



REVA
UNIVERSITY

Bengaluru, India



Relevant Documents for Student Research Project AY-2021-22

List of Students Research Publications on Major Project for AY 2021-22

Sl. No.	Name of the Students	Title of the Paper	National / International	Year	ISBN
1	Ajith Kumar Joel T	Establishment of Ground Station for two-way Communication	International	2021	978-1-6654-0239-2/22
	Steffi Das				
	Chandan MN				
	Charan Yadav NP				
2	Pavan Kalyan	Wearable Smart Heart Monitor using IOT	International	2021	978-1-6654-8316-2
	Reddy Y				
	Rithik Richard				
	N Magalaxmi				
	Sri Charan				
3	K. J. Kumar	Implementation of Low-Power High-Speed Clock and Data Recovery	International	2021	978-981-16-1056-1
4	Shailaja Kalmani	Application of Computer Vision for Multi-Layered Security to ATM Machine using Deep Learning Concept	International	2021	978-1-6654-9710-7
5	Mohmad mohiddin	Embeded System Based Anytime Medicine Vending Machine.	International	2021	978-1-6654-0416-7
	Anand H M				
	Manish R K				
	Vamshi Krishna				
6	Bansilal Bairav	Modeling and Simulation for Capacity Fade	International	2021	978-1-6654-3299-3
	Santoshkumar Hampannavar				
	Kaushik Vishal				
	K M bhargavi				
7	sujoo oommen	A Bluetooth based Intercommunicative Product for Spotting Medicine in Pharmacies	International	2021	978-1-6654-0416-7
	Akhil B H				
	Akash V T				
	Deeraj S				
	Aman Irshad				

8	Pratyushkumar panda	Weather Parameter and Pollution Level Extraction using IoT for Various Traffic Nodal Points with Solar Charging	International	2021	978-1-7281-7213-2/20
	Adithya Ballaji				
	Sujoo ommen				
	Manish Bharat				
9	Neha, MS	Block Chain: The Security Provider	International	2021	978-81-931101-9-5
10	Sangayya Gulledmath	Synergetic Observation of Soil Water Movement Pathways and Expression of Deficit Using Data Mining Techniques	International	2021	978-81-931101-9-5
	Vinay Kumar K.N				
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Establishment of Ground Station for two-way Communication via Geostationary Amateur Radio Satellite

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Abstract—With the recent advances in the field of satellite technology, satellites are being launched for various applications such as broadcasting, meteorology, remote sensing, amateur radio etc. One such satellite launched for amateur radio application is the Es'hail-2/QO-100 satellite. Es'hail-2/QO-100 is a geostationary satellite built by Japan's Mitsubishi Electric company, and launched aboard a SpaceX Falcon 9 rocket on November 15, 2018. The QO-100 carries two transponders specially built for HAM radio communications. This paper aims at setting up a ground station for two-way communication via the QO-100 satellite between various amateur radio operators located in areas spanning from Brazil to Thailand. The ground station is setup using HF Transceiver, Software Defined Radio (SDR), Parabolic Reflector Antenna and Dual Patch Antenna along with frequency Up-converter, Downconverter and Power Amplifier.

Keywords—Software Defined Radio (SDR), POTY feed antenna, Up-converter, HF Transceiver, Power Amplifier.

I. INTRODUCTION

Es'hail-2/QO-100 (Qatar Oscar -100) [9] is the first and only geostationary satellite launched for establishing communication link between amateur radio operators. The QO-100 satellite consists of 2 transponders which acts like a repeater, these transponders can be used for both analog and digital transmission and reception. This paper focuses on developing a ground station for two-way analog communication via the QO-100 satellite.

At the receiver side, the ground station setup will consist of a parabolic reflector (dish) antenna, suitable Low Noise Block (LNB), Bias-T (Power Supply for LNB) and a Software Defined Radio (SDR) connected to a Laptop/PC. At the transmitting side, the ground station setup will consist of a HF Transceiver, Frequency Up-converter, Power Amplifier, and Dual Patch feed antenna connected to a dish antenna. This setup will help to establish an analog communication link with over 100+ countries without the presence of internet. When all existing form of communication fails during natural calamities or disasters, this setup can be used for communication and crisis management.

II. THEORETICAL BACKGROUND

A. About QO-100 satellite

The geostationary satellite Es'hail-2/QO-100 (Qatar Oscar-100) carrying amateur radio transponders was

launched from Kennedy Space Center at 20:46 GMT on Thursday, November 15, 2018 and is now in a geostationary orbit at 25.9° East. It carries 2 amateur radio transponders i.e. Narrowband Linear Transponder and Wideband Digital Transponder operating at 2400 MHz and 10450 MHz bands. The Narrowband Linear Transponder can be used as a repeater for analog transmission and reception using a suitable ground station setup.

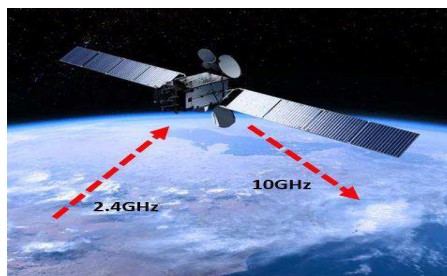


Fig. 1: Es'hail-2/QO-100 satellite [9]

B. Footprint of the QO-100 satellite

The QO-100 satellite is the first amateur radio transponder to be put into geostationary orbit and they are expected to link radio amateurs from Brazil to Thailand.

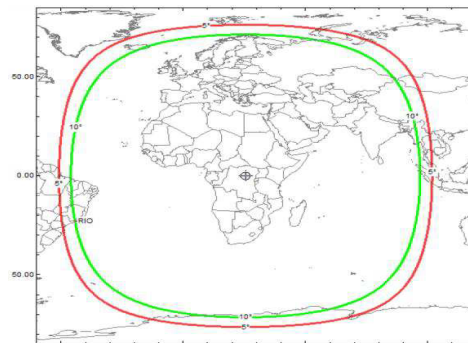


Fig 2: Footprint of the QO-100 satellite [9]

C. The Narrow Band Transponder on the QO-100

For the analog transmission and reception purpose, the narrowband transponder present on the QO-100 satellite can be used by the amateur radio (HAM) Operators. The frequency allocation for uplink and downlink is as shown in the figure.

