SPECIAL FEATURE

Real time driver alert system

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# Digest

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# Missiles - A Marvel of Technology

Missiles were first developed by Germany during World War II. As most of these missiles have guidance systems they are called guided missiles. These missiles are self propelled by jet engine or rockets. Earlier missiles used mechanical systems to keep them flying over a selected routes. The missile use different technologies like radio waves, infrared waves and lasers for guidance to hit the target from radiation emitted from enemy radars, or provided by the missile itself. It can also locate the target location by using a guidance system such as INS, TERCOM or satellite guidance or automatic system. They are classified based on the platform from which they are launched, their range and the type of the target. For missions of land attack Ballistic missiles are used and carry nuclear weapons which could deliver warhead to a target city with no possibility of interception. The Russian Topol M (SS-27 Sickle B) is the fastest (7,320 m/s) missile currently in service.

Cruise missiles are generally associated with land-attack operations, but also have an important role as anti-shipping weapons. They are primarily launched from air, sea or submarine platforms in both roles, although land-based launchers also exist. Cruise missiles are generally further divided into subsonic or supersonic weapons - supersonic weapons such as BrahMos (India, Russia); these are difficult to shoot down, whereas subsonic weapons tend to be much lighter and cheaper, allowing more to be fired. The stealth technology developed in the US to prevent tracking of missiles by radars which uses a combination of technologies or radar cross- section reductions to remain undetected. Stealth technology is used in unmanned air vehicles (UAV).Cruise missiles, ballistic missiles also use this technology where their payloads are more difficult to track, identify and engage by defensive weapon system.

India has set its foot in developing the most lethal and advanced missile systems in the world including anti-ship, air-defence, ballistic, cruise, air to air, anti-missile systems and even the capability to hit targets in space. India also marks itself among the seven countries possessing the Intercontinental Ballistic Missile (ICBM), which can travel a minimum distance of 5,500 km. India is also one of the four nations owning an Anti-Ballistic Missile (ABM) system. India has a formidable stockpile of potent weapons, with the Indian Air Force (IAF) version of the BrahMos, Intercontinental ballistic missile Agni-5 and other pivotal missiles. Along with these, India incorporates the missile series of Prithvi, Dhanush and Nirbhay in its stockpile of ammunition. In March 2019, India joined an exclusive club of countries that has the capability to hit a target in space as it tested the anti-satellite missile via ‘Mission Shakti’. India completed its fully operational nuclear triad (being able to launch nuclear warheads from air, land and sea), which made India just the fourth country, after the US, Russia and China to be able to do so. India is also a forerunner in strategic and tactical missiles technology that caters to several defence strategies. Thanks mostly due to our ‘Missile Man’ Dr. Abdul Kalam.

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# Real Time Driver Alert System

***Abstract :*** *Drowsiness and Fatigue of drivers are amongst the significant causes of road accidents. Every year, they increase the amounts of deaths and fatalities globally. Also, someone dies due to a drunk driver in America every 51 minutes, or 27 times per day. Around one-third of all fatal car, crashes involve an intoxicated person. Our System deals with Automatic Driver Drowsiness Detection based on visual information and Artificial Intelligence. We propose an algorithm to locate, track, and analyze both the driver's face and eyes to measure PERCLOS, a scientifically supported measure of drowsiness associated with slow eye closure using a computer vision system that can automatically detect driver drowsiness in a real-time video stream and then play an alarm if the driver appears to be drowsy. An Alcohol detection system is integrated into the vehicle to detect the drunkenness of the driver and accordingly lock or restrict the vehicle engine.*

**Keywords:** Drowsiness, Alcohol, computer vision, Artificial Intelligence, PERCLOS.

## I. INTRODUCTION

The development of technology allows introducing more advanced solutions in everyday life. This makes work less exhausting for employees, and also increases work safety. Vision-based systems are becoming more popular and are more widely used in different applications. Fatigue is such a psychophysical condition of a man, which does not allow for a full concentration. It influences the human response time, because the tired person reacts much slower, compared to the rested one. People, who work for the transportation business (car and truck drivers, steersmen, airplane pilots), must keep a close eye on the road, so they can react to sudden events (e.g., road accidents, animals on the road, etc.) immediately. Long hours of driving cause the driver fatigue and, consequently, reduces her/his response time. According to the results of the study presented at the International Symposium on Sleep Disorders, fatigue of drivers is responsible for 30% of road accidents [1]. The British journal "What Car?" presented results of the experiment conducted with the driving simulator and they concluded that a tired driver is much worse dangerous than a person whose alcohol in blood level is 25% above the allowed limit. Driver fatigue can cause a micro sleep (e.g., loss of concentration, a short sleep lasting from 1 to 30 seconds), and falling asleep behind the wheel [1].

Facial expressions have the ability to offer deep insights into many physiological conditions of the body. There are numerous algorithms and methodologies available for face detection which is the fundamental first step in the process. Drowsiness in humans is characterized by a few very specific movements and facial expressions- the eyes begin to close, the mouth opens in a yawn, the jaw goes slack and the neck tilts.

Alcohol detection is another major component of the project which is done through IoT sensors. In Alcohol Breath testing drivers are initially tested for alcohol impairment at the roadside with a screening device. Screening devices are about the size of old-fashioned mobile phones. The driver blows into a disposable mouthpiece for each test. The whole process takes about a minute for the device to record the result. Screening devices offer four result categories: "zero," "pass," "warn," and "fail". A sample of the ambient air is tested as a blank check. This is followed by a check sample of an air/ethanol standard. This checks the calibration of the device. The concentration of alcohol in the standard sample is 35 μg/100 ml air [2], which is the UK drink-driving limit. Two samples of breath are then taken from the motorist and tested, each separated by a sample of air. The test ends with a final air and standard check [2].

MQ3 is one of the most commonly used sensors in the MQ sensor series. It is a Metal Oxide Semiconductor (MOS) type of sensor. Metal oxide sensors are also known as Chemiresistors because sensing is based on the change of resistance of the sensing material when exposed to alcohol. So, by placing it in a simple voltage divider network, alcohol concentrations can be detected.

For the real-time application of the model, the input video can be acquired by mounting a camera on the dashboard of the car and can accommodate the driver's face, hands, upper body, and occlusions such as non-tinted spectacles and the alcohol detecting setup can be installed in the steering of the vehicle. Flowchart of drowsiness detection is shown in Fig – 1.

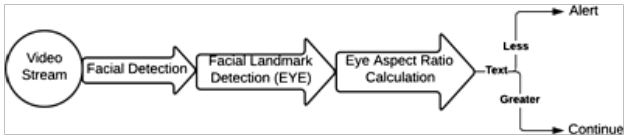


*Fig 1. Flowchart of drowsiness detection*

Alcohol detection block diagram is shown in Fig – 2.

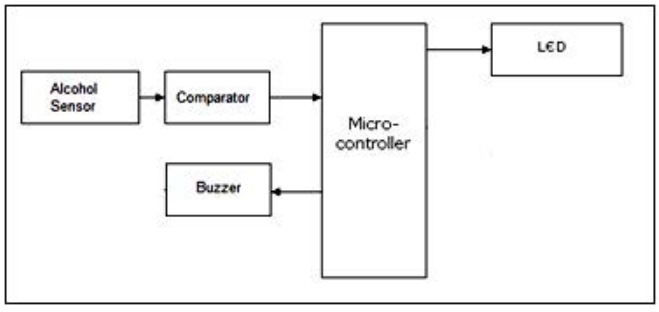


*Fig 2. Alcohol detection block diagram*

## II. IMPLEMENTATION

A. Drowsiness Detection

For this approach, we implement drowsiness detection using OpenCV and Python. The Dlib library is used to detect and localize facial landmarks using Dlib's pre-trained facial landmark detector. It consists of two shape predictor models that each localizes 68 and 5 landmark points respectively within a face image. In this approach, 68 facial landmarks have been used.

Histogram of Oriented Gradients (HOG) based face detector is used in our project. In this method, frequencies of gradient direction of an image in localized regions are used to form histograms. In many cases, it is more accurate than Haar cascades as the false positive ratio is small. Also, tuning at test time requires fewer parameters. It is especially suitable for face detection as firstly, it can describe contour and edge features exceptionally in various objects. Secondly, it performs operations on regional cells which allows the motion of the subject to be overlooked. Moreover, Dalal and Triggs discovered that the HOG descriptor works well for human detection in images, which makes it appropriate for drowsiness detection.

In our model, a HOG-based detector is first instantiated to find the location of the face in each individual frame of the input video stream.

The coordinates of the right eye, left eye, and mouth extracted at this stage are used to compute the aspect ratio for the right eye and left eye based on Euclidean distance. Eye Landmarks are shown in Fig – 3.

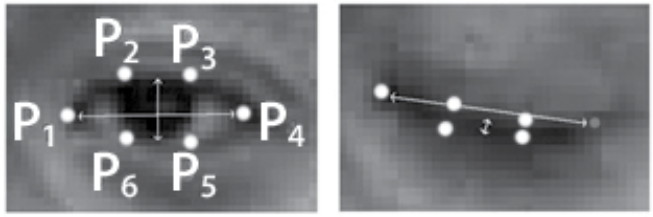


*Fig 3. Eye Landmarks*

$$EAR = \frac{||p2-p6|| + ||p3-p5||}{2||p1-p4||}$$

*Eq1. Eye Aspect Ratio Calculation*

The final display of the drowsiness detection system shows the feed of the video input (from video dataset or real-time capture), along with the computed aspect ratio values and drowsiness detection alerts. If the aspect ratio of the eyes falls below the stipulated threshold, then the message "Drowsiness detected" flashes on the screen.

Steps to train a model are:-

1. Sample P positive samples from your training data of the object(s) you want to detect and extract HOG descriptors from these samples.
2. Sample N negative samples from a negative training set that does not contain any of the objects you want to detect and extract HOG descriptors from these samples as well. In practice N >> P.
3. Train a Linear Support Vector Machine on your positive and negative samples.
4. Apply hard-negative mining. For each image and each possible scale of each image in your negative training set, apply the sliding window technique and slide your window across the image. At each window compute your HOG descriptors and apply your classifier. If your classifier (incorrectly) classifies a given window as an object (and it will, there will absolutely be false-positives), record the feature vector associated with the false-positive patch along with the probability of the classification. This approach is called hard-negative mining.

5. Take the false-positive samples found during the hard-negative mining stage, sort them by their confidence (i.e. probability), and re-train your classifier using these hard-negative samples. (Note: You can iteratively apply steps 4-5, but in practice, one stage of hard-negative mining usually [not always] tends to be enough. The gains inaccuracies on subsequent runs of hard-negative mining tend to be minimal.)
6. The classifier is now trained and can be applied to your test dataset. Again, just like in Step 4, for each image in your test set, and for each scale of the image, apply the sliding window technique. At each window extract HOG descriptors and apply your classifier. If your classifier detects an object with a sufficiently large probability, record the bounding box of the window. After you have finished scanning the image, apply non-maximum suppression to remove redundant and overlapping bounding boxes.

The following steps are followed for the testing of the model:

1. The real Time Input video is fed into the model. Each Frame of the video is resized and converted to grayscale.
2. Dlib's HOG-based face detector is initialized and the location of the face is detected.
3. The facial landmarks for the face region are determined by the predictor and mapped onto the face.
4. The left eye and right eye are extracted, which are then used to compute Eye Aspect Ratio for eyes based on Euclidean distance.
5. The calculated aspect ratios are compared with fixed threshold values 0.30 for the eye to determine signs of drowsiness. If the average aspect ratio of the left and the right eye falls below the threshold, it is recognized as a sign of drowsiness.
6. When continuous signs of drowsiness are detected over a longer duration for more than a certain threshold of consecutive no. of frames, the driver is alerted.

The real time-video is processed at 30 frames per second (fps), so each frame lasts for 0.05 seconds. Drowsy blinks typically last for 30 frames i.e., 1 second. Thus, a normal blink will not be identified as drowsy. Continuous eye blinks also last for a lesser number of frames and is hence distinguishable from drowsy blinks.

B. Alcohol Detection

For alcohol detection, we are using Arduino paired with an MQ3 Alcohol detection sensor. The A0 pin on the MQ-3 sensor is interfaced with the A0 pin on the Arduino UNO board and GND is connected to the GND pin. Basically, the MQ-3 sensor is a low-cost SnO2 semiconductor alcohol gas sensor capable of alcohol detection even at the lowest concentration of 0.05mg/L to 10mg/L[2]. The conductivity of the sensor increases as the alcohol content increases and accuracy and response time of which never hampers due to the smoke, vapor, or gasoline content in the air. The output of whose detection is analog and digital signals corresponding to the level of alcohol detection in the breath exhaled.

When a SnO2 semiconductor layer is heated at a high temperature, oxygen is adsorbed on the surface. In clean air, electrons from the conduction band in tin dioxide are attracted to oxygen molecules. This forms an electron depletion layer just below the surface of SnO2 particles and forms a potential barrier. As a result, the SnO2 film becomes highly resistive and prevents electric current flow.

In the presence of alcohol, however, the surface density of adsorbed oxygen decreases as it reacts with the alcohols; which lowers the potential barrier. Electrons are then released into the tin dioxide, allowing current to flow freely through the sensor.

Buzzer Interfacing is done to warn the driver. The piezo buzzer produces sound based on the reverse of the piezoelectric effect. The generation of pressure variation or strain by the application of an electric potential across a piezoelectric material is the underlying principle. These buzzers can be used as an alert. a user of an event corresponding to a switching action, counter signal, or sensor input. They are also used in alarm circuits.

## III. EXPERIMENTAL RESULTS

The table – 1 describes the recognition accuracy obtained from the approach (eye closure), using standard datasets and real-time. Real-time computational results were calculated by taking the average of 5 trials each of 12 subjects (including 5 males and 7 females) recorded at different locations. The average result included cases with and without glasses. Video frames with instances of 2 states (sleepy and non-sleepy) for every trial. The highest

percentage accuracy obtained is 93.25% for drowsy blink detection.

