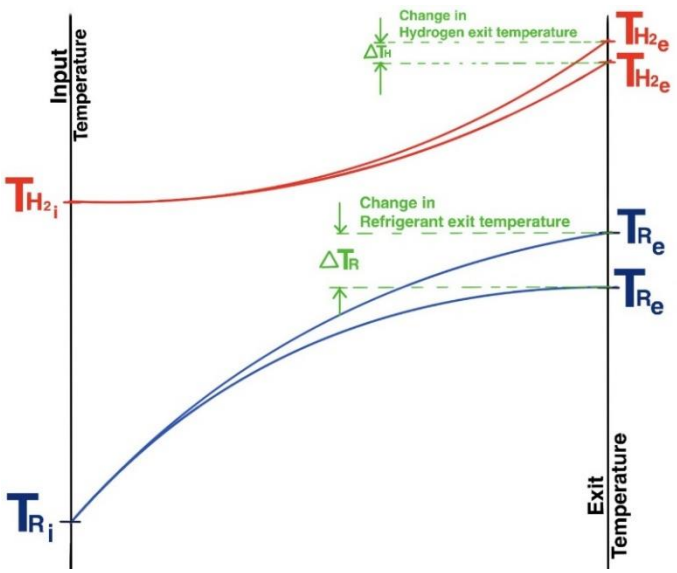

Figure 6: Temperature of hydrogen and the refrigerant at inlet and exit for individual hydrogen fuel cell

Here, we can easily depict from the graph that there is a considerable change in the exit temperature (represented by ΔT_H) with and without using the new design. And similarly the change in exit temperature of refrigerant (represented by ΔT_R) with and without using the new design. So, in this way flow is regulated and a constant temperature optimum condition is maintained. Both of this optimizes the reaction inside the hydrogen fuel cell.

Other development in design was to change the design by giving inclination of 45 degree (vertically) to the fuel cell. This change is to optimize the area available per fuel cell and hence increase the productivity. However, for the sake of comparison and analysis, considered a newly adopted design of hydrogen fuel cell stack with 370 number of individual fuel cell and having dimensions 20x13x50 (breath x height x length), where (breath x height) represent previous individual fuel cell area. Given below is the tabular analysis of new design:

TABLE I
Analysis of different characteristics of old and new design

Characteristic	Old design	New Design (our study)
Number of fuel cells	370	275
Avg. area per FCs	255-260 cm^2	367.69 cm^2
Avg area of complete fuel cell stack	95000 cm^2	101000 cm^2
Volume occupied and	13L	13L but 3.380L for other components
FCs size	1.34mm	1.34mm

It can easily depicted from the above analysis, that new design is more compact with a useful left over volume of 3.380 L and now can be used to install hydrogen and refrigerant/air input and output system inside the stack. Hence, it is the optimum utilization of space, in first place. However by inclination, there is reduction in the number of fuel cell plated while the area per plate and the avg. area of complete cell stack increased. In all, our design is compact, optimized and productive. There is only one way to represent this increased productivity, when is represented on the efficiency graph along with the old model outcome. This analysis is represented in the fallowing graph:

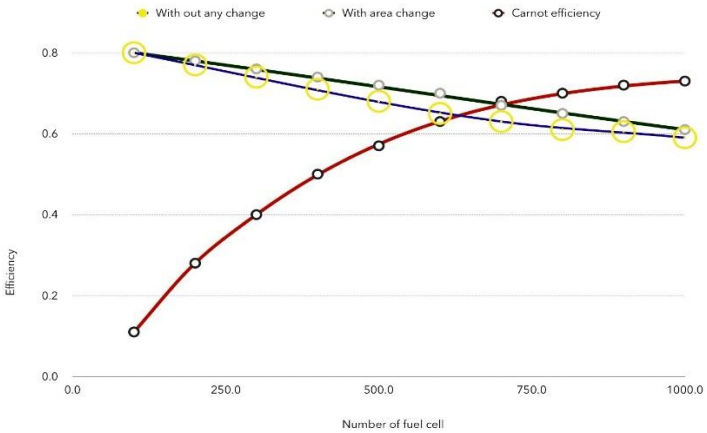

Figure7: Efficiency v/s number of fuel cell plot for all Carnot, old and our new model.