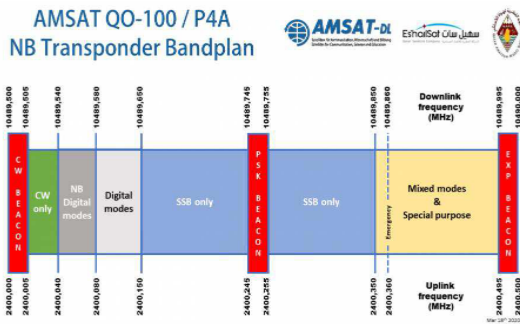


Fig 3: Frequency allocation for the NB Transponder [9]

III. METHODOLOGY

A. Receiver Block

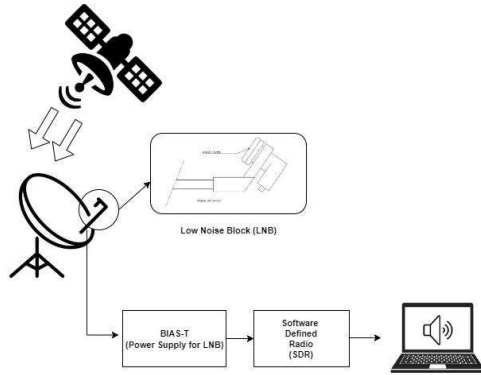


Fig 4: Block diagram of Receiver Setup

For receiving the signals from the QO-100 satellite, firstly a parabolic reflector i.e. a dish antenna is required. The downlink frequency of the QO-100 satellite is about 10.4GHz, but the receiver module (SDR) is capable of receiving only up to 1.5GHz. Therefore, to reduce the frequency to the range that can be received by the SDR, a Low Noise Block (LNB) is used for down converting the frequency. A Bias-T is used which acts like a power supply for the LNB. Finally, the output of the Bias-T is given to the Software Defined Radio (SDR). The SDR is a radio communication device which can be connected to the PC/Laptop via the USB port and the receiving frequency can be tuned by using certain open source software's.

B. Transmitter Block

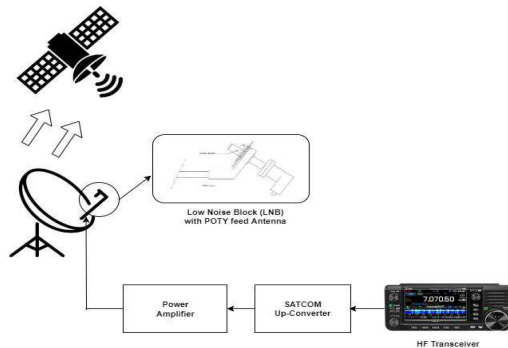


Fig 5: Block diagram of Transmitter Setup

At the transmitting end, first a HF transceiver is required. This HF transceiver is capable of transmitting signals at 5-50MHz frequency (HF Range). But, the uplink frequency of the QO-100 satellite is about 2.4GHz, therefore the frequency has to be increased from 5-50MHz to 2.4GHz. This is achieved by using a frequency up-converter. Since the QO-100 satellite is in a geostationary orbit, the signal has to travel a very long distance (approximately 36,000Kms). To overcome the attenuation and losses, the power of the transmitted signal has to be increased using a power amplifier. The output of the power amplifier is then connected to the dual patch antenna which bombards the signal on the dish antenna, and the reflected signal from the dish reaches the satellite in the space.

IV. HARDWARE REQUIREMENTS

A. 120cm/4ft Dish Antenna

For both signal reception and transmission, a 120cm/4feet diameter parabolic reflector attached with a Low Noise Block (LNB) is required. The dish is made to point at an elevation angle of 30.5° and azimuthal angle of 259.6° which is the lookup angles of the QO-100 satellite.



Fig 6: 120cm/4ft diameter parabolic reflector

B. Low Noise Block (LNB)

A Low Noise Block (LNB) is a frequency downconverter used for converting high frequency signal to low frequency signal that can be received and demodulated by the receiver. Here, a LNB which can down-convert signals from approx. 10.4GHz to 750MHz is required. For this down conversion, a LNB having a local oscillator of at least 9.65GHz is required.



Fig 7: Low Noise Block (LNB) downconverter

C. Bias-T (Power Supply for LNB)

To power up the LNB, a 12V power supply is required. A Bias-T is used because, it can carry both RF and DC signal in a single transmission medium on one port and allows only RF signal in another port. Thereby using a single coaxial cable, the signal can be received from the LNB as well as DC supply can also be given to the LNB.



Fig 8: Working of Bias-T Fig 9: 3 Port 12V Bias-T

D. Software Defined Radio (SDR)

Software-defined radio (SDR) is a system used for radio communication where hardware like amplifiers, filters, etc. are implemented by embedded systems i.e. a chipset fabricated and mounted on a PCB. It consists of the RTL2832U chipset which gives us access to the radio spectrum thereby enabling us to listen to frequencies ranging from 500KHz-1.5GHz. The input impedance of the RTL-SDR is approximately 75ohms. The signal from the antenna can be received via the SDR and the audio signal can be heard and analyzed using a specific software on the PC/Laptop.

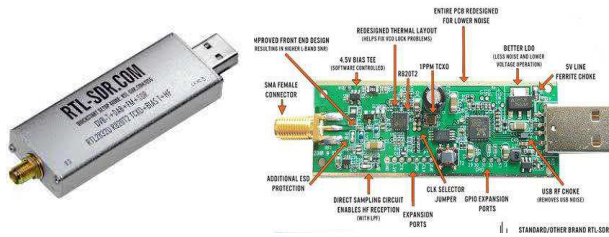


Fig 10: The RTL-SDR dongle and its internal structure [14]

E. HF Transceiver

To transmit the signals to the QO-100 satellite, an amateur radio HF Transceiver is required. The modulation type used will be SSB (Single Side Band) modulation, as SSB is the only analog modulation supported by the narrowband transponder on QO-100 satellite. The HF transceiver will be connected to the external dish antenna via an up-converter and power amplifier.



Fig 11: iCOM IC-7300 HF Transceiver [18]

F. Frequency Upconverter

The uplink frequency of the QO-100 satellite is approximately. 2400MHz. Since the max. output frequency of the HF transceiver is only up to 50MHz, the frequency of the output signal has to be increased to 2400MHz. This conversion is done by using a satellite communication frequency up-converter.



Fig 12: SATCOM Up-converter

G. Power Amplifier

The power of the transmitted signal has to be increased so that it travels longer distance and also it overcomes the atmospheric attenuation. To achieve this, the output of the up-converter has to be given to a power amplifier before connecting it to the transmitting antenna. A 4W, 2400MHz power amplifier is used here.

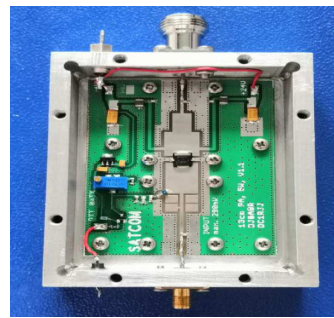


Fig 13: 4W/2400 MHz Power Amplifier

H. POTY feed Antenna

The POTY feed antenna [15] is a dual patch antenna used for transmitting signal at 2400MHz, which is the uplink frequency of the QO-100 satellite. This antenna was fancily named as POTY ("Patch of the Year") feed antenna by the HAM Radio enthusiasts. It consists of two patches made up of copper plate of 2-3mm thickness and these two plates are connected to a copper tube. The copper tube is then inserted into the LNB so that it acts like a waveguide for the LNB.

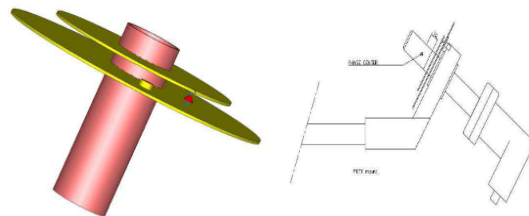


Fig 14: The POTY feed antenna [15]

V. SOFTWARE REQUIREMENTS

A. Zadig

To get the RTL-SDR dongle running on a Windows OS, a driver is necessary for the installation. Zadig is a device driver software used for installing and configuring the RTL-SDR on the PC/Laptop. When the RTL-SDR dongle is plugged into the USB port for the first time, the Zadig tool has to be setup to complete the installation of the dongle.