Table 1. Accuracy data

| Features | Recognition Accuracy | |
|---|---|---|
| | Real Time | Dataset |
| Eye | 82.02% | 93.25% |

The following results were obtained in real-time implementation of the algorithm. Fig.-4 & 5 shows detection of drowsiness and not being drowsy

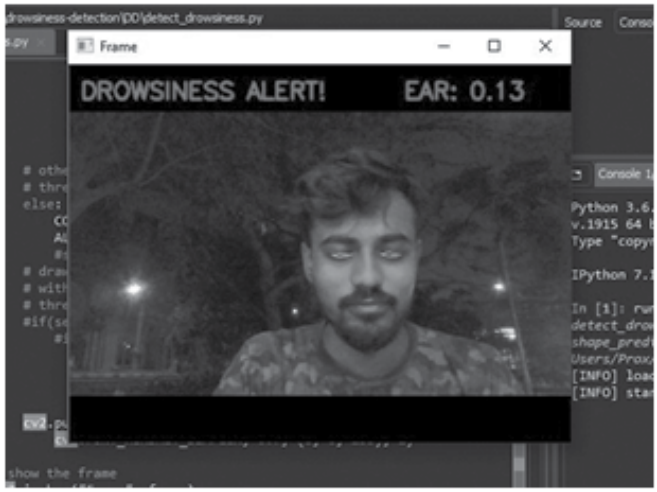


*Fig. 4. Detection of drowsiness*

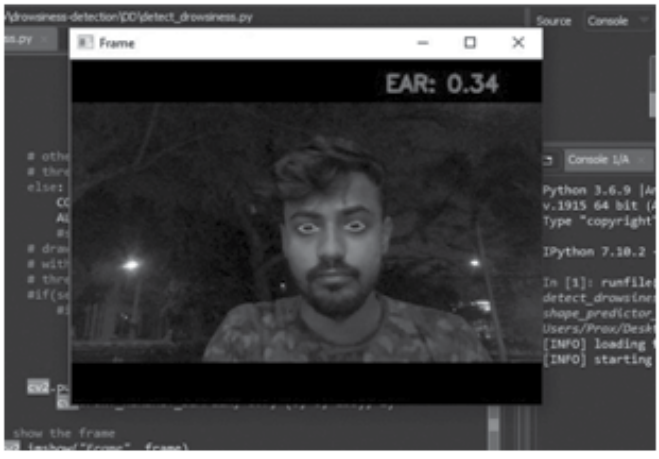


*Fig. 5. Detection of not being drowsy*

Whenever a drunken person tries to take control of a vehicle, the alcohol sensor will detect the presence of alcohol and if the presence of alcohol is detected by the sensor, it will shut down the vehicle's engine and sound an alarm thereby alerting the nearby people. The LCD screen present in the vehicle will display "Alcohol Detected" so that people are aware of the situation and hence can take the necessary action that may be required. Therefore, by using this system on a vehicle, any kind of loss of life or damage to property can be avoided. Fig. – 6 & 7 shows Sensor's detecting of alcohol

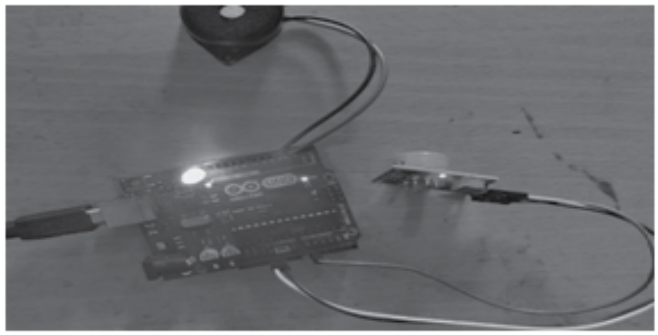

*Fig. 6 Sensor detecting alcohol present*

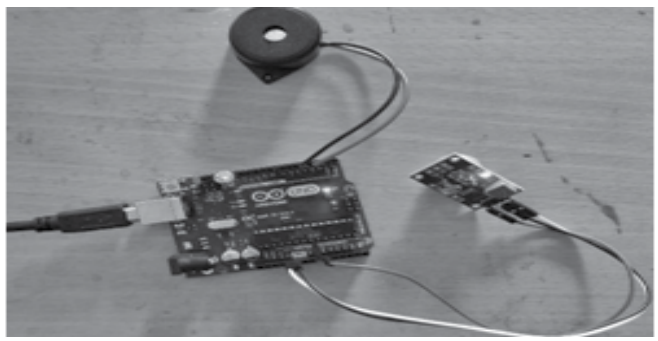

*Fig. 7. Sensor detecting alcohol absent*

## IV. CONCLUSION

The face detector which is based on Histogram of Oriented Gradients (HOG) was implemented. The quantitative metric used in the proposed algorithm was the Eye Aspect Ratio (EAR) to monitor the driver's blinking pattern. The average real-time test accuracies obtained were 82.02% and 93.25% respectively. The results of real-time detection are lower as the model currently works exceedingly well under good to perfect light conditions like those found in the dataset videos, whereas the real-time testing was performed under a variety of lighting conditions. Future work will focus on enhancing the model to work under poor to mediocre lighting conditions, and including more drowsiness signs such as head nodding for the drowsiness detection model.

We have also developed an efficient system to tackle the menace of drunken driving. Our main aim is to minimize the loss of lives and property which happen due to drunken driving. This system once implemented on a large scale will prove to be really helpful by shutting down the vehicle's engine and alerting the nearby people before any mishap takes place. The sensor used in the

project is very accurate and can be configured according to the requirements thereby increasing the efficiency.

Future studies should include research to improve the quality of the face and eye detection under low-lighting conditions, for example, during night-time driving on the highway. Infrared illuminators may be able to improve the quality of the face and eye detection and enhance the algorithm performance. Besides eye blinks and head movements, other indicators of driver fatigue, such as yawn detection and vehicle dynamics, should also be considered and incorporated for driver fatigue detection. This fatigue detection system is not without limitations. For example, computer vision algorithms use batteries quickly. Drivers are expected to use this technology with a car charger to

power the module. Future breakthroughs in battery technology may reduce this limitation. Another limitation is that eye detection is difficult for drivers wearing sunglasses. When eye detection is not possible, head nods and rotations can still be used to detect fatigue. In these scenarios, yawn detection and vehicle dynamics should be considered to compensate for the reduction of fatigue detection performance when eye blink information is not available.

This system improves the security of individuals and in this manner giving convincing progression in the vehicle business regarding decrease setbacks caused in light of driving.

## ACKNOWLEDGMENT

We take this opportunity to extend our gratitude and thanks to our project supervisor Prof. Satyananda Champati Rai for guiding us to do this project, particularly when we were stuck at places that were difficult to overcome.

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Hrishik Mishra, a SiliconTech alumnus (EEE, 2010) is currently working as a research associate at the Department of Analysis and Control of Advanced Robotic Systems in the Institute of Robotics and Mechatronics of the German Aerospace Center (DLR). Additionally, he is pursuing his doctoral studies at the Vienna University of Technology under Prof. Andreas Kugi's supervision.

At DLR, Hrishik is conducting research in the area of orbital robotics where he aims to develop robotic technologies for on-orbit servicing operations (e.g.refueling satellites), on-orbit assembly (e.g. building a telescope), and active debris removal. Through his research, he has got the opportunity to work on projects that are funded by DLR (internal), the European Union (EU), European Space Agency (ESA), and other external organizations like NASA.

Hrishik has contributed to an 'ESA-funded project COMRADE', in which he performed a feasibility study to grasp ENVISAT, which is a decommissioned 8000-Kg satellite moving uncontrollably in space. Recently, he has delivered a control design to the 'ESA-funded project MIRROR', which aims to assemble a large telescope in orbit using a walking robot. He is also currently contributing to the control design in the ' EROSS+ project', the follow-up of which will be a mission to demonstrate the capability of robotic capture of a tumbling satellite.

Apart from European collaborations, he also contributed to the TumbleDoc project, which is a collaboration between DLR, NASA, and the Massachusetts Institute of Technology (MIT). In this project, the goal was to use the 'NASA Astrobee platform on the ISS' to simulate the relative dynamics between two satellites. A preliminary test on the International Space Station (ISS) has already been conducted and the work is in progress.

# Analysis, Design, and Layout of CMOS SRAMIP in MOSIS 0.5 micrometre

***Abstract :*** *This research focuses on the design and analysis of 6T Static Random Access Memory (SRAM).Discussing on SRAM tells about its Static and Volatile properties, implying data retention which persists for as long as the device is powered without any form of refresh/ reloading, but once supply is cut then data will be lost. The next memory location does not depend on the previous memory location. This SRAM project discusses the design of a 1k*32 bit memory array in MOSIS 0.5umtechnology.*

## I. INTRODUCTION

This work focuses on the Design, Analysis, Simulation, and Layout of Compact 6T CMOS SRAM. With the rapid growth in the VLSI industry, Static Random Access Memory (SRAM) is an integral part of the modern-day. In modern-day semiconductor chips, memory has a very important role in storing large TBs of data values as well as program instructions. 6T SRAM is a static semiconductor memory that uses bistable latching circuitry to store each bit. The memory stored becomes volatile when power is turned off and it eventually loses the data. SRAM memory circuits are designed to permit the modification (writing) of data bits as well as their retrieval (reading) of data stored in the memory array. This work will somehow show the solutions which can be considered to increase the read/write time (speed) in the circuit saving the time taken earlier [1,2].

## II 6T-SRAM ARCHITECTURE AND WORKING

A. SRAM Architecture

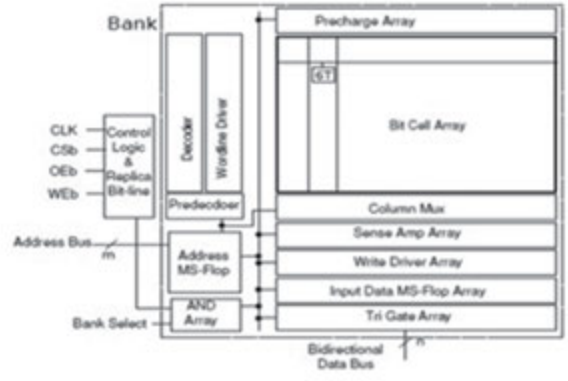


*Fig.1. SRAM Architecture*

The SRAM memory array consists of a number of rows and columns in each array can be denoted as N(rows) and M(columns).Each word in the array is M-bits wide and the total number of words is N. Row and Column decoders are used to select the unique particular word and also a particular bit. This division of memory array into smaller units reduces the delay and hence improves performance. A Sense Amplifier is used during the read operation to amplify the particular bit line. The Pre charge Circuitry is present for each pair of bit lines per column in the memory array, pre charges the bit lines before the read/write operation as shown in Fig 1.

B. 6T SRAM Basic Structure

The memory array has a number of 1-bit SRAM cellsconsisting of 6-Transistors comprising ofTwo NMOS,TwoPMOS,TwoAccess/Passtransistors (NMOS). Thetwoinvertersare cross-coupled and connected to back to back to provide abistable circuithaving twostableand oneunstable point [1]. The Circuit diagram shown in Fig 2.

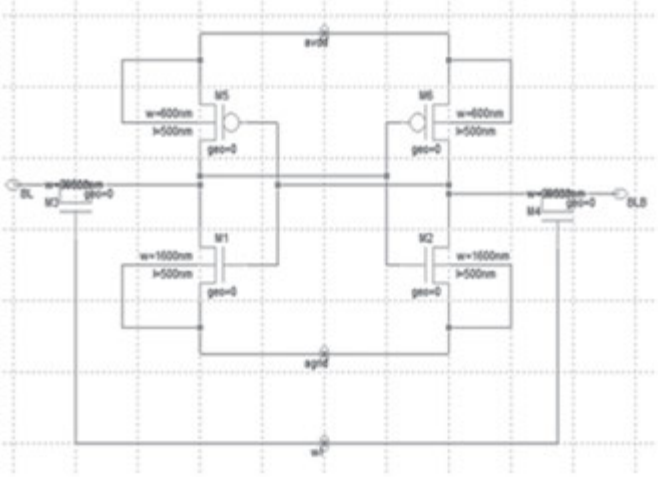

*Fig.2. 6T SRAM Circuit Diagram*

The Access transistors play an important role in reading/ writing the data. The word line and bit lines are connected to the access transistors enabling them when needed. This SRAM cell is a CMOS technology-oriented cell as it is more reliable to the inherent effects. The node 1 voltage v (Q) is the data (Q) and the node 2 voltage is complementary of the data which is Q bar. The bit line and bit line bar get charged/discharged by the parasitic capacitances [2]. Layout is shown in Fig 3.

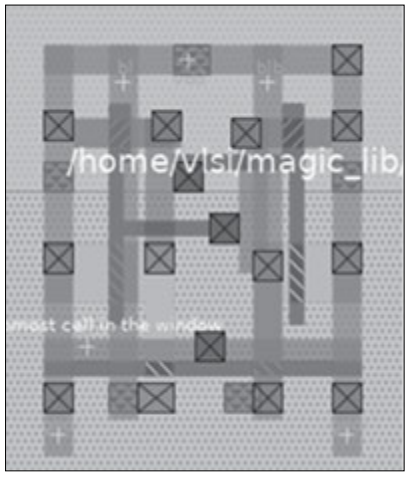


*Fig.3. Layout of 6T SRAM Cell*

C. 6T SRAM Working

There are3modesofoperationin a6TSRAMCell-

- Read-Reading the data stored in the memory
- Write-Writing/modifyingthedatainthememory
- Hold-Whenwordlineis 0 (OFF) and the data retains its previous state.

Read Operation-

Assume Q stores 0 and the bitlines(bl and blb) areprecharged.The Access transistors are made on by providingread pulse to the wordline(WL).The value of Q is transferredto BL by discharging it through the access transistor andkeeping the BLB at its precharge value.The data shouldn't beflipped so V(Q)<Vtn(M2)max.The value of Q is read via thebitlines at the nodes and the BL value is amplified through thedifferentialsenseamplifier [3].

Write Operation-

If the value needs to be modified,that is done in the writeoperation mode by changing the value of bitlines where one ofthe bit linesispulled down.

Assume Q storing 0, changing it to 1 needs the BLB to bepulled down by the write driver. The write pulse is given to the word line making the access transistors active. The Q bar discharges its value 1 and becomes 0 while Q cannot be pulledhighbecauseV(Q)>Vtn(M2)max [4].

Read/ Write Operations can be done by proper sizing of all 6transistorsaccordingto theread/write conditions.

D. SizingofTransistors

$$\frac{k_{n,3}}{k_{n,1}} = \frac{\left(\frac{W}{L}\right)_3}{\left(\frac{W}{L}\right)_1} < \frac{2\left(V_{DD} - 1.5\,V_{T,n}\right)V_{T,n}}{\left(V_{DD} - 2\,V_{T,n}\right)^2}$$

$$\frac{\left(\frac{W}{L}\right)_5}{\left(\frac{W}{L}\right)_3} < \frac{\mu_n}{\mu_p} \cdot \frac{2\left(V_{DD} - 1.5\,V_{T,n}\right)V_{T,n}}{\left(V_{DD} + V_{T,p}\right)^2}$$

Compilation methodology in shown in Fig 4.