In this graph, there are three different curves which different three different operation cycles. The red curve represent the carnot efficiency, the blue represent the old cycle efficiency and black shows the new design efficiency. This graph can easily depict that the efficiency of working fuel cell stack decrease with increase in number of cells. However, the new design have less steep decreasing curve and hence have higher all-round efficiency. Further, this hike in efficiency is due to both, cathode redesign and the stack fuel cell modification. Hence, this fuel cell is more efficient and if needed can produce high power at the same time. This is very compact design so far in which there is optimum usage of available volume.

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V. CONCLUSION AND FUTURE SCOPE

The described design and its associated reinforcement not even made this device compact, it is also efficient at first place. This new development presented a compact hydrogen fuel cell stack with innovative cathode redesign, in which air and refrigerant channel cross section area is changed along the direction of flow. This change in area acts as diffuser and nozzle like structure and hence regulates the flow in our terms. Actually this change optimized the design by putting a temperature drop of the fuel cell stack. Other development in design was to change the design by giving inclination of 45 degree (vertically) to the fuel cell. This change is to optimize the area available per fuel cell and hence increase the productivity. It can easily depicted that new design is more compact with a useful left over volume of 3.380 L and now can be used to install hydrogen and refrigerant/air input and output system inside the stack. Hence, it is the optimum utilization of space, in first place. However by inclination, there is reduction in the number of fuel cell plated while the area per plate and the average area of complete cell stack increased. Hence, new developments in hydrogen fuel cell stack is big achievement in technology which make us step forward to green-use and optimized performance of hydrogen vehicles, full filling the future expectations at first place.

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Parametric Analysis of Schizophrenic Speech

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***Abstract*—** Schizophrenia is a mental disorder affecting the everyday functioning of an individual. Its symptoms include hallucinations, distorted perception of reality, alogia, and cognitive problems. It also tends to have a considerable effect on the speech of the affected person. In the absence of methods for its diagnosis, speech can be used as an early indicator to detect the disorder. In this paper, various parameters of speech have been investigated for schizophrenic speech and compared with healthy speech. It was observed that pitch, jitter, and shimmer of schizophrenic speech showed considerable deviation from healthy speech. An overall identification rate of 83.23% was obtained for feature vector with all the parameters. Out of all the investigated parameters, shimmer was observed to offer the highest identification rate of 82.94% for recognition of schizophrenic speech.

***Keywords*—** Schizophrenia, speech, Mahalanobis distance, shimmer

I. INTRODUCTION

Schizophrenia is a severe mental disorder which is characterized by a wide range of unusual behavior such as hearing voices (hallucinations) and distorted or false perception, often bizarre beliefs. Such individuals are unable to distinguish between reality and imaginative events [1]. Unusual experiences seem real to the affected person whereas others assume that they are lost in their own world.

Owing to the symptoms of schizophrenia, a person with the illness is likely to interpret reality in a way that seems abnormal to others. Persons with schizophrenia are not aware of the changes in their behaviour. They may not accept that they are behaving differently. This is because for them, the lines between external and internal reality are blurred and they are unable to differentiate between the two. The onset of schizophrenia usually occurs between puberty and early adulthood. It is a condition that develops gradually, often over a period of weeks to months. Symptoms in the early stages of schizophrenia may be similar to other mental health issues: adjustment problems, depression or anxiety [2]. In the initial stages of the illness, the person may show negative symptoms such as remaining aloof and withdrawn, preferring to stay away from friends and family. They may lose interest in daily activities and hobbies they enjoyed earlier, and ignore personal grooming or hygiene, even if they were very particular about it before. Their behaviour changes too. If not detected and treated, the problem may become more severe and the person may turn aggressive verbally and physically.