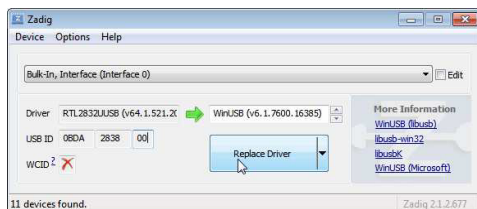


Fig 15: Installation of RTL-SDR dongle using Zadig tool

B. SDR Console

SDR Console is a PC-based DSP application used for Software Defined Radio (SDR). The main purpose of using SDR Console is to tune the receiving frequency of the SDR. Other parameters such as modulation type, bandwidth, RF gain, sampling frequency etc. can be varied as required. It also shows a waterfall diagram or frequency spectrum of the signal where the signal pattern can be analyzed.

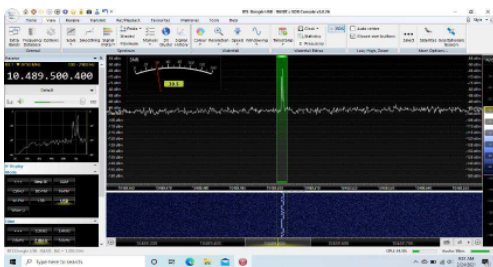


Fig 16: Image showing the waterfall in SDR Console

VI. IMPLEMENTATION

A. Receiver Setup

As seen in the methodology, the receiving station is setup using a 120cm diameter dish antenna. A Low Noise Block (LNB) having a local oscillator frequency of 9.75GHz is used for down-converting the frequency of the received signal. The receiving frequency of the QO-100 satellite is in the range of 10.489GHz to 10.499GHz, but after down-converting the frequency of the received signal via the LNB, the intermediate frequency that received is about 739-740MHz.

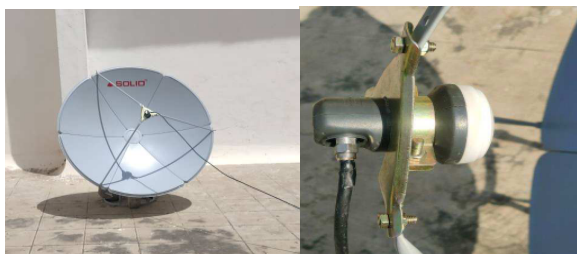


Fig. 17: The 120cm dish antenna with the LNB mounted

From the LNB, a RG-6 coaxial cable of about 18m length is connected to the input port of the Bias-T. The Bias-T is used to power up the LNB and it is connected to a 12V power supply. The output port of the Bias-T is connected to the Software Defined Radio (SDR), which in turn is connected to the Laptop/PC. In the Laptop/PC, using the SDR console software, the receiving frequency can be tuned and the stations on air via the QO-100 satellite can be listened.



Fig 18: The Bias-T

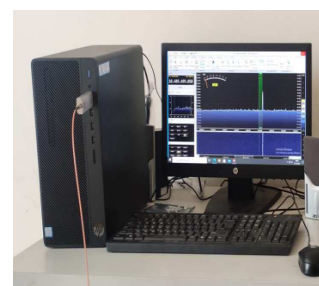


Fig 19: SDR connected to PC

B. Transmitter Setup

For transmitting signals to the QO-100 satellite, the dual patch (POTY feed) antenna has been designed. The complete dimensions of the POTY feed antenna is as shown in Fig. 20.

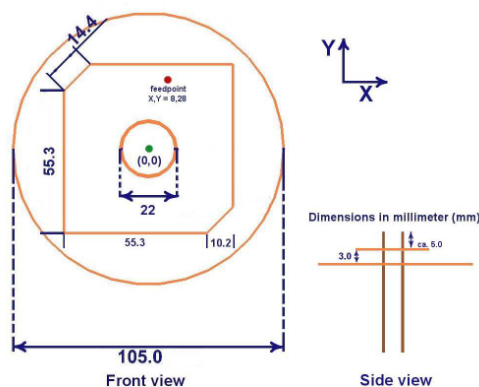


Fig. 20: Dimensions of the POTY feed antenna [15]

The antenna was designed using a copper plate of 3mm thickness and a copper pipe of 22mm outer diameter (OD). Firstly, the copper plate was cut into the desired shape using water jet cutting. The sketch was designed using AutoCAD 2007 tool and the .DWG file was fed to the water jet cutting machine.



Fig. 21: Materials used for constructing the antenna

After cutting the copper plates into the desired shapes, the copper plates were placed on the 22mm OD copper pipe. To achieve a working frequency of 2.4GHz, the plates should be placed at a distance of 3mm apart from each other. Once the copper plates were placed in the position on the copper pipe, the copper plates were fixed firmly onto the 22mm OD copper pipe by brazing. Using a N-type flange mount, the connections were made between the plates and the dual patch antenna was tested using a Vector Network Analyzer (VNA).



Fig. 22: The final design of the POTY feed antenna



Fig. 23: POTY feed antenna testing using VNA

The uplink frequency of the QO-100 satellite is about 2.4GHz, therefore the designed antenna should also achieve a working frequency of 2.4GHz. The test results of the antenna can be seen in the VNA from Fig. 23. The following table shows values of the different parameters obtained upon testing.

Operating Frequency	2.4GHz
VSWR at 2.4GHz	1.225
Impedance at 2.4GHz	50.20Ω

Table 1: Results obtained after testing the antenna

For ideal operation of an antenna, it's VSWR should be less than 2 and its impedance should match with the transmitting device. Here the transmitting device used is the iCOM HF Transceiver which operates at 50Ω impedance. From the test results it can be concluded that, the designed POTY feed antenna can be used for transmitting signals to the QO-100 satellite as the VSWR and the impedance values obtained after testing are well within to the required values.

After the antenna design is completed, to setup the transmitting station, firstly the HF Transceiver is required.

Here, the iCOM IC-7300 HF Transceiver is used. The output of the HF transceiver is given to the Satcom Up-converter to increase the transmitting frequency from HF (High Frequency) range to 2.4GHz which is the uplink frequency of the QO-100 satellite. Then, the frequency up-converted signal is amplified using a 4W, 2.4GHz power amplifier. Finally, the output of the power amplifier is fed to the POTY feed antenna by using a hardline, low loss LMR 400 coaxial cable. The POTY feed antenna is attached to the LNB mounted on the dish and signal from the POTY feed antenna strikes the dish and gets reflected towards the satellite, thereby completing the uplink procedure.



Fig. 24: POTY feed antenna and LNB mounted on the dish



Fig. 25: The complete ground station setup

VII. RESULTS

The entire ground station setup is implemented at REVA University HAM Radio Club (Bengaluru, India) and the grid locator is MK83tc. Initially only the receiving part was setup and the CW Beacon and SSB modulated signals transmitted by the QO-100 satellite was successfully received. The signals received were clear and perfectly readable with a Signal to Noise Ratio (SNR) of about 35-40dB.