E. Implementation in Open RAM

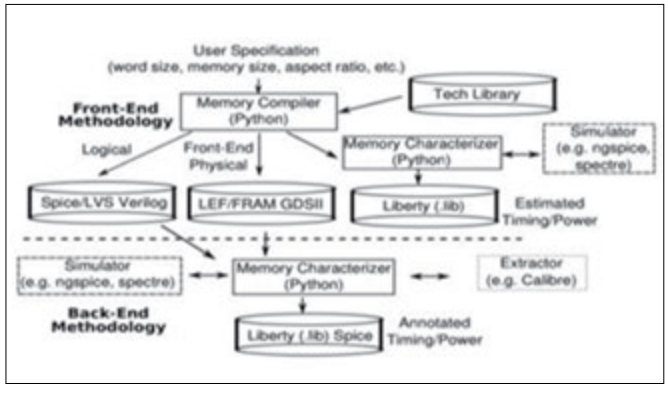


*Fig.4. Compilation methodology in Open RAM*

MemoryCompilerrequires3 inputs-

- DRCandLVS-DesignRules
- ReferenceTechnologies-FreePDK45andSCMOS
- Custom Cell s1.6 TS RAM Cell

  2. SenseAmplifier

3. Write Driver
4. D-FF(Controllogic)
5. Tri-statebuffer

These Custom Cells are designed by using Open Source toolslike NgSpice, Magic, Netgen, and CppSim.

Stepsfollowedto implement these CustomCells-

1. Spice netlist(.sp)/Circuitschematic usingSue2
2. PreLayoutSimulationsusingNgSpice
3. LayoutofCellsusing Magic
4. LVScheck usingNetgen
5. ExtractedSpicenetlist
6. PostLayoutSimulations usingNgSpice

F. SRAMBlocks

**Pre-Charge Circuit-**

The Pre-Charge Circuit shorts the Bitline and Bitlinebarusing one PMOS transistor at the centre and two remainingPMOStransistorsequalizesboth the bitlinesto VDD.

The layout is shown in Fig 5

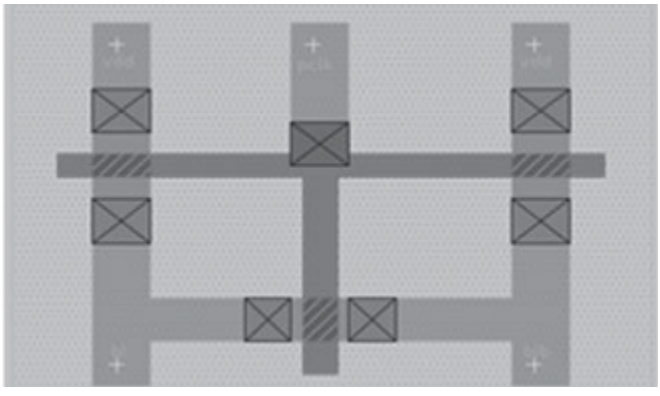

*Fig.5. Layout of Pre-Charge Circuit*

**Sense Amplifier-**

Sense amplifier is the most important block in the SRAMmemory I/O,which senses the data from the array. A latch-based CMOS circuit sense amplifier is used as a senseamplifier whose pull-down transistors are critically matchedwhichhelpsinqualitysense/readoftheSRAMarray. The layout is shown in Fig 6.

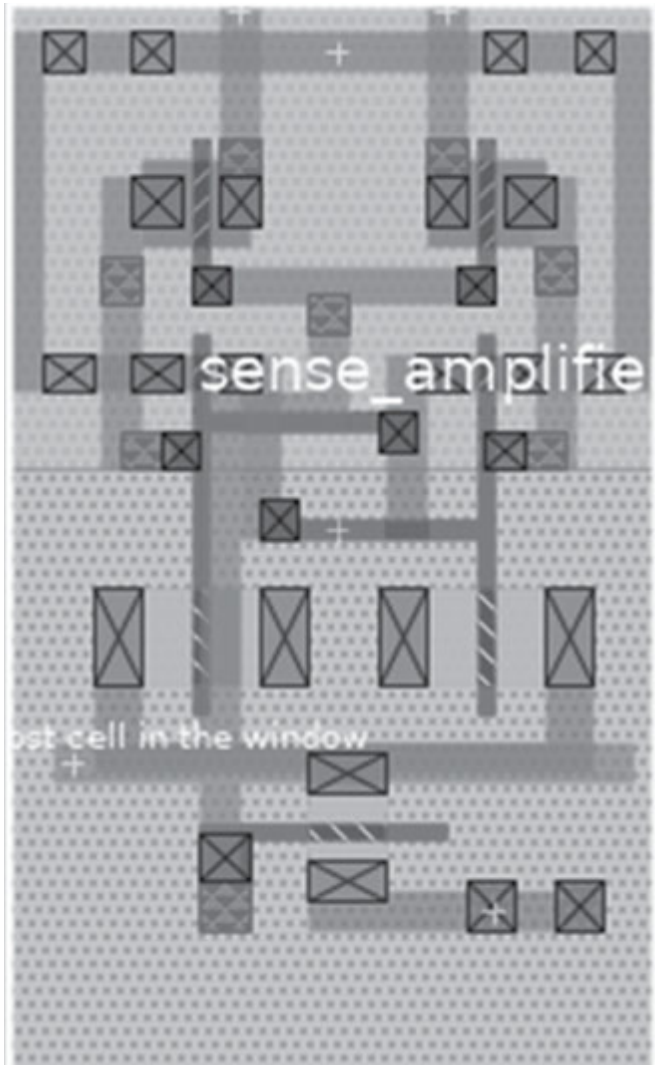


*Fig.6. layout of sense amplifier*

**Write Driver-**

The write driver is used to drive the input signal into the bit-cell during a write operation. It can be seen in Figure 13 thatthe write driver consists of two NAND gates and twoinverters,with two pull-down NMOS transistors pulling downone of the required bit lines to 0.It takes in a data bit andoutputs that value onto the bit-line,and its complement on thebit-line bar. BothNAND gatesare enabledby theWENsignal.The bit linesalwaysneedtobecomplementedtoensure thatthe

correct data is stored in the bit-cell. Also, the drivers need to be appropriately sized as the memory array grows and the bit-line capacitanceincreases. Block diagram and layout is shown in Fig 7 (a) & (b) respectively.


*Fig.7(a). Block diagram of Write Driver*

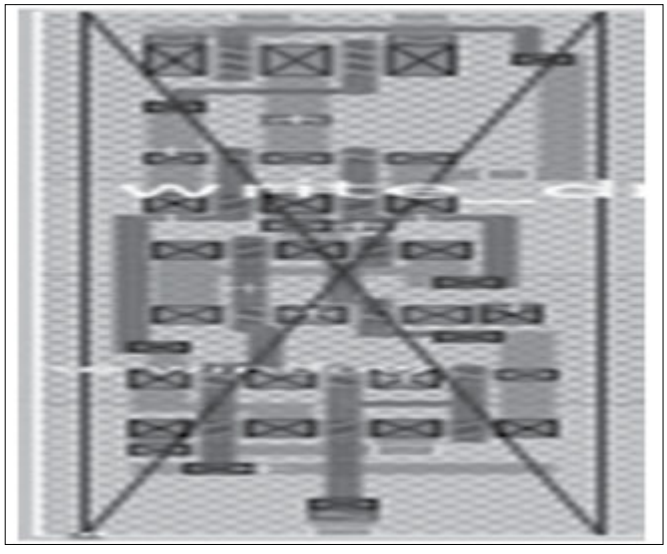

*Fig.7(b). Lay out of Write Driver*

**D-Flip Flop-**

It is necessary to synchronize the inputs and outputs with aclock signal by using a synchronous input and output. In Open RAM, a master-slave D-FF is used for the process. ALayout is shown in Fig.10(c). This ensures that the inputandoutputsignalsstayvalid fortheentire clock cycle. Layout is shown in Fig 7 (c). The layout of tristate buffer is shown in Fig 7(d).

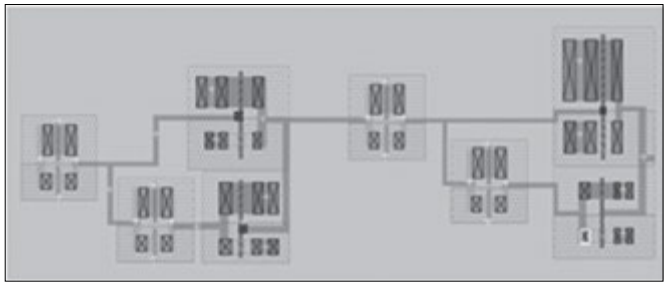

*Fig.7(c). Layout of D-flip flop*

Tristatebuffer-

It is used to output the data on to the data bus.

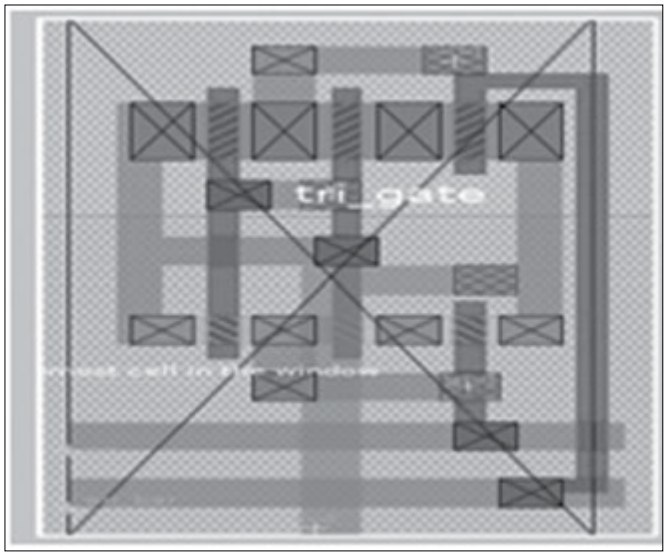


*Fig.7(d). Layout of tristate buffer*

## III. SIMULATION RESULTS

The PreLayout Simulation was done using NgSpice withan estimation of Fast-Single-6T parasitic model as suming the parasitic value of the whole SRA Marray as-

n* value of parasitic of 1-bit Cell

n=Number of Bit Cells in the Memory array

Steps to simulate 6TS RAM-

1. Sizing of the 6-Transistors with Vtn iterations underextremities
2. Write Spicenet list (.sp)
3. Run the DC Simulation in all corners (ss, nom, ff)-(temperature ranges-(-40-105)) (Fig.G(a))
4. Testthe Vthvs. Tinallcorners(Fig.G(d))
5. Find the mn, mp and Vtn,Vtp values in all corners and Temperatures (Table.1(a)) 6. Total Simulation=DC (9 write+9read) + Tran.( 9 write+9 read)

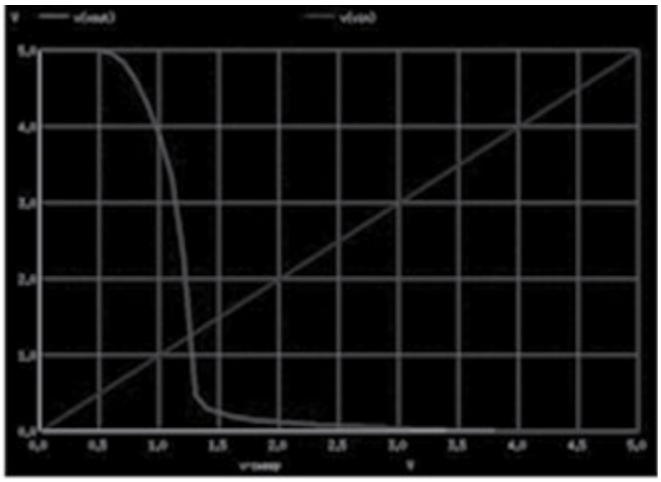

*Fig. 8(a). DC Simulation of memory Cell*

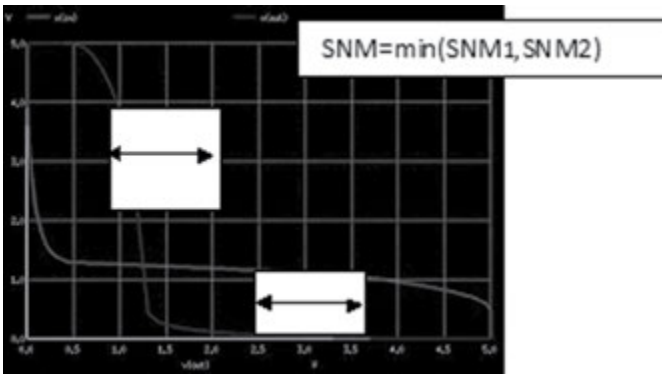


*Fig. 8 (b). SNM of 6T (Hold State)*

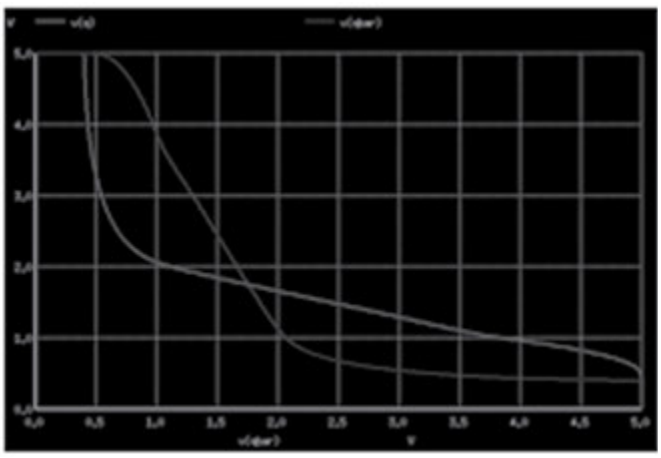

*Fig. 8 (c). SNM of 6T (Read State)*

SNM=Signal-Noise Margin-The maximum DC noise that can be tolerated by the memory cell before the read/write operation or can be said before flipping the data.