Across the world, schizophrenia affects approximately one per cent of the population, and is observed in both men and women. The common age of onset is 15 to 25 years, though there are cases in which the disorder can develop in people beyond this age group as well [3]. A person with schizophrenia is not likely to behave strangely all the time. The symptoms can be unpredictable in when they appear and disappear, and the intensity of the unusual experience fluctuates. The most common symptoms categorised as positive symptoms [4] are:

- Hallucinations: Seeing or hearing people or things that do not exist. The person may also have the experience of tasting, touching or smelling something that isn't there. Most people also report they hear voices speaking to them, commanding or abusing them.
- Delusions: These are beliefs that can persist even after they have been proved to be false or unreasonable. Some people believe that someone they know is trying to control them or poison them; some may believe that someone is communicating with them through a secret code on television. The person may feel everyone is talking about him/her and may be very suspicious all the time. In rare cases, the person may believe that he or she is a celebrity or a historical figure.
- Disorganized thinking: Sometimes, the person is unable to think clearly. Their talk appears illogical, irrelevant or disconnected and this makes no logical sense to people around them. The person may stop abruptly before finishing a sentence, give irrelevant answers to questions, or occasionally they make up their own nonsensical words.
- Disruption of normal behaviour: The person may tend to avoid spending time with others, instead they prefer being alone. They speak in a flat monotonous tone, often in monosyllables, and their facial expressions are mask-like, displaying little or no emotion.

Another category of symptoms include cognitive problems [5]. The person's impaired thinking makes it difficult for them to focus on simple tasks for longer durations. They have trouble paying attention to what other people are saying, and may forget even to do simple routine tasks which most people take for granted. This usually results in their poor performance at studies or at work. This problem is seen in the early stages of illness but family and friends may fail to

identify the problem due to lack of awareness about the illness.

Though there is no known cure for schizophrenia, there are several treatments that can help the person live his or her life independently. Schizophrenia is a chronic disorder and needs management so that the person can return to normal daily functioning [6]. The key to easier management lies in early diagnosis. The earlier one identifies the problem and gets a diagnosis, the greater are the chances of good outcome. However, there are no prescribed methods for its diagnosis [7]. In the absence of such methods, one can only rely on symptoms for early detection of the disorder.

Schizophrenia leads to auditory dysfunction has been studied in [8]. Low level speech parameters are altered for a schizophrenic patient [9]. The degradation of speech parameters of a schizophrenic individual has been explored from interviews of patients in [10]. This research work deals with study of spectral characteristics of a speech signal. Speech parameters such as pitch, jitter and shimmer have been investigated to find their effect on identification of schizophrenic speech. Section 2 describes the procedure used, section 3 discusses the results and section 4 contains the conclusion and future scope.

II. Experimental Procedure

A database for speech was prepared consisting of 12 (6 male and 6 female) schizophrenic patients and 12 (6 male and 6 female) healthy individuals. The speech was segmented and labelled into 800 sentences. Parameters including mean pitch, median pitch, standard deviation, minimum pitch, maximum pitch, jitter and shimmer were extracted for each sentence using PRAAT software.

The extracted feature vectors were used to represent each sentence of schizophrenic and healthy speech. The mean vector for both category of speech was estimated. K-means based centre of gravity was used to divide the feature vectors into two clusters representative of both categories of speech. In order to evaluate the identification rate, the Mahalanobis distance of each feature vector from mean as well as centre of gravity was estimated. The distance D_m of a feature vector S from mean vector M_v or centre of gravity vector C_v is calculated as follows:

$$D_m = \sqrt{(X_v - S)^T \Sigma^{-1} (X_v - S)} \qquad (1)$$

where target vector $X_v \in (M_v | C_v)$. The identification rate was calculated by identifying the class with the minimum distance for each sentence from the target vector. If minimum distance was found from target vector of schizophrenic speech, the input sentence was labelled as schizophrenic and vice versa. The block diagram of various steps involved in the procedure is shown in Figure 1. The importance of each parameter in the feature vector for clustering was also estimated to find out the dependence of schizophrenic speech on each parameter.