Later the transmission part was setup and till date, contacts have been made with Amateur Radio (HAM) operators from various countries like Brazil, Finland, Romania and many more. Signal reports were exchanged with the HAM operators via the QO-100 satellite, the signals transmitted by stations on air was copied very loud and clear with perfect readability. Also, we received our signal reports from the HAM operators with whom we had contact through the satellite and as per their return signal report, the signals transmitted from our ground station setup was also clear and perfectly readable. The following table shows some of the contacts that we have made with other HAM operators via the QO-100 satellite ground station setup.

Call-sign	Handle	Date and Time	Grid Locator	Country
PT9BM	Gustavo	31/03/2021 09:45 IST	GH40jh	Brazil
OH5LK	Jussi	31/03/2021 21:25 IST	KP20lf	Finland
YO9DOC	Mihai	31/03/2021 22:10 IST	KN25lu	Romania
DO2TC	Peter	16/04/2021 15:30 IST	JO73ao	Germany
IW0EHS	Luciano	16/04/2021 15:35 IST	JN61cs	Italy
OM3WAN	Benko	19/04/2021 15:50 IST	JN88vp	Slovakia
IKOYKM	Enrico	19/04/2021 16:10 IST	JN61ht	Italy

Table 2: Contacts made via the QO-100 satellite

VIII. APPLICATIONS

- 1) Establish communication link with 100+ countries without the help of internet.
- 2) Communication support during disaster management when all forms of existing communication fails.
- 3) Communication support during natural calamities such as tsunami, floods etc.
- 4) It is a portable setup and can be installed anywhere within the footprint of the satellite.

IX. CONCLUSION AND FUTURE SCOPE

A. Conclusion

The objective of establishing ground station setup for two-way communication via geostationary amateur radio satellite is achieved successfully. Through this setup, many contacts were made with various HAM operators from around the world within the footprint of the satellite. QO-100 satellite was launched in the year 2018 and the average lifespan of a satellite is about 15 years. Now this ground station setup is expected to provide communication support via the QO-100 satellite for at least the next 12 years or even maybe beyond that. Mainly, this ground station setup will help in providing communication support during natural calamities, disasters and distress communication when all the existing form of communications i.e. cellular and network based communication fails.

B. Future Scope

This paper focused on setting up a ground station for two-way voice based communication via the QO-100 satellite. In future, this work can be further enhanced by modifying the ground station to receive and transmit Digital Amateur Television (DATV) signals via the wideband transponder on the QO-100 satellite. Quadrature Phase Shift Keying (QPSK) is the digital modulation technique used for the DATV signals. By using the same POTY feed antenna, along with any advanced full-duplex SDR such as Adalam Pluto, LimeSDR, LimeSDR Mini etc., and the software to

run the full-duplex SDR, a fully functional ground station setup can be established for transmitting and receiving DATV signals from the QO-100 satellite.

X. REFERENCES

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Wearable Smart Heart Monitor using IOT

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Abstract—Sudden cardiac death is a common and tragic occurrence that typically occurs in the prime of life and has far-reaching effects for the individual's family. Out-of-hospital sudden cardiac mortality accounts for more than 60% of all deaths caused by cardiovascular disease, the world's leading cause of death. Shocking progress has been made in our understanding of sudden cardiac death, as well as its prevention and management, over the last few decades. With the growing popularity of smart wearable gadgets, there has never been a better time to give a solution. Heart rate, heart rate variability, body temperature values, and blood oxygen levels are all crucial signs that must be measured on a regular basis for those with heart disease. An android-based application is being developed to realize this healthcare service, which can monitor these parameters for cardiovascular patients who should be under constant supervision. Wearable sensors are used in the monitoring system to continuously measure various characteristics. If the predetermined parameters for the patients, such as heart rate, heart rate variability, blood oxygen level, and body temperature, are exceeded, an e-mail or message is sent to family members and the doctor. The information gathered by the heart rate module can be preserved and accessed for future medical applications. Patients can be mobile in their own social context as a result of this wearable technology, allowing them to live their lives with confidence.

Keywords—Blood Oxygen Level, Heart Diseases, Heart Rate, Temperature, Wearable Sensors.

I. INTRODUCTION

Kevin Ashton coined the term "internet of things" in 1999 [5]. It's a communication network that connects physical things to one another or to larger systems. This network gathers billions of data points from a variety of gadgets that we use on a daily basis and converts them into useful information. E-health services, which are closely linked to all of us, are one of these key opportunities. Every day, the number of IoT applications in the health industry grows. Heart attacks are claiming the lives of a growing number of people. When the blood supply to the heart is cut off, a heart attack can happen. We are unable to save the lives of many people due to delayed heart attack diagnosis. In this study, we propose an IoT-based system for detecting heart attacks by monitoring heart rate (Internet of Things). Due to a lack of infrastructure, people living in rural areas are unable to get preventive health care. As a result, deaths in these areas occur at an early age. Furthermore, as the world's population ages, the elderly's needs for life support are growing in tandem with changes in family structure.

Chronic heart illness is characterized by a significant risk of death as a result of the heart's excessive exhaustion during sleep, particularly in chronic obstructive pulmonary disease (COPD) and obstructive sleep apnea syndrome (OSAS). Devices that offer continuous monitoring of these patients is both expensive and delicate, and their utilization necessitates the use of experienced staff. Such patients can be monitored constantly using wearable health sensors while continuing to enjoy their lives in the social context. Heart failure, ageing, Parkinson's disease, and diabetes are among the conditions for which heart rate and heart rate variability are utilized as diagnostic tools.

The Internet of Things (IoT) is a brand-new reality that has profoundly transformed our way of living. It's also a way to transform modern health care by delivering more targeted and preventive care. This study presents an IoT-based heart rate detection system. The treatment among most heart-related ailments nowadays necessitates long-term monitoring as well as ongoing monitoring. In this sense, IoT is highly valuable because it replaces traditional monitoring systems with a more efficient method by giving important information about the patient's status to the doctor. Furthermore, the nurses or duty doctor on duty at the hospital can use the real-time monitoring system to check the patient's heart rate in the serial monitor. Devices that gather patient heart data can be transferred to the patient's family or doctor via smart phone applications thanks to SMART HEART, which has a low cost, low power consumption, and great performance.

II. RELATED WORKS

Due to the sheer growing industry, health monitoring is a big worry these days. In an ever-expanding industry, there is a continual need to keep the system up to date.

According to Nayeemuddin et al. [1], the focus is on patient health administration, which provides data regarding a patient's physiological state. Their technique focuses on a specific patient issue by monitoring and filtering fundamental physiological data with the ultimate goal of accurately depicting a patient's health in the internet. The data is used by a social protection supervisor who provides critical advice. It has a data verification unit, a microcontroller, and LabVIEW programming. The temperature, heart rate, circulatory strain, and ECG of the patient are all examined. The proposed structure can examine the patient's physiological data with great precision, which is a significant benefit. The wearability of the gadget might be improved further.