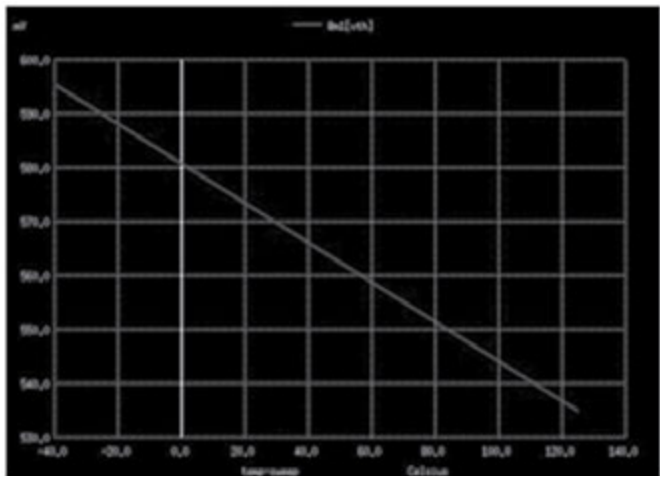

*Fig. 8 (d). Vthvs. Temperature (°C)*

Table 1. mn, mp,Vtn and Vtp at all temperatures and corners

| Corners | Vtn | | | Un | | |
|---|---|---|---|---|---|---|
| | -40 | 25 | 125 | -40 | 25 | 125 |
| NOM | 0.59 | 0.57 | 0.53 | 473 | 448 | 301 |
| FF | 0.54 | 0.52 | 0.48 | 568 | 478 | 559 |
| SS | 0.60 | 0.58 | 0.54 | 670 | 460 | 650 |

| Corners | Vtn | | | Un | | |
|---|---|---|---|---|---|---|
| | -40 | 25 | 125 | -40 | 25 | 125 |
| NOM | -0.6 | -0.7 | -0.53 | 142 | 148 | 115 |
| FF | -0.65 | -0.60 | -0.52 | 140 | 152 | 130 |
| SS | -0.7 | -0.6 | -0.54 | 170 | 133 | 120 |

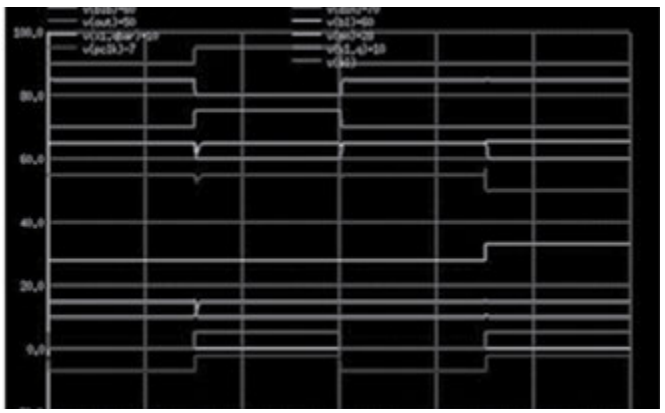

*Fig. 8(e). Pre Layout Simulation*

In Fig.G (e)., 6T SRAM Cell integrated with Sense amplifier, Precharge Cell, Write Driver-Blocks of a 6T SRAM. Operations done-Precharge (0-14.9ns),Write, Precharge, Read.

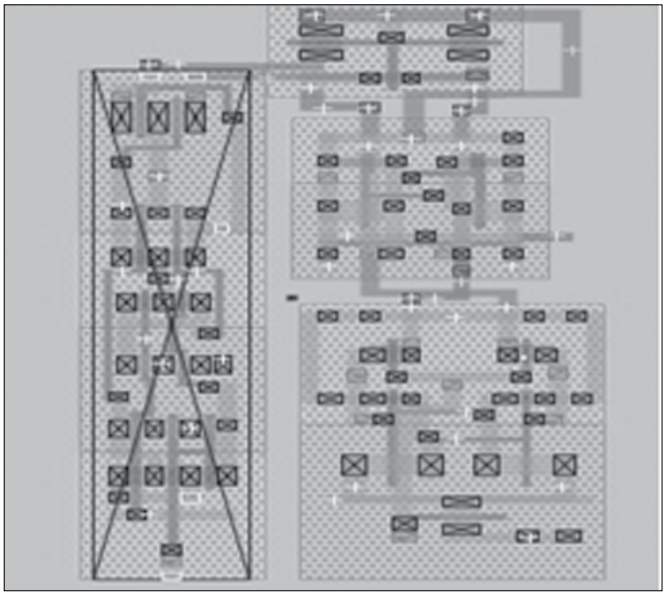

*Fig. 8 (f). Integrated Circuit Layout*

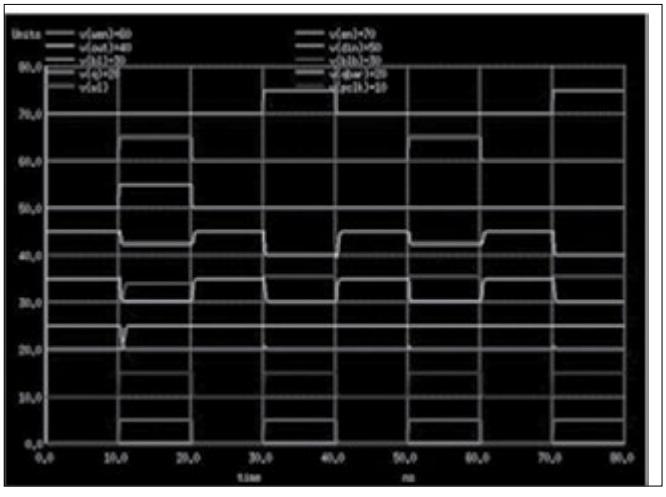

*Fig. 8 (g). Post Layout Simulation*

Simulation results are shown in Fig 8 ( a, b , c, d, e, f and g) respectively.

## IV. CONCLUSION

SRAMs are faster and less power-hungry than DRAMs. This low-power and High-Speed SRAMs are usually used inhigh-performance microprocessors used in cache memoriesandextensivelycan beused in SoCs. Because of their flexibility SRAMs are an integral part of thememory design and parameters to be taken care of,widelyusedin smartphonesand variousportable devices.Asmorethan half of the transistors present on a chip have been dedicatedtocachememorySRAMsplaya vitalroleintheSemiconductorindustry.

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# SIGN LANGUAGE TO SPEECH CONVERSION USING ARDUINO

***Abstract :*** *Human beings interact with each other to convey their ideas, thoughts, and experiences to the people around them. But this is not the case for deaf-mute people. Sign language paves the way for deaf-mute people to communicate. Through sign language, communication is possible for a deaf-mute person without the means of acoustic sounds. The aim behind this work is to develop a system for recognizing the sign language, which provides communication between people with speech impairment and normal people, thereby reducing the communication gap between them. Compared to other gestures (arm, face, head and body), hand gesture plays an important role, as it expresses the user's views in less time. In the current work flex sensor-based gesture recognition module is developed to recognize English alphabets and few words. In this project we propose a Sign Language Glove which will assist those people who are suffering for any kind of speech defect to communicate through gestures i.e. with the help of single handed sign language the user will make gestures of alphabets. The glove will record all the gestures made by the user and then it will translate these gestures into visual form as well as in audio form. The Hand talk glove senses the movements through the flex sensors pads which detect the different patterns of motion and the way the finger curls. The device can sense carefully each resistance and each movement made by the hand. Currently the device can convert only few words, but depending on the success of this device few more additional words may be added later onto this expressive system. The Gestures can be converted to voice by using a Bluetooth Voice App.*

**Keywords:** : Light emmiting diode (LED), Light crystal display (LCD), Global Positioing System (GSM), Integrated Circuit (IC), Ground (GND)

## I. INTRODUCTION

Sign language is the language used by deaf and mute people and it is a communication skill that uses gestures instead of sound to convey meaning simultaneously combining hand shapes, orientations and movement of the hands, arms or body and facial expressions to express fluidly a speaker's thoughts. Signs are used to communicate words and sentences to audience. A gesture in a sign language is a particular movement of the hands with a specific shape made out of them. A sign language usually provides sign for whole words. It can also provide sign for letters to perform words that don't have corresponding sign in that sign language [1].

In this project Flex Sensor plays the major role. Flex sensors are sensors that change in resistance depending on the amount of bend on the sensor. In this project we propose a Sign Language Glove which will assist those people who are suffering for any kind of speech defect to communicate through gestures i.e. with the help of single handed sign language the user will make gestures of alphabets [2]. The glove will record all the gestures made by the user and then it will translate these gestures into visual form as well as in audio form. This project uses Arduino microcontroller to control all the processes and flex sensors to track the movement of fingers. A LCD display is used to display the user's gesture and Bluetooth Voice App to translate the gesture into audio signal. This project is developed to recognize complex words like food, water, tea etc. [3].

## II. RESEARCH BACKGROUND

Sign language is the only communication tool used by speech impaired and hearing impaired people to communicate to each other. However, normal people do not understand sign language and this will create a large communication barrier between speeches impaired, hearing impaired and normal people. In addition, the sign language is also not easy to learn due to its natural differences in sentence structure and grammar [4]. Therefore, there is a need to develop a system which can help in translating the sign language into voice and voice to sign language in order to ensure effective and easy communication between different communities. Many methods for hand gesture recognition using image processing have been proposed.

"Hand Gesture Recognition System using Image Processing" uses digital image processing techniques using modified SIFT algorithm. With the help of the algorithm the sign language is decoded successfully. The advantage using this algorithm is high processing

speed which can produce result in real time. Although the proposed system is fast it also requires expensive materials. "Sign Language Recognition Using Image Processing" uses image processing with the help of SURF (Speed up Robust Features) algorithm. Video camera is used to record hand movements, and the input video is partitioned into frames, for each frame, a set of features are extracted. The system is implemented in MATLAB [5].

"Deaf-Mute Communication Interpreter" uses sensor based technique comprising of flex sensor, tactile sensors and accelerometer to translate American Sign Language gestures to both text and auditory voice. Although, they were only able to translate thirteen sign into their respective alphabets namely letters 'A', 'B', 'C', 'D', 'F', 'I', 'L', 'O', 'M', 'N', 'T', 'S' and 'W' and tactile sensor were used to improve the accuracy of three letters M, N and T.

"Sign Language to Speech Translation System Using PIC Microcontroller" consists of flex sensors that is used to detect finger gestures and gyro sensors for providing a signal corresponding to the orientation of the motion of the hand. "Design of Smart Gloves" uses pair of gloves with flex sensors along each finger, thumb and arm is used to capture the movement of user. The problem with this work is it can detect only few letters [6].

"A Review Paper on Smart Glove - Converts Gestures into Speech and Text" uses five flex sensors and accelerometer attached on the back of the glove to measure the bending and motion of the hand. The problem with this work is to recognize some letters. Besides that, letters 'M', 'N', 'O', 'R', 'S', 'T', 'V' and 'X' cannot be displayed due similar in gesture with other letters. "Digital Text and Speech Synthesizer Using Smart Glove for Deaf and Dumb" uses five flex sensor to detect gesture and accelerometer used for sensing axis x, y and z, find the angle of the glove tilted with respect to the. The glove is capable of translating their sign language gestures into speech through android phone. This smart glove focuses the translation of gestures of words only. "Smart Glove: Gesture Vocalizer for Deaf and Dumb People" uses glove at the transmitter side which has to be worn by the user. This glove is mounted with 4 flex sensors each on the 4 fingers of the glove namely thumb, index, middle and ring. This work also focuses the translation of gestures of words only.

## III.COMPONENTS USED

### A. Arduino

Arduino is an open-source electronics platform based on easy-to-use hardware and software shown in Fig. 1. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board [8].

Arduino boards are able to read inputs e.g. light on a sensor, a finger on a button, or a twitter message-and turn into an output activating a motor, turning on an LED, publishing something online.

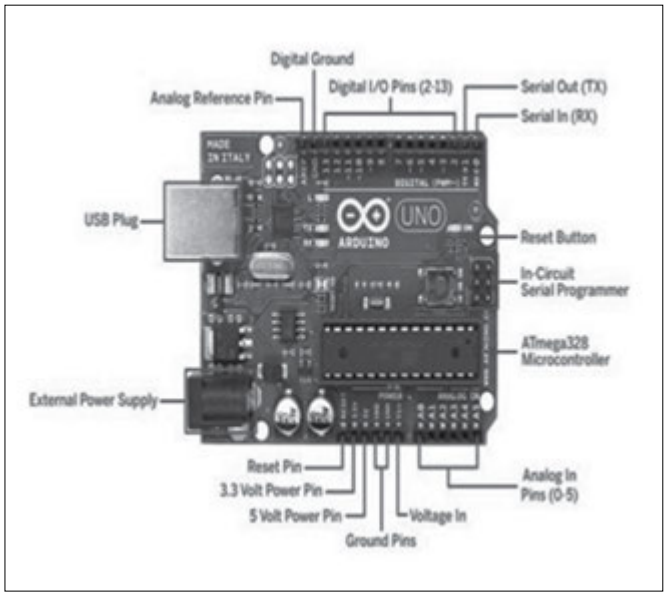


*Fig 1:Pin configuration of Arduino Uno*

PIN DESCRIPTION:

1. USB: The USB port is used to power the board from the computer's USB port and also to transfer the program code from computer into the Arduino microcontroller.
2. External Power: It is used to power the board if the USB connector is not used. An AC adapter (9 volts, 2.1mm barrel tip, and centre positive) could be used for providing external power. If there is no power at the power socket, then the Arduino will use power form the USB socket. But it is safe to have power at both the power socket and USB socket.

3. Digital Pins (I/O): The Arduino Uno has 14 digital pins (0 to 13) of which the 6 are PWM (~). These pins can be either inputs or outputs. But we need to mention it in the Arduino sketch (Arduino programming). The PWM (Pulse Width Modulated) pins acts as normal digital pins and also used to control some functions, say for example, control the dimming of LED and control the direction of servo motor. Both digital inputs and digital outputs can read one of the two values either HIGH or LOW.

4. Analog Pins: The Analog pins (0 to 5) acts as inputs which is used to read the voltage in analog sensors such as temperature sensor, gas sensor, etc. Unlike digital pins which can only read one of the two values (HIGH or LOW), the analog inputs can measure 1024 different voltage levels.

5. ATmega Microcontroller: The Arduino uses ATmega328 microcontroller. It is a single chip microcontroller created by Atmel. This chip works well with Arduino IDE. If damaged, this controller can be easily replaced. The Atmega328 has 32 KB of flash memory for storing code (of which 0,5 KB is used for the bootloader).It has also 2 KB of SRAM and 1 KB of EEPROM.

6. LED: There is a built-in LED driven by digital pin 13. When the pin is High value, the LED is on, when the pin is Low, it's off.Using an external power source (as opposed to 5 volts from the USB connection or other regulated power source) we can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.

7. 5V: This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7-20V), the USB connector (5V), or the VIN pin of the board (7-20V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage the board.

8. 3.3V: A 3.3-volt supply generated by the on-board regulator. Maximum current draw is 50 mA.

9. GND: Ground pin.

10. IOREF: This pin on the Arduino/Genuine board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source or enable voltage translators on the outputs to work with 5V or 3.3V.