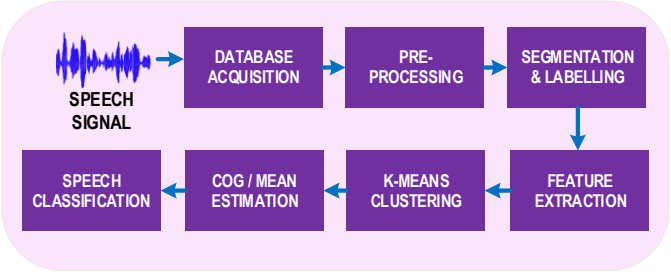

Fig.1: System architecture

III. Results and Discussions

The waveforms and spectrograms of the speech database for both female and male speakers used in the experiment have been shown in Figure 2 and 3 respectively. It was observed that the spectrograms of schizophrenic speech were visually distinguishable from healthy speech for the same sentence spoken. The differences were more prominent in female speakers. In order to find the parameter affecting the speech of schizophrenic individuals, various parameters were analysed.

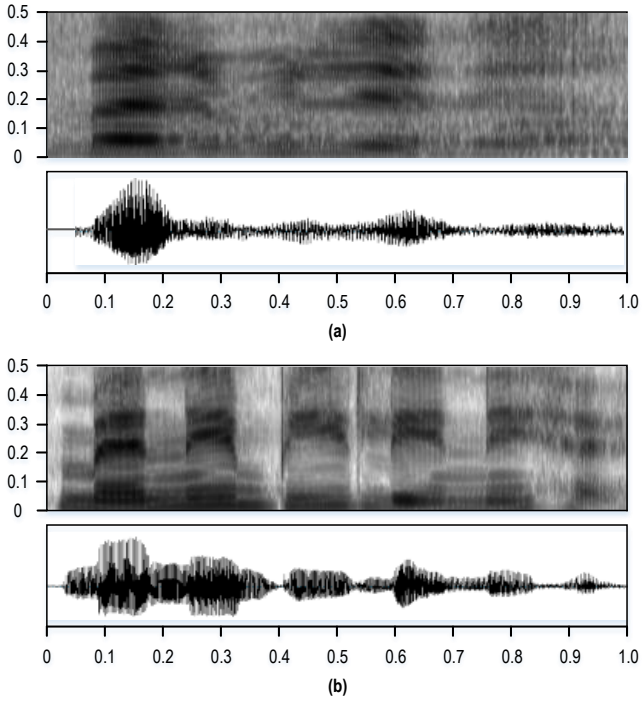

Fig.2: (a) Schizophrenic female speech (b) Healthy female speech

Table I shows the mean values obtained for schizophrenic and healthy speech for both male and female. There is considerable change in values of pitch, jitter, and shimmer as can be observed from the values. The value of shimmer for schizophrenic speech (1.29, 1.28) are higher than healthy speech (0.79, 0.97) in case of both females and males. Similarly, the value of jitter was also observed to be higher for schizophrenic speech (2.20. 1.95) as compared to healthy

speech (1.73, 1.74). The difference as observed from values is more prominent for female speakers. Also, jitter and shimmer have been observed to be less dependent on the gender of the speaker and more dependent on the state, i.e., healthy or schizophrenic. On the other hand pitch although changes due to the state but more variations are observed with the gender of the speaker.