Kyeonghye Guk et al. [2] express their concern about the world ageing population and the activities that must be taken to avoid or monitor various chronic and acute illnesses as a growing social issue in their study. They address this by employing these devices, that enable measurement for diagnosis and health monitoring. Wearables include accessories, integrated clothes, body attachments, and body implants. They look at how wearables have changed as electronics, biocompatible materials, and nanomaterials have advanced. The capacity to keep and analyze data while providing point-of-care diagnostics might be one of the next advances. C. Senthamarasi et al. [3] released a paper that discussed how individuals are experiencing unexpected mortality as a result of various illnesses that develop due to lack of attention at given time. The goal of their system is to create a device, so that doctors can monitor their patients who are hospitalized or at home from anywhere and at any time using an IOT-based integrated healthcare system that tracks their movements and ensures they are being properly cared for. Their system was developed to provide real-time information on a patient's physiological state through the internet or via mobile devices. The system consists of data-gathering sensors and a microcontroller programmed with software to provide the desired results. The device, among other things, shows and saves the patient's heart rate, temperature, and EEG. A mobile device with the right application loaded can also be used by the doctor to obtain information about the patient. S.S. Abarna et al. [4] investigate the critical tasks, that include several sensors and also the equipment's capacity to communicate with a caregiver or a doctor. The device can send recorded data to a caregiver or a doctor, as well as display. They also emphasize the need of data and keep track of a variety of medical issues. The doctor can access the information at any time [9-10].

III. METHOD

A. Objective

At home, it is difficult to provide accurate information on the patient. Those who are elderly or have had a stroke should stay in the hospital for a longer period of time. Staying in a hotel can be expensive at times. If the patient is in a critical condition, it may be too late if the nearest hospital is not near. The data of patient is not permanent, and data transmission takes time.

The objective is to design and create an integrated smart IoT system with a low-power communication module that can gather heart rate, blood oxygen levels, and body temperatures without interfering with daily living using a smartphone. This study also presents the application of machine-learning algorithms for sensor data analytics in order to accurately forecast and/or diagnose abrupt cardiac illnesses.

B. Problem Definition

Heartbeat, blood oxygen level, and body temperature are some of the most important aspects of our bodies, and if they are wrong or undergo significant changes, the entire body will be impacted. We need to keep track of our pulse rate in a lot of situations, whether it's for a doctor's examination or to stay in shape. When a person is outside of his/her house and there is an elderly or ill person at home he/she cannot see what is going on. By employing this equipment, a person may check on a patient's status from anywhere using a smartphone and the internet, and in the event of a terrible scenario, he will take appropriate action.

As a result, it is quite suspicious when a person can watch the patient outside of his/her house. In the hospital, doctors are frequently required to monitor a patient's heart rate; however, checking pulse rate, blood oxygen level and body temperature on a regular basis is extremely challenging for doctors. Using this the doctor can continuously monitor vital parameters and can also access previously recorded data.