11. Reset: Typically used to add a rest button to shields which block the one on the board. It is used to reset the microcontroller. Pushing this button will temporarily connect the reset pin to ground and restart any code that is loaded on the Arduino.

**B. Flex Sensor**

Input sensor that is flex sensor plays major role. As bending angle increases, resistance of flex sensor also increases as shown in Fig. 2. This change in resistance will be converted into voltage change by connecting flex sensor to potential divider circuit [7]

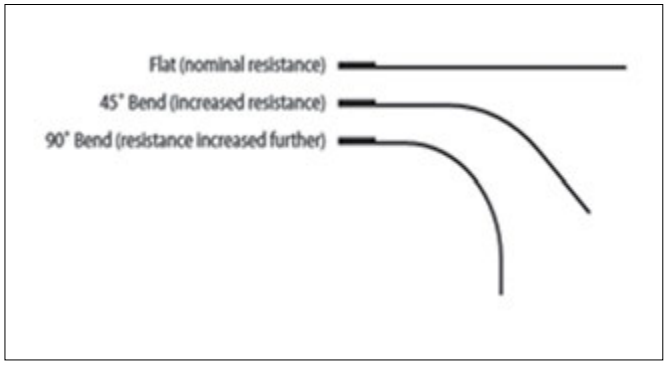


*Fig 2: Flex Sensor*

Flex sensors are normally attached to the glove using needle and thread.They require a 5 V input to operate and it gives output between 0 and 5 V. As bending angle of sensor increases resistance of flex sensor also increases.As the sensor varies the output voltage changes accordingly. The resistance of flex sensor will only change in one direction.When sensor is in not working i.e. unflexed at that time its resistance upto 10 kΩ and for flexed sensor it will increase upto 30 kΩ - 40 kΩ. This change in resistance will be converted in to voltage change by connecting flex sensor potential divider circuit.

Voltage divider is used to determine the output voltage levels. Voltage across two resistances connected in series i.e. .basically resistance to voltage converter. The resistor and flex forms a voltage divider which divides the input voltage by a ratio determined by the variable (R1) and fixed resistors (R2).

### C. Bluetooth Module:

Fig. 3 shows a HC-05 is a Bluetooth module which is designed for wireless communication. This module can be used in a master or slave configuration. Bluetooth serial modules allow all serial enabled devices to communicate with each other using Bluetooth.

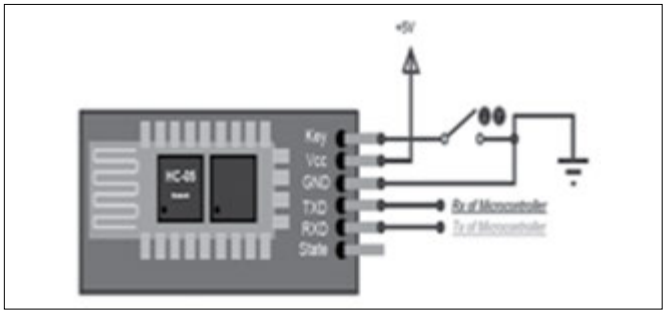


*Fig 3: Bluetooth Module*

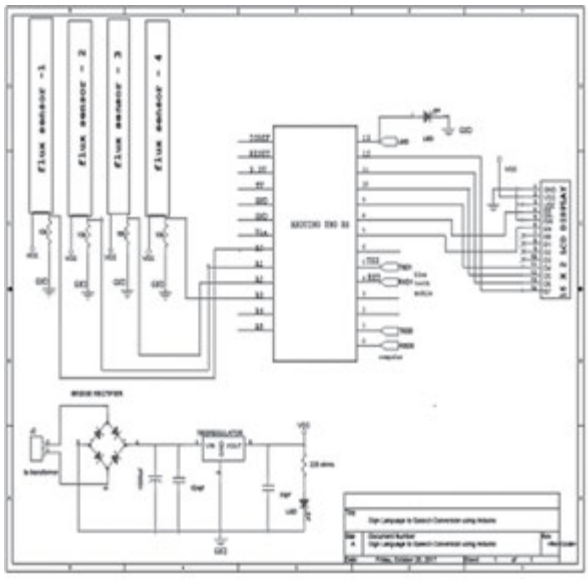

*Fig 5: Schematic diagram*

## IV. METHODOLOGY

Fig.4 shows the block diagram of the talking hand glove and the components used are as follows. The schematic diagram is shown in fig. 5.

1. Resistor
2. Arduino UNO
3. LED (Red)
4. Transformer
5. Bridge rectifier circuit
6. Filter capacitor
7. LCD
8. Flex sensor
9. Bluetooth module
10. Voltage regulator

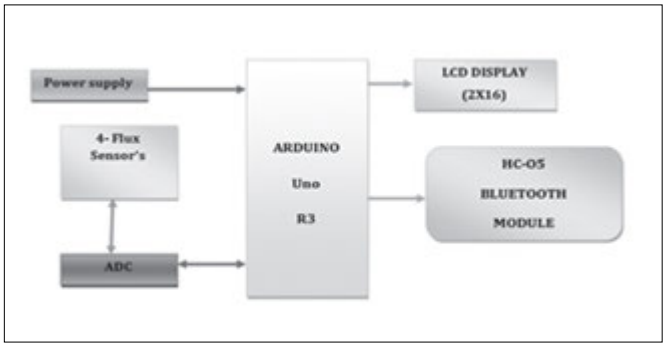


*Fig. 4: Block diagram of the Talking Hand Glove*

## V. RESULTS

The result is displayed in fig. 6 and 7. Where the talking hand signals are interpreted by the project.

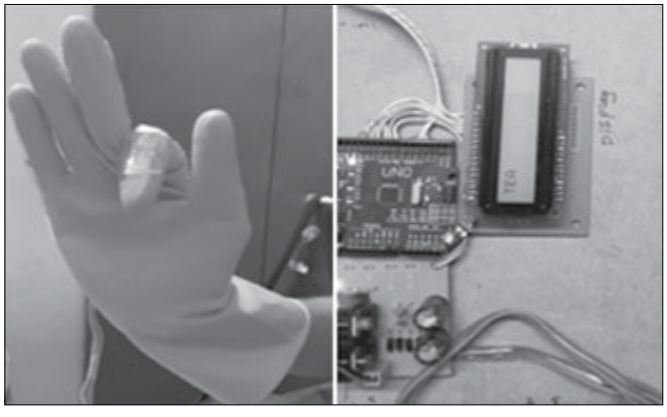

*Fig. 6: Result when coffee asked*

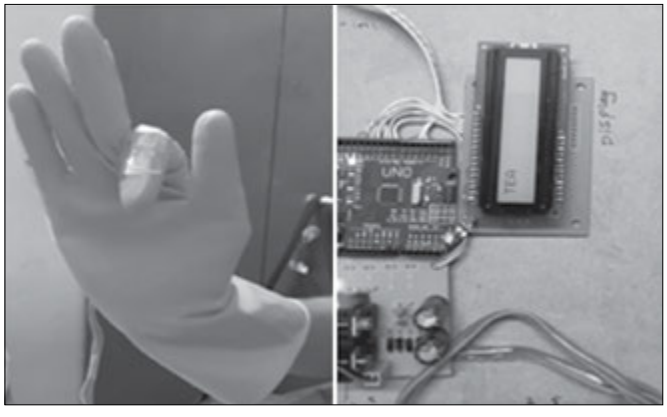

*Fig. 7: Result when tea asked*

## VI. CONCLUSIONS

The hearing impaired people using glove technology will enable normal people to communicate with them too. The use of flex sensor, touch sensors and an accelerometer on to a glove demonstrate that it is helpful to beak the gap between speech impaired, hearing impaired and normal people. This device will be an apt tool not only for the people got such disability naturally rather it also helps disability due to oral diseases and accidental cause make them to learn gesture through application easily. The project can be enhanced further by including more words and different standard sign language.

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# The Era of mRNA Vaccines

The Covid pandemic that hit the world in January 2020 paved the way for the developments of messenger RNA vaccines. This technology had previously been in development for about 20 years. At a time when more than 1.5 million deaths had occurred from Covid, this technology was finally approved by the US government and it paved the way towards one of the biggest technological revolutions in the world of therapeutics and vaccines. This technology paved its way into creation of vaccines for not just Covid, but also several other infectious diseases, including malaria. A very important feature of said vaccine is that, even if the corona virus mutates, which is a common trend seen in said virus, this vaccine structure can be easily modified to suit the needs.

These vaccines primarily work by introducing a fragment of mRNA that is similar or corresponds to the protein present in the virus, usually acquired from the outer membrane of the virus. Hence, it counters the general practice of introducing weakened virus in order to train the host body, whose immune system shall then be ready for batting the infection when it actually happens. Using the mRNA blueprint, the cells produce more proteins like the virus. The, the body's normal immune response upon realizing the presence of foreign body kicks in. it produces antibodies which are specialized proteins that help battle the infection. After being produced once, these antibodies remain in the body even after countering the pathogen so that in case of a re-infection, the body can quickly detect and destroy the pathogen without causing serious illness.

Since it is identified by a variety of cell surface, endosomal, and cytosolic innate immune receptors, exogenous mRNA is intrinsically immunostimulatory. This property of mRNA could be advantageous or harmful depending on the therapeutic application. It has the potential to be beneficial for vaccination since it may function as an adjuvant to stimulate dendritic cell maturation and hence elicit powerful T and B cell immunological responses in some situations. Innate immune sensing of mRNA, on the other hand, has been linked to antigen expression suppression and may have a deleterious impact on the immune response. Upon the arrival of the quickly mutating Covid era, scientists saw this as in opportunity to optimize the vaccine type for treating most infectious diseases. They identified that, the mRNA vaccines can easily be modified based on the mutation of the virus and any required antibodies in the body can be easily triggered.

As the name implies, mRNA vaccines are founded on the principle of in vitro transcribed (IVT) mRNA. Using recent breakthroughs, it is now possible to engineer mRNA strands with slightly modified nucleotides capable of activating humoral and cellular immune responses through the production and display of protein products but with limited immunogenic behaviour from the mRNA strand itself. Modern vaccine formulations can use lipid nanoparticles to combat the issue of low in vivo stability and susceptibility to degradation (LNPs). These ionizable formulations typically include a main amino lipid as well as helper lipids (cholesterol, PEGylated lipid, and phospholipid) to aid in cellular uptake and release.To enhance electrostatic complexation of the positively charged LNP and the negatively charged mRNA strand, the microfluidic mixing process to generate the encapsulated lipoplexes is performed at a low pH. Engineering these carriers for enhanced organ selectivity and targeting, drug release and endosomal escape, and cellular absorption are all ongoing topics of research. In the past, Moderna Therapeutics was the first commercial organisation to demonstrate in vivo stability of mRNA-LNP formulations against influenza, and the insights from that research were essential in the creation of their COVID-19 vaccine, as well as Pfizer's.

Discovering the ability to engineer mRNA constructs with modified 5′-methylguanosine triphosphate caps and 3′-poly-adenosine tails was another critical step in the development of clinically applicable mRNA. These post-transcriptional modifications are essential for proper ribosome binding, stability, and protection from nuclease-mediated degradation, and ligating custom sequences can allow IVT mRNA to avoid common degradation factors, promote longer bioavailability, and aid in more effective translation.

The rapid development of COVID-19 mRNA vaccines emphasises the benefits and utility of mRNA delivery as a vaccination strategy, and it is important to examine how well this technology can be refined and improved to provide therapeutic and prophylactic treatment solutions for a wide range of diseases. Beyond COVID-19, a number of infectious and tropical diseases continue to wreak havoc on populations in developing countries, with few options for prevention. The fundamental principles underlying mRNA vaccines could potentially be used to develop effective treatments for these diseases.

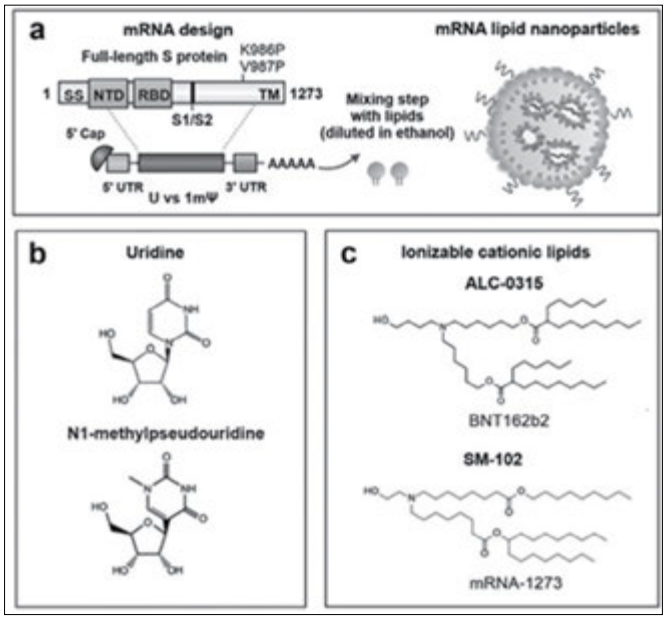


*Fig. 1: COVID-19 mRNA vaccine design*

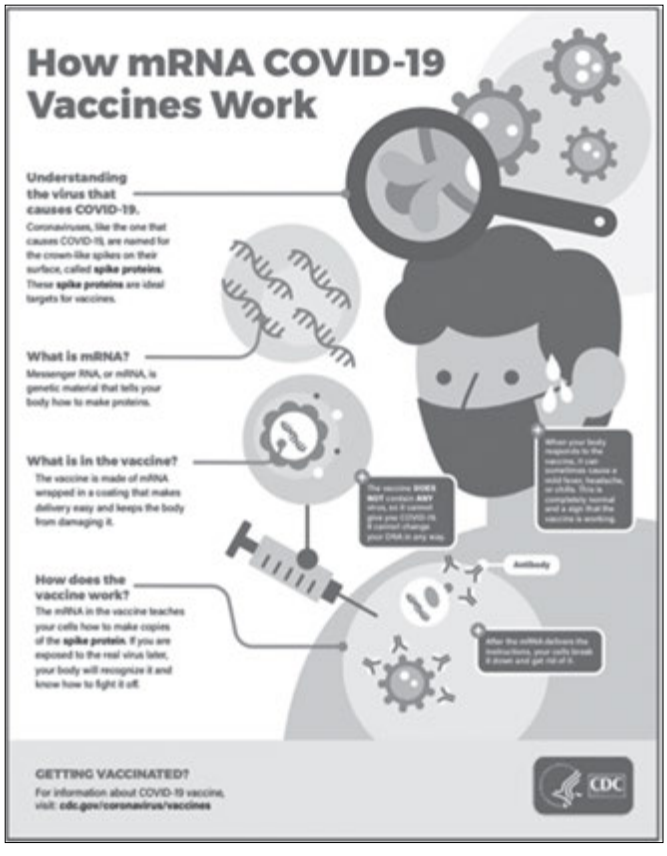


*Fig. 2: How mRNA COVID-19 Vaccines Work*

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# Minimization of Traffic Congestion in Vehicular Ad Hoc Network (VANET)

In many countries of the world, because of large population, poor road infrastructure and rapidly growing economies, severe traffic congestion occurs. The problem is severe because of increase in variety of vehicle types and non-adherence to lane discipline. Existing methods or techniques for detecting traffic congestion do not deal with the variety of vehicle types and absence of lane discipline. This research work proposes novel approaches to detect congestion as well as accidents, the main cause of congestion.