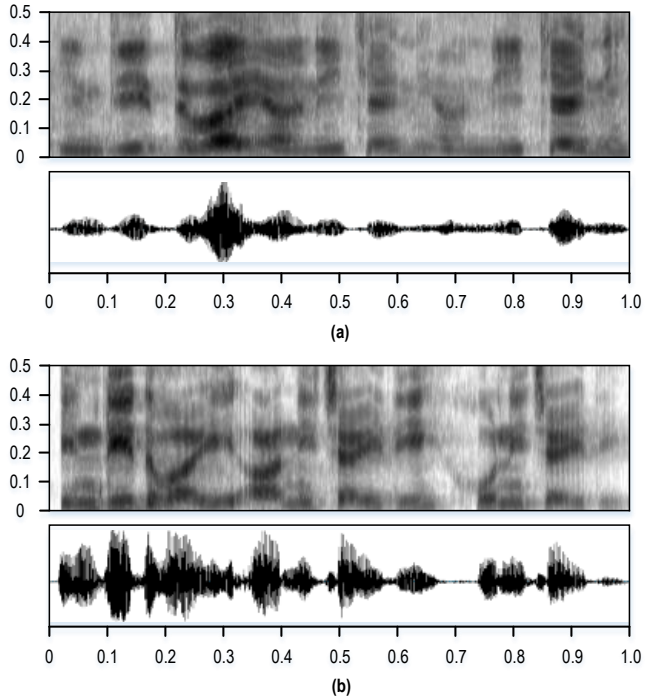

Fig.3: (a) Schizophrenic male speech (b) Healthy male speech

Table I Mean speech parameter values

	Female Schizo	Female Healthy	Male Schizo	Male Healthy
Median Pitch (Hz)	232.61	234.25	145.16	140.89
Mean Pitch (Hz)	225.78	230.78	147.12	142.08
Standard Deviation	35.74	30.45	16.84	17.71
Min Pitch (Hz)	139.52	161.48	112.81	111.98
Max Pitch (Hz)	289.34	286.56	195.36	201.51
Jitter (%)	2.20	1.73	1.95	1.74
Jitter (sec)	0.01098	0.00007	0.00023	0.00014
Shimmer (%)	13.39	7.38	11.91	9.97
Shimmer (dB)	1.29	0.79	1.28	0.97

The identification rate was estimated from mean vector as well as from the centre of gravity for each parameter separately as well as all in combination. The results obtained for schizophrenic and healthy speech irrespective of the gender are shown in Table II.

Table II Speech identification rate

	Centre of Gravity		Mean	
	Schizo	Healthy	Schizo	Healthy
Median Pitch (Hz)	47.64	50.29	52.64	49.7
Mean Pitch (Hz)	44.7	48.82	56.76	49.7
Standard Deviation	40.29	66.17	100	0
Min Pitch (Hz)	67.64	49.41	87.05	22.35
Max Pitch (Hz)	47.35	54.7	29.11	72.35
Jitter (%)	48.82	62.35	100	0
Jitter (sec)	43.42	58.21	100	0
Shimmer (%)	67.05	83.23	100	0
Shimmer (dB)	71.47	82.94	100	0
Overall	77.35	84.7	49.41	54.7

Mean vector exhibited poor results for jitter and shimmer classifying entire speech into one cluster. The results with mean vector were also unsatisfactory for pitch parameters. It was observed that much better results were obtained for clustering using centre of gravity. Clustering using centre of gravity yielded satisfactory results for all the speech parameters considered. Shimmer with identification rate of 71.47% for schizophrenic speech and 83.23% for healthy speech was found to be most dominant. Jitter also exhibits satisfactory results with an identification rate of 48.82% for schizophrenic speech and 62.35% for healthy speech. An overall identification rate of 77.35% for schizophrenic speech and 84.70% for healthy speech was obtained from all the parameters taken together.

IV. Conclusion And Future Scope

Schizophrenia is a mental disorder which alters the speech of an individual. In this paper, the effect of the disorder on various parameters of speech have been studied. Pitch, jitter and shimmer were found to be most affected parameters. Schizophrenic and healthy speech were clustered to find their centre of gravity. The importance of each parameter on clustering was estimated using Mahalanobis distance. Shimmer was found to be most dominant for clustering followed by jitter. Shimmer exhibited an identification rate of 71.47% for schizophrenic speech and 83.23% for healthy

speech while jitter had 48.82% for schizophrenic speech and 62.35% for healthy speech. An overall identification rate was estimated to be 77.35% for schizophrenic speech and 84.70% for healthy speech. The schizophrenic speech can be further analysed to develop an automatic tool for diagnosis and identification of the disorder in the general population which is our future agenda.

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