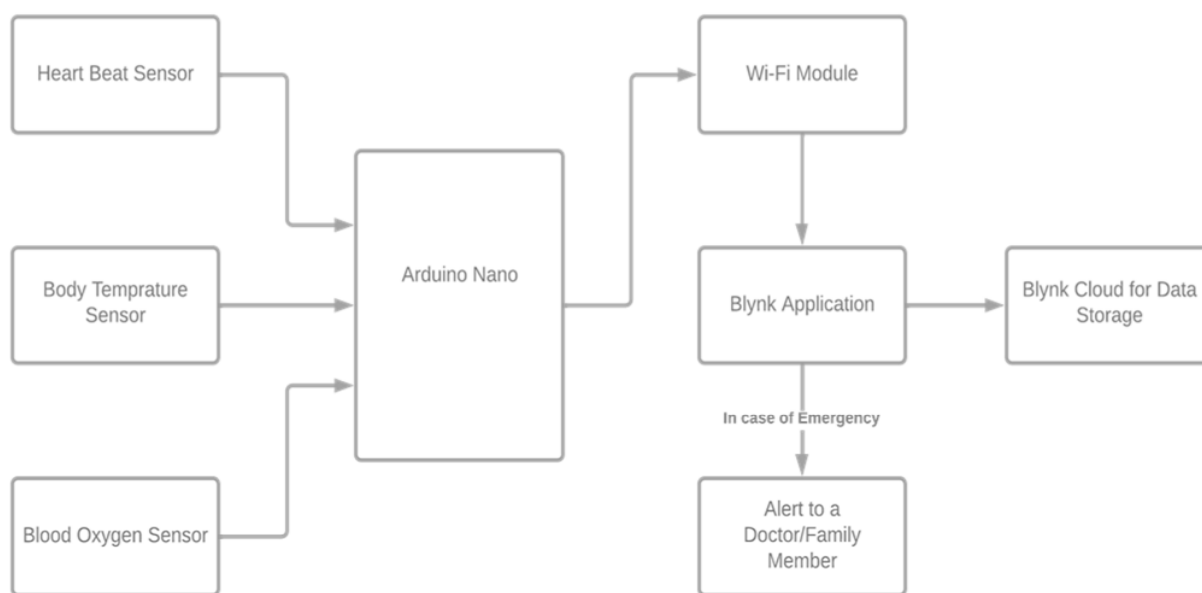


Fig. 1. Block Diagram of Smart Heart

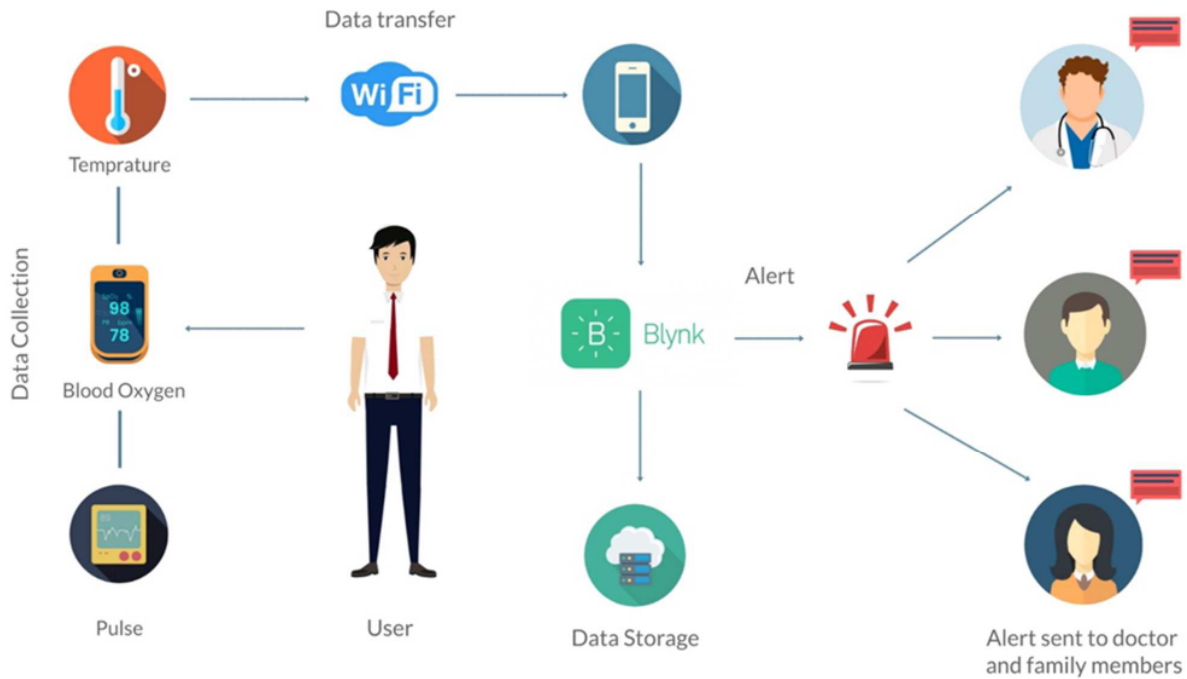


Fig. 2. System Architecture

C. Working

Our system's strength is based on current wireless communications, which give users with minimal power and maximum flexibility of movement during physical exercise. We've also employed compact, lightweight smart IoT devices as shown in the block diagram in Fig 1 that are easy to use, such as the smartphone and wristband. To integrate the sensors, we ran a series of tests using the output of the embedded sensors to evaluate and distinguish between unusual heart rate, body temperature, and pulse oxygen levels.

The subjects wear the integrated sensors as shown in Fig 2. and keep their smartphones in their pockets or hands. While the individual is leading a normal life, the implanted heart rate, pulse oxygen, and temperature sensors continuously gather the information. The smartphone will evaluate the data after receiving it over a low-power Bluetooth connection channel to determine if the user's state is normal or abnormal [10].

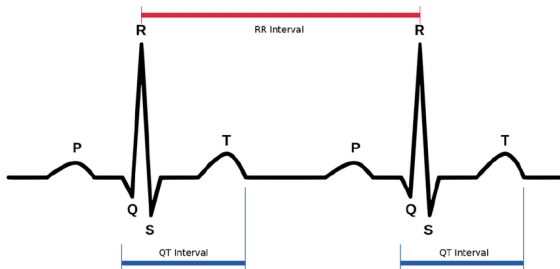


Fig. 3. PPG signal

Photoplethysmography (PPG) as shown in Fig 3. is a simple optical method for detecting volumetric changes in peripheral circulation blood. It's a low-cost, non-invasive technology for taking measurements on the skin's surface. The

procedure delivers important data about our cardiovascular system. Recent technological advancements have reignited interest in this approach, which is frequently utilized in clinical physiological monitoring and assessment [8]. Low-intensity infrared (IR) light is used by PPG. Light is absorbed by bones, skin pigments, and both venous and arterial blood when it flows through biological tissues. Because blood absorbs light more strongly than the surrounding tissues, PPG sensors may detect changes in blood flow as changes in light intensity. The amount of blood flowing through the blood vessels is proportional to the voltage signal from PPG [7]. This technology can detect even slight variations in blood volume, but it cannot be used to quantify the amount of blood.

A PPG signal consists of numerous components, including volumetric changes in arterial blood that are linked to heart activity, fluctuations in venous blood volume that modify the PPG signal, a

DC component that depicts tissue optical properties, and modest energy changes in the body. The location of measurement and the contact force between the site and the sensor are two important elements that influence PPG data. Variations in blood flow are more common in the arteries than in the veins.

A sensor and a control circuit constitute the Heartbeat Sensor. An IR LED and a Photo Diode are set in a clasp in the sensor area of the Heartbeat Sensor as shown in Fig 4. The Control Circuit is made up of an Op-IC and a few other elements that helps link the sign to the Microcontroller. On the off event that we investigate the Heartbeat Sensor's circuit graph, we can see how it works better. Each heartbeat will change the amount of blood in the finger, as well as the light from the IR LED passing through the finger and being detected by the Photo Diode.

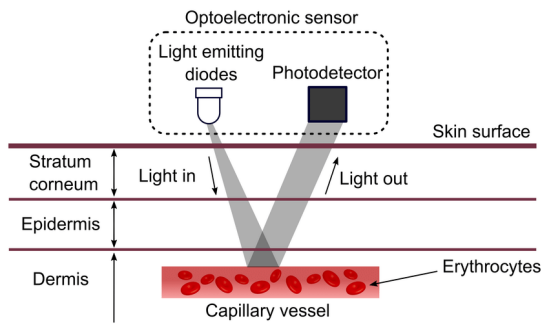


Fig. 4. Working of Pulse Sensor

The non-upsetting contribution of the first operation – amp is delivered to the yield of the picture diode through a capacitor, which prevents the DC Components of the sign. The first operation is to use amp as a non-reversing enhancer with a 1001 intensity factor. The yield of the first operation, amp, is one of the contributions to the second operation, amp, which functions as a comparator. The output of the second operation – amp – activates a transistor, which sends the signal to a microcontroller such as the Arduino Nano. It is worn on the finger and detects the heart rate before sending it via Bluetooth to an Android mobile application. The importance of early detection of the condition in averting future problems cannot be stressed. There are two situations in which a message or an email is sent to the patient's immediate contacts.

- Bradycardia (60 beats per minute or less more as mentioned in TABLE I) is a heart heartbeat that is irregularly sluggish. The normal rhythm of the heart is thrown off when the electrical impulse that causes your heart to contract is not created in your heart's natural pacemaker—the SA node. Bradycardia is more common in the elderly, although it has also been reported in children and teenagers. Bradycardia is usually caused by one of two things: When the heart's natural pacemaker is broken, or when the central nervous system is not providing the right signals to the heart to beat.
- Tachycardia is a rapid, irregular heart rate (100 beats per minute or more as mentioned in TABLE I). The kind of tachycardia will be classed as ventricular or supraventricular depending on where the rapid heart rate originates (whatever chamber of the heart).

TABLE I. HEART RATE PARAMETERS

Heart Rate(bpm)	Arrythmia
60 – 100	Normal Sinus Rhythm
Lesser than 60	Sinus Bradycardia
Greater than 100	Sinus Tachycardia

The pulse oximetry sensor unit detects signals related to the human body's oxygen saturation level from the fingers, which are flanked by two sensors: an optical transmitter (comprising two LEDs, one red and the other infrared) and an optical detector (only one photodiode that can detect both the red and infra-red spectrum of light). SpO2 data is interpreted by changing the LED pulse lengths and sampling rate per second. The normal arterial oxygen pressure ranges between 75 and 100 millimeters of mercury (mm Hg). Supplemental oxygen is frequently required when the pressure falls below 60 mm Hg. The normal range for blood oxygen values is 95 to 100 percent as shown in TABLE II. Hypoxemia is defined

as a drop in blood oxygen levels below 90%. Hypoxemia is defined as a low amount of oxygen in the blood, particularly in the arteries. It's a symptom of a respiratory or circulation issue, and it can cause a variety of symptoms, including shortness of breath. An alert will be generated if blood oxygen goes below 90% and the patients immediate contacts are alerted through a message or an email.