In Intelligent Transport System (ITS) as the vehicles are dynamic in nature, instinctive formation of a wireless network for transfer of information between the vehicles can be done by Vehicular Ad Hoc Networks (VANETs). Actually, detection of traffic congestion depends on VANETs to interchange vehicle condition data or collected traffic data between vehicles (V2V communication) or between vehicles and traffic control centre (V2I communication), to find the road congestion event and notify the drivers coming to the congested area.

The proposed technique of congestion detection is implemented through hardware by using ATmega8 microcontrollers. The working module is having a central node (CN), a road side (RS) module and a number of on-board (OB) modules. Speed, rain, braking frequency and fog, which are some important attributes, are integrated in the controller for event detection. The proposed model is specially developed to notice congestion within a distance of 500 metres only.

As these messages having different attributes and coming from different vehicles are large in number, an intelligent system based on fuzzy clustering technique is designed to minimize the number of discrete messages by taking out important attributes from the messages of a vehicle to reduce the traffic load of the network. By this, congestion is detected as well as quantified.

These fuzzy clustering techniques for detection of congestion such as K-Means, Fuzzy C-Means (FCM) and Fuzzy K-Means (FKM) algorithms are analysed on the basis of data points and number of clusters. TheK-Means clustering algorithm has a high cluster formation speed than FCM algorithm and the FKM algorithm. Individual data point has a chance of belonging to a cluster in FCM and FKM techniques than belonging to just one cluster as in K-means. That means fuzzy techniques are preferable than hard clustering techniques to get an idea about traffic congestion as vehicles are dynamic in nature.

After detection of congestion in a lane by using fuzzy techniques, FCM algorithm is used in LABVIEW to control the green light duration at a junction to minimize the congestion in one lane for longer period.

As accidents are the main reason of traffic congestion, it is detected by considering the health condition of driver as well as the condition of vehicle and the shortest path is selected for ambulance to reach nearby hospitals to save the lives of the patient. For shortest path selection, Dijkstra's algorithm is used by considering single as well as multiple destination points and the congestion level of the road.

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# Design of a Miniaturized Rectangular Patch Antenna for 5G Applications

***Abstract :*** *- In this paper, a rectangular patch antenna (RPA) is proposed for 5G applications resonating at a frequency of 28 GHz and is excited with an inset feed.Rogers RT/Duroid 5880 material is used as a dielectric material having relative permittivity of 2.2 and thickness of 1.5 mm. The proposed antenna is designed usingANSYSHFSS(High Frequency Structure Simulator). The proposed antenna has overall dimensions of 7.5 mm × 6.05 mm and provides an average gain of 4.8 dB, an optimal return loss of -19.65 dB and a huge bandwidth of about 1.83 GHz which makes the antenna quite suitable for mobile devices.*

**Keywords:** microstrip, rectangular patch antenna, 5G, HFSS, inset feed

## I. INTRODUCTION

The revolution in mobile telecommunications i.e. wireless cellular technology started with the introduction of 1G which later evolved and advanced to 2G, 3G and presently as 4G and 4G LTE. The industry today is getting prepared for 5G and its implementation. 5G is the next generation of mobile technology.According to experts, it offers faster and more reliable internet speeds on mobile phones. It also provides very reliable and quick responding connections. It is going to be very important for enabling new use cases for this technology such as self-driving cars, virtual reality, delivery drones, smart cities and billions of interconnected devices.

Microstrip patch antenna (MPA) plays a vital role in this fastest-growing wireless communication industry. The evolution in wireless communication can't be thought without some modifications in microstrip patch antenna designs.The wireless devices working for 5G applications need antennas that arecompact, inexpensive and can be fabricated easily. So, printed antennas are preferred.

According to TRAI, the spectrum bands suitable for 5G transmissionsin India are – 700MHz, 3.5GHz, and 26/28 GHz. The proposed antenna is operating at a frequency of 28 GHz. Some patch antennas having compact structure resonate at more than one frequency to be used for various 5G applications [1-2].Also in these antennas different feeding techniques are used depending on the requirements.

The major feeding techniques includecoaxial feed, aperture coupled feed, microstrip line feed, and proximity- coupled feed. The coaxial feed is awidespread technique used to excite the MPAs and the proximity coupling provides the largest bandwidth, has low spurious radiation but fabrication is difficult. In [3], a dual-polarized proximity fed patch antenna having a proximity fed square ring and a square patch stacked resonates at various frequencies with good radiation properties. Also PIFA antennas have gained quite a momentum and are increasingly used in the mobile phone market. Small factor PIFA antennas for 5G applications can resonate for more than one frequency band and can be used to operate in WiMAXbands[4-5]. Use of various techniques can help in improving the different 5G antenna features and parameters. For example, the use of a group of microstrip patches along with a waveguide aperture can help attain a comparatively wide beam and a maximum gain though in a tilted target direction[6].

## II. ANTENNA STRUCTURE AND DESIGN

The antenna design consists of an inset feed patch over a substrate which is placed on a ground plane. The rectangular patch has the dimensions of about 3.75 mm × 3.8 mm and is excited using a lumped port. The material Rogers RT/Duroid 5880 is used for the substrate with predefined parameters as in the dielectric constant(□r=2.2) and height (h=1.5mm). The overall size of the RPAis 7.5 mm × 6.05 mm. The RPA is resonating at a frequency of 28 GHz. The initial design parameters of the proposed RPA are obtained using the following empirical formulae [7]:

$$W = \frac{v_0}{2f_r}\sqrt{\frac{2}{\varepsilon_r + 1}} \quad (1)$$

$$\varepsilon_{reff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}[1 + 12\frac{h}{W}]^{-1/2} \quad (2)$$

$$\Delta L = 0.412h\frac{(\varepsilon_{reff} + 0.3)(\frac{W}{h} + 0.264)}{(\varepsilon_{reff} - 0.258)(\frac{W}{h} + 0.8)} \quad (3)$$

And

$$L = \frac{v_0}{2f_r\sqrt{\varepsilon_{reff}}} - 2\Delta L \quad (4)$$

Where

$L$=length of the patch

$W$=width of the patch

$V_0$=V elocity of light in free space

$h$ = Height of substrate

$f_r$= Resonant frequency of patch

$\varepsilon_r$= Relative permittivity of substrate

$\varepsilon_{reff}$=E ffective relative permittivity

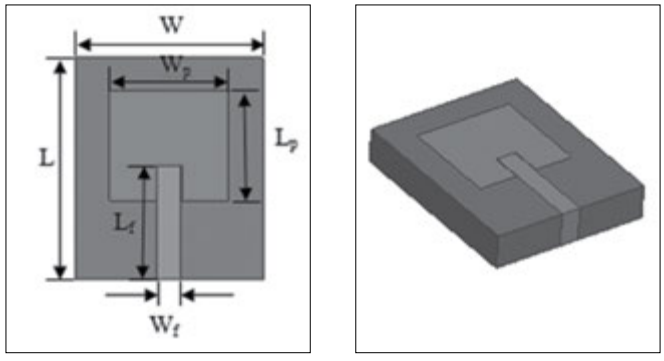
$\Delta L$ =E xtension of the patch on each side of its length considering fringing effect.

The design parameters of the proposed RPA are displayed in Table 1. These parameters were optimized using parametric optimization inbuilt in HFSS to obtain desired results.

Table 1. mn, mp,Vtn and Vtp at all temperatures and corners

| Dimension | Value (mm) |
|---|---|
| Length of ground plane/ substrate(L) | 7.5 |
| Width of ground plane/ substrate(W) | 6.05 |
| Length of the patch(Lp) | 3.75 |
| Width of patch(Wp) | 3.8 |
| Length of the feed line(Lf) | 3.91 |
| Width of the feed line(Wf) | 0.74 |

The proposed antenna design and its different views are shown in Fig. 1.




*a.* *b.*

*Fig. 1. RPA with inset feed (a) Top view (b) 3D view*

## III. RESULTS AND DISCUSSIONS

### A. Return loss plot

The return loss is defined as the power lostwhen the signal gets reflected back whenever there is a discontinuity or impedance mismatch while transmitting the signal by means of any transmission media. The return loss of anyMPA is preferred to be below -10dBfor efficient transmission and better results. The proposed RPA has a return loss value of -19.65 dBwith a very high bandwidth of 1.83 GHz, within 27.07 GHz to 28.90 GHz. The return loss plot is shown in Fig. 2.

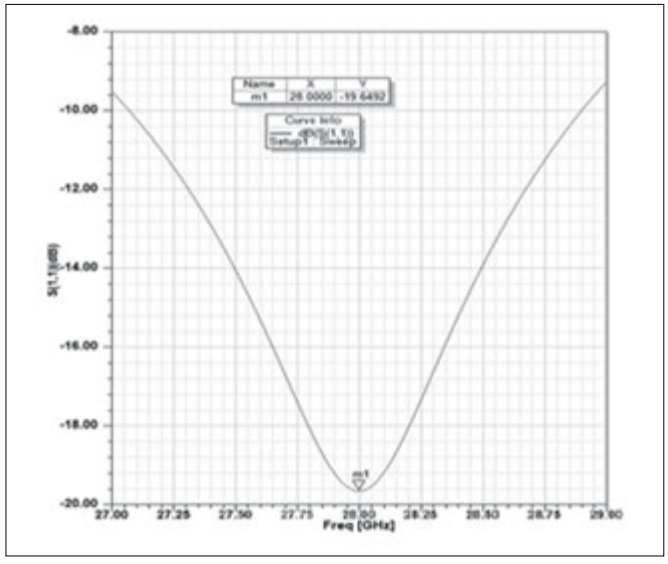
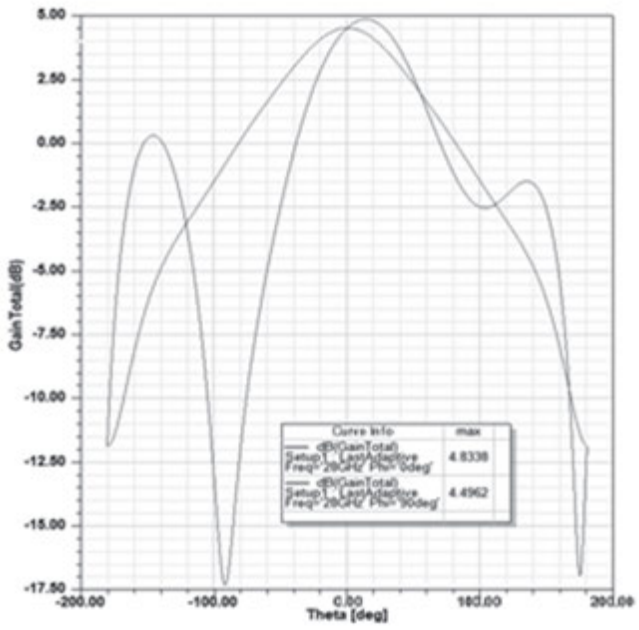


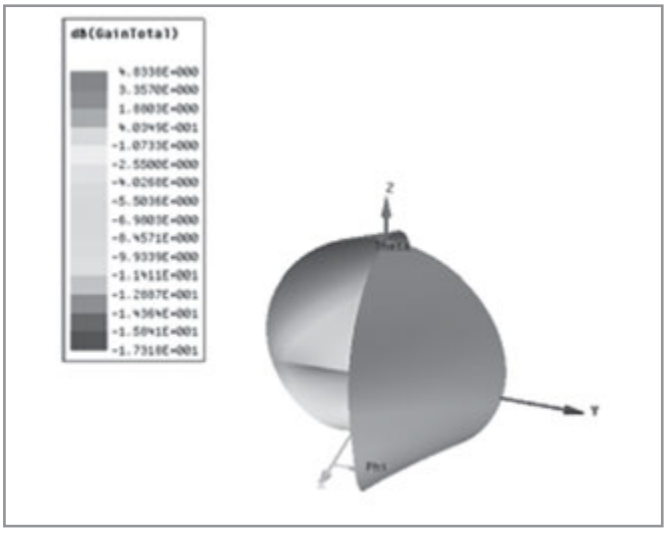

*Fig. 2. Return loss characteristics of the proposed antenna resonating at 28 GHz*

**B. Gain**

In simple words, the gain of any antenna refers to how strong it can transmit or receive a signal in a specified direction. Ideally, the optimal gain of an MPA should be between 5-9 dB. The gain of the proposed RPA in E-plane is 4.83 dB and in H-plane is 4.49dB. The E-Plane and H-Plane gain plotsare as shown in Fig. 3(a) and the 3D polar plot is shown in Fig. 3(b).




*a.*




*b.*

*Fig. 3. Gain characteristics of proposed antenna (a) Rectangular plot (b) 3D polar plot*

**C. VSWR plot**

A VSWR value under 2 is considered suitable for most antenna applications. The proposed antenna shows a VSWR value of 1.2324. The VSWR plot is shown in Fig. 4.

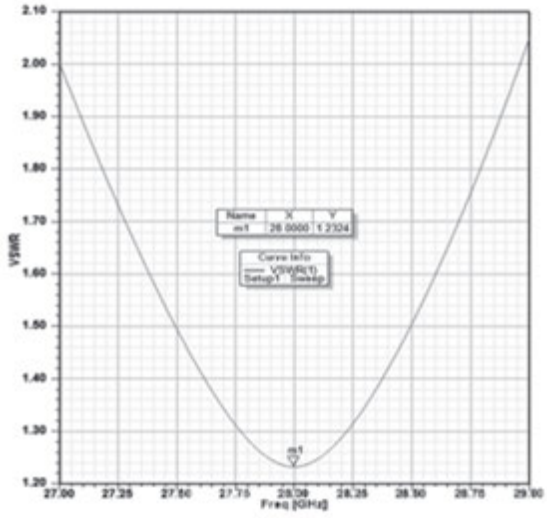



*Fig. 4. VSWR characteristics of the proposed RPA*

**D. Radiation Pattern**

Fig. 5 shows the radiation characteristics of the proposed RPA. The antenna shows an almost omnidirectional radiation pattern and thus is suitable for applications requiring good all-round coverage.