TABLE II. BLOOD OXYGEN SATURATION PARAMETERS

Oxygen Saturation	State
Greater than 97%	Normal
Lesser than 96%	Risk of Hypoxemia

The DHT11 sensor is made comprised of a capacitive humidity sensor and a thermistor for temperature sensing. A moisture-holding substrate acts as a dielectric between the humidity sensor capacitor's two electrodes. The capacitance value fluctuates as the humidity level changes. The resistance values are measured, processed, and converted into digital form by the IC. To monitor temperature, this sensor uses a Negative Temperature Coefficient Thermistor, which causes the resistance value to decrease as the temperature rises. To produce a greater resistance value even for the smallest change in temperature, this sensor is often made of semiconductor ceramics or polymers.

The DHT11 has a temperature range of 0 to 50 degrees Celsius with a 2-degree precision [6]. This sensor has a humidity range of 20 to 80 percent and is accurate to 5%. This sensor has a sampling rate of 1 Hz. It offers one reading every second, in other words. The DHT11 has a tiny dimension and a 3 to 5 volt working voltage. While measuring, the maximum current utilized is 2.5 mA.

TABLE III. BODY TEMPERATURE PARAMETERS

Temp Range(°F)	State
97 °F - 99 °F	Normal
Lesser than 95 °F	Hypothermia
Greater than 99 °F	Fever

Hypothermia is a medical emergency caused by your body losing heat faster than it can create it, resulting in a dangerously low body temperature. The average body temperature is 98.6 degrees Fahrenheit (37 C). Hypothermia (hi-poe-THUR-me-uh) is when your body temperature drops below 95 degrees Fahrenheit (35 C) as shown in TABLE III. Exposure to cold weather or immersion in cold water is a common cause of hypothermia. The most common hypothermia treatments are strategies to bring the body's temperature back to normal. Your heart, brain system, and other organs are unable to function correctly when your body temperature decreases. Hypothermia, if left untreated, can result in heart and breathing system failure, as well as death. An alert is generated when the body temperature goes below 95 degrees Fahrenheit and the patients immediate contacts are alerted through a message or an email.

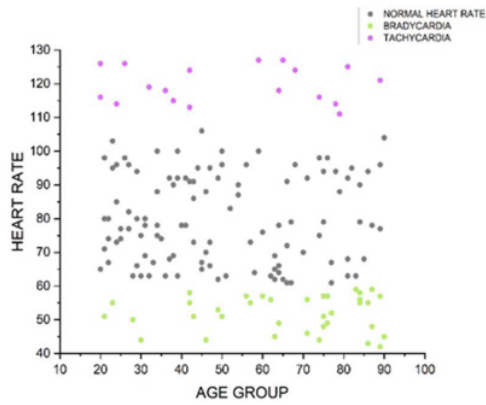


Fig. 5. Scattered Plot of Heart Rate

IV. RESULT AND DISCUSSIO

A human cardiac rate monitoring and control system based on the Internet of Things is being developed. For data collecting, this system makes advantage of the capabilities of a cardiac pulse sensor. The microcontroller captures and processes a human's heartbeat as data signals. The data is analyzed and sent to the IoT platform for additional analysis and visualization. The system was able to measure and read the user's pulse rate, temperature and oxygen saturation and transfer the sensed data to the Android mobile app, resulting in accurate experimental findings and plotted graphs individually for data collected for each sensor as shown in Fig 5., Fig 6 and Fig 7. Furthermore, employing sensor networks and IoT technologies, this research article proposes a flexible, reliable, and confidential strategy for a heartbeat rate monitoring and control system [11]. The gadget that has been developed can be used in the medical industry to help people. The implemented gadget can be used in the medical industry to help medical practitioners do their tasks more effectively and reliably.

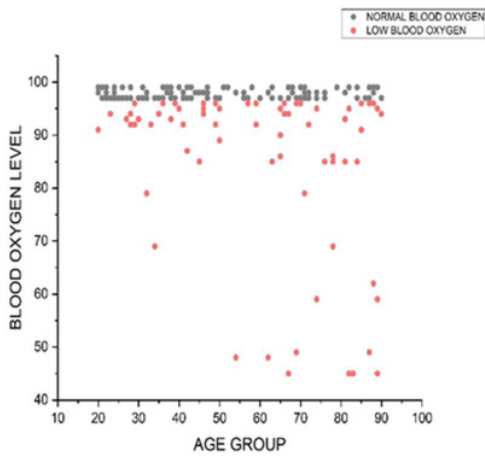


Fig. 6. Scattered Plot of Blood Oxygen Level

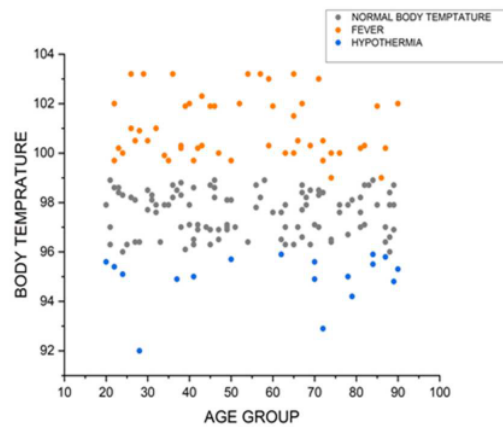


Fig. 7. Scattered Plot of Temperature

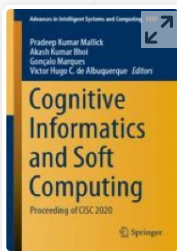
V. CONCLUSION

Heart attacks are becoming more common nowadays. This technology uses heart beat sensing to identify a person's heart rate even if they are at home. This method aids in the measurement of a person's body temperature, heartbeat, and oxygen level. The heartbeat sensor, which is connected to the microcontroller, detects the person's heartbeat and communicates it through the Wi-Fi module. After configuring specific settings, a person may begin monitoring his or her heart rate, and if the rate exceeds a specified threshold, an alarm will be sent to the doctor and family. The main goal of establishing this project with the Android Open-Source platform is to notify Medical Emergency and the patient's emergency contacts about the patient's health state as soon as possible. We're working on a prototype that uses continuous parameter monitoring to detect and predict heart attacks and generate alarms. When the body temperature and heart rate and blood oxygen level surpass or fall below the chosen threshold levels, a notice will be sent to the doctor. The heart rate and body temperature are used to achieve this goal. It can very handy when continuous monitoring is necessary in a life-threatening situation. Furthermore, it is a highly usable equipment owing to its mobility, which means that patients may carry it with them at all times, eliminating the need to stay in hospitals because the Heart Rate Monitor can be used practically everywhere.