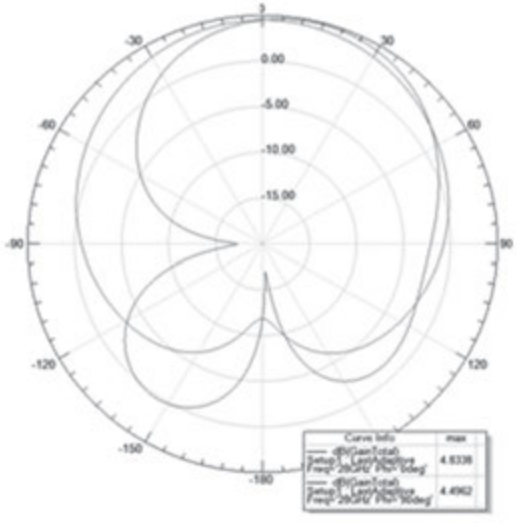



*Fig. 5. Radiation Pattern of the proposed RPA resonating at a frequency of 28 GHz*

A comparison among the proposed RPA and other MPAs available in literature resonating at 28 GHz is mentioned in Table 2.

Table 2. Comparison of Proposed RPA with Other Antennas in Literature

| Reference Antenna | Antenna Size (mm2) | Return Loss(dB) | Gain (dB) |
|---|---|---|---|
| [2] | 11.1 × 5 | NA* | 4.4 |
| [3] | 19 × 19 | -34.5 | 8.03 |
| [8] | 7.9 × 10.5 | -17.17 | 7.5 |
| [9] | 8 × 7.5 | -14 | 4.2 |
| Proposed Antenna | 7.5 × 6.05 | -19.65 | 4.834 |

**Not Available*

The Table IIindicates that the proposed RPA is a miniaturized one with effective gain and other parameters making it suitable for use in compact and hand-held devices.

## VI. CONCLUSIONS

In this paper, an inset feed RPA is designed for 5G applications for the frequency band of 28 GHz. The design and simulation of the proposed RPA is performed using HFSS. The various performance parameters of the RPA such as gain, VSWR, return loss,etc. lie in the optimal ranges. The proposed antenna is omnidirectional in nature. Comparative studies shows that the antenna is compactmaking it suitable for different 5G applications specifically for mobile devices.

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# Detection of Diseases and Its Control in Agriculture

***Abstract :*** *- The goal is to try and make a prototype to help farmers to detect diseases in plants in the agriculture. The main idea is to detect the results using image recognition and pattern recognition. The work process starts with the collection of data i.e. the images basis of which the disease control to be implemented of leaves to be specific all the diseased plants and some other datasets. After the leaves have been grouped into necessary sets that are the training set and the test sets, the sets are trained individually. After training the sets deep learning is being used to apply the image processing and the pattern recognition techniques. The deep learning method being used is the artificial neutral networks. Using the model to detect the disease control, prevention methods by suggestion of the type of medicine or cure could be used to prevent the disease from spreading. An information broadcast mechanism which very likely inform other clients using this prototype about the detected virus and prevention methods. To test the prototype image is selected from the system itself. To display the working of the prototype, GUI is being used to interact with the model that is the detection of the disease and remedy prediction. The prototype is made as simple as it can be to execute. As for now it is being run through the code. Advancements on the model can be done in the future in order to make continuation like into an application*

**Keywords:** machine learning, deep learning, artificial neural network, convolution neural network, image processing, pattern recognition, and disease prediction.

## I. INTRODUCTION

Being agriculture as our prime occupation of our country modernization has only spreads its shadow upon the aftermath of plantation and during its growth rather than during the process of nurturing of the crops which are usually less prioritized. In our defense we would like to extend our hands to make it a priority than irrigation and harvesting. The implementation of our technique based on some popular methodologies known till date. This project would play the part of the screening process where the viruses' type, detection methods and most importantly their control in which would clearly stand out on its own as a part of the modernization that is required which have left unfocused bringing out our now developing nation to a new era of improvement.

### A. Problem Statement

An image of a plant[4] leaf which is infected is given. Infections to a few plants can be harmful because it could spread to other plants nearby if immediate actions are not taken. Help the cultivator/farmer with the detection of diseases in the plants which could be a less fruitful for the efforts made till now and suggest control for the infestations.

### B. Objective of the project

"The objective of this project is to detect the diseases in the plants through their leaves and provide remedies for those infections".

An image of the plant[5] is provided which will be used through the system to get tested for any disease or infections. The prediction is done with respect to similar cases of the test subject. The prediction is done using neural networks concept of deep learning. The training of the working sets will help to predict more accurately. After the disease is detected remedy for the issue is provided.

### C. Organization of the project

- Data is collected from sites and other sources to constitute as the source for the project
- Then data is manually filtered to create the folders where the data can be used for the execution
- Working sets that are training and test sets are created
- CNN is used to train the working sets for the prediction using image processing and pattern recognition
- For display of the working, GUI is used for interacting through the system
- For the prediction made for the infections, solution to the cause is provided

## II. RELATED CONCEPTS USED

### A. Digital Image Processing

DIP is the use of a digital computer to process digital images through an algorithm [2]. As a subcategory

or field of digital signal processing, digital image processing has many advantages over analog image processing. It allows a much wider range of algorithms to be applied to the input data and can avoid problems such as the build-up of noise and distortion during processing. Since images are defined over two dimensions (perhaps more) digital image processing may be modeled in the form of multidimensional systems. The generation and development of digital image processing are mainly affected by three factors: first, the development of computers; second, the development of mathematics (especially the creation and improvement of discrete mathematics theory); third, the demand for a wide range of applications in environment, agriculture, military, industry and medical science has increased. Image processing basically includes the following three steps:

- Importing the image via image acquisition tools;
- Analyzing and manipulating the image;
- Output in which result can be altered image or report that is based on image analysis

**B. Pattern Recognition**

This is the process of recognizing patterns by using machine learning algorithm. Pattern recognition can be defined as the classification of data based on knowledge already gained or on statistical information extracted from patterns and/or their representation. One of the important aspects of the pattern recognition is its application potential.

Examples: Speech recognition, speaker identification, multimedia document recognition (MDR), automatic medical diagnosis.

In a typical pattern recognition application, the raw data is processed and converted into a form that is amenable for a machine to use. Pattern recognition involves classification and cluster of patterns.

- In classification, an appropriate class label is assigned to a pattern based on an abstraction that is generated using a set of training patterns or domain knowledge. Classification is used in supervised learning.
- Clustering [3] generated a partition of the data which helps decision making, the specific decision making activity of interest to us. Clustering is used in an unsupervised learning.

Features may be represented as continuous, discrete or discrete binary variables. A feature is a function of one or more measurements, computed so that it quantifies some significant characteristics of the object. A set of features that are taken together, forms the features vector.

Pattern recognition possesses the following features:

- Pattern recognition system should recognize familiar pattern quickly and accurate
- Recognize and classify unfamiliar objects
- Accurately recognize shapes and objects from different angles
- Identify patterns and objects even when partly hidden
- Recognize patterns quickly with ease, and with automaticity.

**C. Deep Learning**

Deep learning is a branch of machine learning which is completely based on artificial neural networks is ashown in figure 1. A neural network is going to mimic the human brain so deep learning is also a kind of mimic of human brain. In deep learning, we don't need to explicitly program everything. The concept of deep learning is not new. It has been around for a couple of years now. It's on hype nowadays because earlier we did not have that much processing power and a lot of data. As in the last 20 years, the processing power increases exponentially, deep learning and machine learning came in the picture.

Architecture:

1. Deep Neural Network – It is a neural network with a certain level of complexity (having multiple hidden layers in between input and output layers). They are capable of modeling and processing non-linear relationships.
2. Deep Belief Network (DBN) – It is a class of Deep Neural Network. It is multi-layer belief networks.

Steps for performing DBN:

a. Learn a layer of features from visible units using Contrastive Divergence algorithm.

b. Treat activations of previously trained features as visible units and then learn features of features.

c. Finally, the whole DBN is trained when the learning for the final hidden layer is achieved.

3. Recurrent (perform same task for every element of a sequence) Neural Network – Allows for parallel and sequential computation. Similar to the human brain (large feedback network of connected neurons). They are able to remember important things about the input they received and hence enable them to be more precise.

Advantages:

1. Best in-class performance on problems.
2. Reduces need for feature engineering.
3. Eliminates unnecessary costs.
4. Identifies defects easily that are difficult to detect.

Disadvantages:

1. Large amount of data required.
2. Computationally expensive to train.
3. No strong theoretical foundation.

Table 1. Difference between ML and Deep Learning

| Machine Learning | Deep Learning |
|---|---|
| Works on small amount of Dataset for accuracy. | Works on Large amount of Dataset. |
| Dependent on Low-end Machine. | Heavily dependent on High-end Machine. |
| Divides the tasks into sub-tasks, solves them individually and finally combine the results. | Solves problem end to end. |
| Takes less time to train. | Takes longer time to train. |
| Testing time may increase. | Less time to test the data. |

APPLICATION:

1. Automatic Text Generation – Corpus of text is learned and from this model new text is generated, word-by-word or character-by-character.

   Then this model is capable of learning how to spell, punctuate, form sentences, or it may even capture the style.
2. Healthcare – Helps in diagnosing various diseases and treating it.
3. Automatic Machine Translation – Certain words, sentences or phrases in one language is transformed into another language (Deep Learning is achieving top results in the areas of text, images).
4. Image Recognition – Recognizes and identifies peoples and objects in images as well as to understand content and context. This area is already being used in Gaming, Retail, Tourism, etc.
5. Predicting Earthquakes – Teaches a computer to perform viscose-elastic computations which are used in predicting earthquakes.

**D. Neural Networks**

NN are artificial systems that were inspired by biological neural networks. These systems learn to perform tasks by being exposed to various datasets and examples without any task-specific rules. The idea is that the system generates identifying characteristics from the data they have been passed without being programmed with a pre-programmed understanding of these datasets.

(i) Supervised v/s Unsupervised Learning

Neural networks learn via supervised learning, Supervised machine learning involves an input variable x and output variable y. The algorithm learns from a training dataset. With each correct answer, algorithms iteratively make predictions on the data. The learning stops when the algorithm reaches an acceptable level of performance.

Unsupervised machine learning has input data X and no corresponding output variables. The goal is to model the underlying structure of the data for understanding more about the data. The keywords for supervised machine learning are classification and regression. For unsupervised machine learning, the keywords are clustering and association.

(ii) In a regular Neural Network there are three types of layers:

1. Input Layers: It's the layer in which we give input to our model. The number of neurons in this layer is equal to total number of features in our data (number of pixels in case of an image).
2. Hidden Layer: The input from Input layer is then feed into the hidden layer. There can be many hidden layers depending upon our model and data size. Each hidden

layers can have different numbers of neurons which are generally greater than the number of features. The output from each layer is computed by matrix multiplication of output of the previous layer with learnable weights of that layer and then by addition of learnable biases followed by activation function which makes the network nonlinear.

3. Output Layer: The output from the hidden layer is then fed into a logistic function like sigmoid or softmax which converts the output of each class into probability score of each class.

   The data is then fed into the model and output from each layer is obtained this step is called feed forward, we then calculate the error using an error function, some common error functions are cross entropy, square loss error etc. After that, we back propagate into the model by calculating the derivatives. This step is called Back propagation which basically is used to minimize the loss.

(iii) Types of Neural Networks

There are seven types of neural networks that can be used.

- The first is a multilayer perceptron which has three or more layers and uses a nonlinear activation function.
- The second is the convolutional neural network that uses a variation of the multilayer perceptrons.
- The third is the recursive neural network that uses weights to make structured predictions.
- The fourth is a recurrent neural network that makes connections between the neurons in a directed cycle. The long short-term memory neural network uses the recurrent neural network architecture and does not use activation function.
- The final two are sequence to sequence modules which use two recurrent networks and shallow neural networks which produce a vector space from an amount of text.

## III. PROPOSED METHOD

To build a model that will train itself a set of times so that any new outcome could be predicted from the data. The provided data is to train the training and test sets to get familiarized with all other data. After the data is trained on the basis of working sets deep learning is used to train in relation to systems based on components. It has been proven to be a very effective with data which most likely may be inter-related. Using this concept, we will predict the outcome for the data provided. After the prediction, solution to the issue will be provided so that it can be tackled as soon as possible.

Neural Networks (NN), or more precisely Artificial Neural Networks (ANN), is a class of Machine Learning algorithms that recently received a lot of attention (again!) due to the availability of Big Data and fast computing facilities (most of Deep Learning algorithms are essentially different variations of ANN). The class of ANN covers several architectures including Convolutional Neural Networks (CNN), Recurrent Neural Networks (RNN) e.g. LSTM and GRU, Auto-encoders, and Deep Belief Networks. Therefore, CNN is just one kind of ANN. Generally speaking, an ANN is a collection of connected and tunable units (a.k.a. nodes, neurons, and artificial neurons) which can pass a signal (usually a real-valued number) from a unit to another. The number of (layers of) units, their types, and the way they are connected to each other is called the network architecture.

In deep learning, a convolutional neural network (CNN, or ConvNet) is a class of deep neural networks, most commonly applied to analyzing visual imagery. Convolutional networks were inspired by biological processes in that the connectivity pattern between neurons resembles the organization of the animal visual cortex.

***Convolutional Neural Networks (CNN):***

CNN or ConvNets are neural networks that share their parameters. Imagine you have an image. It can be represented as a cuboid having its length, width (dimension of the image) and height (as image generally has red, green, and blue channels).

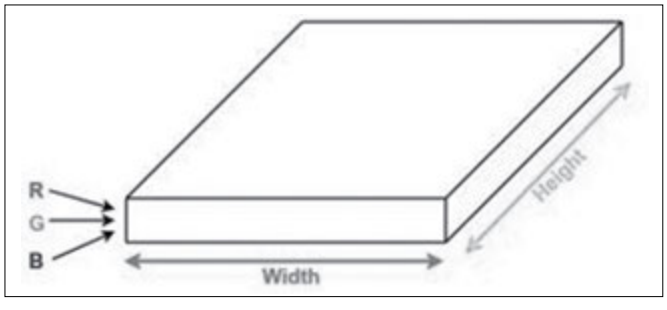


*Fig. 1. shows CNN representation of image.*

Now imagine taking a small patch of this image and running a small neural network on it, with say, k outputs and represent them vertically. Now slide that neural network across the whole image, as a result, we will get

another image with different width, height, and depth. Instead of just R, G and B channels now we have more channels but lesser width and height. his operation is called Convolution. If patch size is same as that of the image it will be a regular neural network. Because of this small patch, we have fewer weights.

Mathematics involved in CNN:-

- Convolution layers consist of a set of learnable filters (patch in the above image). Every filter has small width and height and the same depth as that of input volume (3 if the input layer is image input).

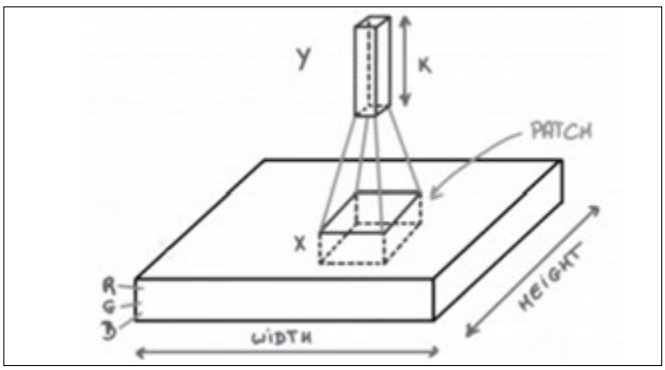


*Fig. 2. Usage of image in CNN*

- For example, if we have to run convolution on an image with dimension 34x34x3. Possible size of filters can be axax3, where 'a' can be 3, 5, 7, etc but small as compared to image dimension.
- During forward pass, we slide each filter across the whole input volume step by step where each step is called stride (which can have value 2 or 3 or even 4 for high dimensional images) and compute the dot product between the weights of filters and patch from input volume.
- As we slide our filters we'll get a 2-D output for each filter and we'll stack them together and as a result, we'll get output volume having a depth equal to the number of filters. The network will learn all the filters.

A covNets is a sequence of layers, and every layer transforms one volume to another through differentiable function. Types of layers:

Let's take an example by running a covNets on of image of dimension 32 x 32 x 3.

1. Input Layer: This layer holds the raw input of image with width 32, height 32 and depth 3.
2. Convolution Layer: This layer computes the output volume by computing dot product between all filters and image patch. Suppose we use total 12 filters for this layer we'll get output volume of dimension 32 x 32 x 12.
3. Activation Function Layer: This layer will apply element wise activation function to the output of convolution layer. Some common activation functions are RELU: max(0, x), Sigmoid: 1/(1+e^-x), tanh, Leaky RELU, etc. The volume remains unchanged hence output volume will have dimension 32 x 32 x 12.
4. Pool Layer: This layer is periodically inserted in the covNets and its main function is to reduce the size of volume which makes the computation fast reduces

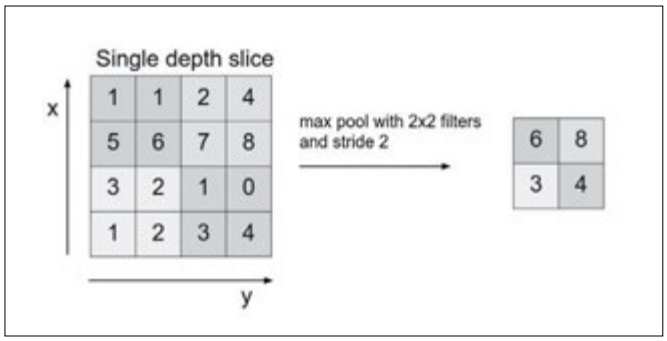


*Fig. 3. Pool Layer*

memory and also prevents from over-fitting. Two common types of pooling layers are max pooling and average pooling. If we use a max pool with 2 x 2 filters and stride 2, the resultant volume will be of dimension 16x16x12.

5. Fully-Connected Layer: This layer is regular neural network layer which takes input from the previous layer and computes the class scores and outputs the 1-D array of size equal to the number of classes.

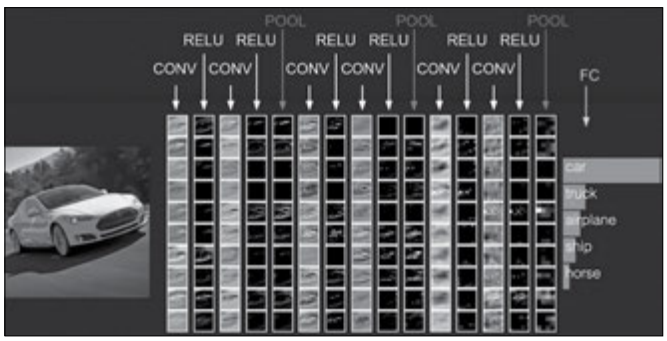


*Fig.4. Fully-Connected Layer*

## IV. WORK OUTCOME

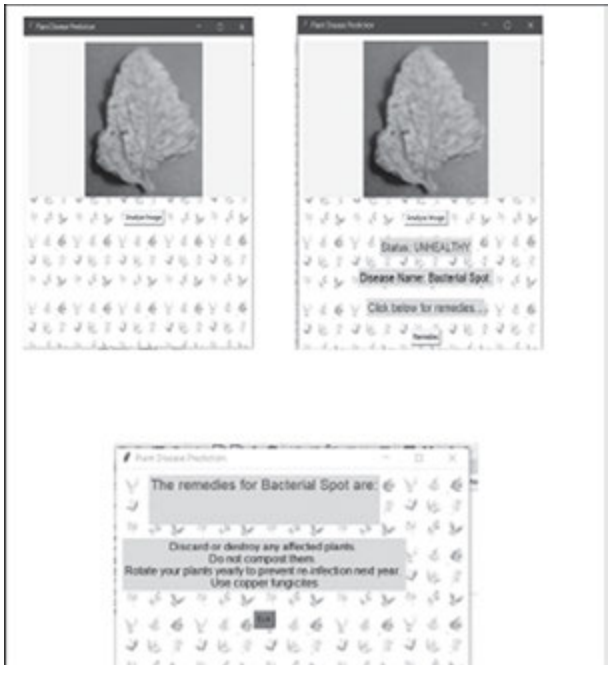


*Fig. 5. Disease detection and remedy prediction*

Fig 3, 4, and 5 shows disease detection and fully connected layer and remedy prediction respectively.

## V. CONCLUSION

The proposed CNN based leaves disease identification model is capable of classifying four different deficiencies in leaves from the healthy one. Since CNN does not require any tedious pre-processing of input images and hand designed features, faster convergence rate and good training performance, it is preferred for many applications rather than the conventional algorithms. The classification accuracy can be further increased by providing more images in the dataset [1] and tuning the parameters of the CNN model.

## VI. FUTURE SCOPE

- Right then our vision is limited that is we are starting for a prototype with local machine
- That too for common crops.
- But if this vision fulfills next step to upgrade to the wide area coverage.

## ACKNOWLEDGMENT

We take this opportunity to extent my gratitude to the people who made it possible for me and my teammates to create this project. We want to thank the institute for having to create a project in our academic curriculum so that what we learned till now can be implemented in the most effective way. We want to thank our project supervisor Prof. Chittaranjan Mohapatra for guiding us to do this project when we were stuck at place we were difficult to overcome. We want to thank our family and friends who were available during this COVID-19 pandemic to keep us in good mind and health so that we can complete our duty without any objections and obstructions.wide area coverage.

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# WAMAN DATTATREYA PATWARDHAN

One of the top-ranked nuclear chemists of India, Waman Dattatreya Patwardhan has been one of the pioneering figures accountable for the nuclear advancement of this country. India owes a lot to him for his contributions to the field of rocket science and nuclear science that led to revolutionary developments in the sector. Patwardhan was at the crux of important projects like The Indian Nuclear Program, Indian Space Program, with undisputed expertise in rocket propellants and nuclear chemistry. His extensive work on Military explosives, missile and rocket programs in India and eminent programs including the Smiling Buddha Project set a niche for him making him one of the most revered and competent scientists that led India to become one of the emerging superpowers in South Asia.

He was one of the scientists on board at the Defense Research and Development Organisation (DRDO) working intensively in the fields of Explosives Engineering and Nuclear Chemistry. He also went on to work for Indian Space Research Organisation (ISRO) and lent his exemplary wisdom and prowess in the fields of rocket propulsion, missile development, and explosive technology.

He served as the founder director of the Explosives Research and Development Laboratory (renamed later as the High Energy Materials Research Laboratory (HEMRL)) of India. He spearheaded the first space rocket launch for India at Thumba and the solid rocket propellant for the same. The technology of Charge Line Mine Clearing (CLMC), which he developed in the 1960s saved numerous lives in the wars of 1965 and 1971. This technology is still being used today. This device can clear mines in a minefield in a straight line by forming a mine-free path allowing soldiers to safely march forward. He developed devices to create smoke screens for providing cover and coloured smokes for signaling using guanidine nitrate.

A milestone in technology was attained when he developed devices for oxygen supply in submarines using potassium super oxide. He developed a process to purify potassium and making super oxide which was a challenging task. He established the solid propellant for the first rocket developed by ISRO which was launched from Thumba. He, assisted by his colleague Dr. S. A. Joshi, was also instrumental in developing the detonation system for India's first nuclear device tested in 1974, a project known as Operation Smiling Buddha, headed by Dr. Raja Ramanna. He had good working relations with defense ministers like Mr. Y. B. Chavan, Mr. Swaran Singh, Army officials like Gen. Bewoor, scientific advisors like Dr. Nagchowdhury and Dr. R.V. Tamhankar (Director DMRL), Dr. Raja Ramanna

(Director, BARC). Even Dr. Abdul Kalam worked with him for some time in his early career days.

Dr. Patwardhan's expertise in the science and technology of explosives was prominent even in the western world. Publishers of "Nature" journal requested him to send a review on the textbook of explosives, by Urbanski, which was later published. The foundations of different propellants and explosives technology for Indian armed force were laid in ERDL, by Dr. Patwardhan. He was recently honored by the High Energy Materials Research Laboratory (HEMRL: formerly ERDL) by naming an auditorium as "Patwardhan Hall".

He was keenly interested in agriculture and astronomy. He performed many experiments and wrote a path-breaking book on Hydroponics (agriculture without soil). A low cost technology to produce parabolic mirrors for reflecting telescopes used for astronomical observations was also developed by him. At the age of eighty, Dr. Patwardhan worked on another invigorating technology: airbags, used in modern cars, together with Dr. Ramaswamy. He visited the U.S. in 1997 for this purpose. When he was 86, he flourishingly developed a method to precipitate an extract of a seed called Semecarpus anacardium (Bhallataka or bibba) which is supposed to be a parallel medicine for cancer.

Dr. Patwardhan was conferred with the Padma Shri in 1974 for his exemplary contributions to the field of nuclear and rocket science and his association with the premier institutions of science and technology has fabricated a chain reaction of breakthroughs and discoveries that changed the fate of the Indian subcontinent. It was his sheer attention to detail and determination to think out of the box that inspired him to create state of the art defense machinery for India and take India from a vulnerable country to an emerging global superpower.

## ANTARCTICA'S 'DOOMSDAY GLACIER' IS HEMORRHAGING ICE FASTER THAN IN THE PAST 5,500 YEARS

Ancient bones revealed how fast the melting ice raised the Antarctic shorelines. Antarctica's so-called Doomsday Glacier is losing ice at its fastest rate in 5,500 years, raising concerns about the ice sheet's future and the possibility of catastrophic sea level rise caused by the frozen continent's melting ice. The finding comes from a study of prehistoric sea-deposits found on the shores surrounding the "doomsday" Thwaites Glacier and the neighboring Pine Island Glacier, both located on the West Antarctic Ice Sheet. The chilling news? Antarctica's glacial melt, driven by climate change, is advancing faster than ever before in recorded history, researchers have reported June 9 in the journal Nature Geoscience. "These currently elevated rates of ice melting may signal that those vital arteries from the heart of the West Antarctic Ice Sheet have been ruptured, leading to accelerating flow into the ocean that is potentially disastrous for future global sea level in a warming world," co-author Dylan Rood, an Earth scientist at Imperial College London, said in a statement. As one of Antarctica's fastest-melting glaciers, Thwaites has earned the nickname "Doomsday Glacier." Since the 1980s, Thwaites has lost an estimated 595 billion tons (540 billion metric tons) of ice, contributing to a 4% rise in global sea levels. Thwaites and its northern neighbor, the Pine Island Glacier, cover enormous expanses; Thwaites has a surface area of about 74,130 square miles (192,000 square kilometers) (making it nearly as big as Great Britain) and Pine Island 62,660 square miles (162,300 square km).

*Source: livescience.com*

# **Plastic:** A Stumbling Block on India's Path to Net Zero Aim of 2070

Plastic pollution plays a significant role in global greenhouse gas emissions and climate change. India is generating 9.46 megatons of plastic waste each year. In November 2021, India's ambitious net-zero target for carbon emissions were celebrated by many, as the country committed to becoming carbon-neutral by not adding any greenhouse emissions to the atmosphere by 2070. As the world's fourth-biggest carbon emitter, these targets marked India's cognizance of the issue of climate change, and its commitment to address it. But with the country's industrial practices headed in a different direction, it seems difficult to realistically achieve net-zero in the next 50 years. A recent analysis by the Council for Energy, Environment and Water Research (CEEW), a think tank in New Delhi, estimated a cost of over $10 trillion (Rs. 700 lakh crore), for the upgraded infrastructure of renewable energy sources for electricity, transport, building, and industry sectors to meet the net-zero targets. India is among the many countries scaling up its petrochemical industries. With an investment of $100 billion to boost domestic production by 2030, the next decade will catalyse India's crude oil demand and accelerate petrochemical production. Industrial practices like decarbonisation, and plastic-based fuels touted to be sustainable, are less optimal and cost-effective than claimed, with the result contributing to more emissions and a larger carbon footprint. According to Vaibhav Chaturvedi, co-author of the CEEW report, it is in the petrochemical sector's commercial interests to introduce circular economies that allow plastics to remain in the industrial ecosystem, rather than find non-plastic-based alternatives. The report is a grim reminder that recycling plastics as an industrial fuel is not a viable long-term solution to pollution. As India's petrochemical industries expand, infrastructure interventions that consider the plastic lifecycle may nothelp to turn the tide on climate change.

***Source:*** *https://idronline.org/article/environment/plastic-a-stumbling-block-on-indias-path-to-net-zero/&https://www.wwf.org.au/news/blogs/the-lifecycle-of-plastics*

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