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Implementation of Low-Power High-Speed Clock and Data Recovery

[K. J. Kumar](#) & [A. Raganna](#)

Conference paper | [First Online: 02 July 2021](#)

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Abstract

The digital clock and data recovery (CDR) circuit during transmission SERDES application was parallel to serial data from one sub-system or systems to another system. Here, the burst of data and clock signals complexity of the system-on-chip (SoCs) has increased in high-speed data communication. Here, no needs to transmit the clock along with the data, if transmit the clock from one system to another system, it increases the noise and reduces the clock

quality to avoid that in SERDES application transmit only serial data without a clock and at the receiver end using this serial data using clock data recovery (CDR) mechanisms that generate the clock as well as sample the serial data into same generated CDR clock. The serial data store into the register or FIFO as per our application requirement. In present technologies, the SOC and parallel data transmission at high speeds become a very critical task. To meet with the high processing speeds and enhance system performance, it becomes essential to have SOC high-speed interconnects. Here, CDR with SERDES technology SOC chip and reducing the clock skew as well as reducing the board utilization, in this case like research organizations add additional functionalities and improve the design implementation performance with un-clocked data transmission. Presently, they are widely used in computer networks such as WAN, LAN, and Ethernet, as well as backplane links like PCI express and high-speed telecommunication architectures like SONET and SDH, are among other examples of high-speed serial data links.

Keywords

CDR **SERDES** **PLL** **Phase detector**

SONET **SDH**

Application of Computer Vision for Multi-Layered Security to ATM Machine using Deep Learning Concept

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Abstract— In today's world, the area of computer vision is advancing at a breakneck pace. Specifically, the goal of this study is to give a comprehensive overview of current breakthroughs in the use of computer vision methods to solve the security risk associated with accessing ATM machines. It is proposed in this paper that a complete solution for ATM security be developed, which would help in the enhancement of privacy and security via the use of emerging facial authentication technologies. During transaction initiation, this approach leverages facial recognition by obtaining a real-time picture of the client and then assessing the true perspective, where the recognized face is checked against ATM card owners' data stored in the database. Face recognition technology allows the system to recognize and identify each user separately, thereby turning the face into a password. This eliminates the possibility of fraud resulting from ATM card theft and copying. A detailed review of the use of machine learning in computer vision and its implementation on embedded hardware, as well as distinct security issues for ATM machines, is provided in this study.

Keywords— *Computer Vision, Face recognition, Automated teller machine Security, Hardware Implementation, Multi-layer protection.*

I. INTRODUCTION

The world is continually and constantly changing. Using wirelessly connected technology in a variety of day-to-day tasks is transforming and enhancing the level of life in the human society. Many devices/products are currently emerging that are based on interactive computer and communication technologies, and through this multimedia intellectual ability, it provides delightful, dependable, and efficient personal services to many people, allowing them to feel at ease in their daily lives and activities. Future innovations are being built with high levels of security in mind as a result of the fast growth of science and technology in recent years. On the other side, threats are being created to undermine this degree of security. Though advancements in automation have had a good overall influence, many

financial institutions such as banks and applications such as ATMs are still vulnerable to theft and fraud.

With technological advancements in financial infrastructure, most bank clients choose to conduct their banking transactions via Automatic Teller Machines (ATMs). People currently rely heavily on Automated Teller Machines. People, on the other hand, face challenges to carry their ATM card always; they may bother bringing their ATM card or forget their own Security code. The ATM card may be broken, and consumers may find themselves unable to access their funds. The present ATM system uses a card and a PIN, which mostly causes an increase in attacks in the form of stolen cards or due to statically provided PINs, card cloning, and other threats. Then there's the issue of PIN hacking. Other types of fraud include eavesdropping, spoofing, brute force assaults, and blackmailing the victim. In the worst-case scenario, ATM machines may be robbed.

An ATM is a programmed system that lets deposit and withdraw money from their bank accounts. Since banking customers tend to favor ATMs for withdrawing cash, deposits, and several other operations, banks are emphasizing ATM security. As a result, ATMs must be adequately safeguarded from criminal activity or other undesirable elements.

ATMs have lately risen to prominence as a critical piece of technology in the banking industry. This institution may carry out a variety of functions such as depositing monies, withdrawing cash, transferring funds, and offering additional financial services. It is an important component of our financial activity. Because of their multipurpose functions, ATM units are growing at an exponential rate. As we all know, the incidence of ATM thefts rises in tandem with the number of ATM machines. Therefore, as consequence, it must be secured both electronically and physically. The banking industry has previously taken precautions against software-related thefts.

ATMs, on the other hand, are often subjected to physical assaults by criminals. Because financial clients utilize ATMs for a variety of activities, including cash

withdrawals, cash deposits, and a variety of other transactions, banks put a high value on ATM security. ATMs must be effectively protected from criminal activity and other unwanted factors. Burglary and theft are major worries for any family or banking system (ATM). Individuals can install Smart Security Systems that are controlled by a single device to reduce their ongoing tension.

1.1. The following are some of the ATM securities that are available

Alert-Based Monitoring System is activated when a person enters the ATM room, which may be done remotely. If there is any unusual activity, an alert will be sent to the central monitoring station for investigation. The monitoring station will have immediate access to the audio and video feeds from the ATM room because of inspecting the same. When an unlawful behavior is confirmed, a strong signal is delivered, and security is also updated to take care of the problem.

The Motion Based Monitoring system employs a particular watch that is utilized at night since the risk of burglary is higher at that time. Whenever somebody enters the room, an alarm signal is sent to the monitoring center that has access to the video and audio in the room. This activity is monitored at the monitoring station. If it is the client and there are no unlawful movements or actions, the alarm is closed; otherwise, a two-way communication channel is established to notify the person within the room.

It is regularly watched by the Live Site Monitoring system, which is located in the ATM room. If any undesired conduct is seen, a siren will sound, a two-way communication channel with audio will be activated to warn the user, and security will be deployed as soon as possible to the location.

There will be no ATM access granted if there is any suspicious movement detected within the ATM room. If there is movement detected within the ATM room, the projected system will be focused on recognizing a user's face, and the system will eventually detect the user's face accurately before granting access to an ATM machine. Access to the machine is permitted only when the user is validated through face recognition. If the user's face is not recognized, a warning will be displayed. The room is going to be locked if the user's face is not identified. The system then generates a security code and sends it to security personnel, who will be able to open the door and proceed with the following actions.

In today's world, information can be found on smartphones, notebooks, personal computers, and other devices. The one that affects the average person is that it can now be utilized to make day-to-day living easier and faster. As the number of financial services and ATMs grows, so does the number of fraudulent assaults on them. Many solutions have been proposed to counteract such assaults. Biometrics delivers more secure and cutting-edge methods for reducing ATM thefts and assaults. A person's biometric character will differ from that of others. As a result, biometrics may be integrated into regular ATMs.

II. LITERATURE SURVEY

As a solution to privacy and security concerns, the author devised a novel Smart Home Security system that takes use of two emerging technologies, face identification and voice recognition, to provide a unique level of protection [1]. The user's phone will be able to check the state of the home. The system will do face recognition by collecting a real-time feed of the person at the door and looking for speech patterns that correspond with the data supplied, and the system will also tell the owner if the data is not accessible in the data sets offered. The total accuracy of the suggested method was 82.71 percent. The proposed work's major goal was to build a more secure ATM system with improved overall experience, usability, and transaction ease. The author incorporated technologies such as face recognition and OTP to improve account security and user privacy. This fully removes the possibility of fraud due to ATM card theft and duplication, and the randomly generated OTP relieves users of the need of memorizing PINs [2].

The author emphasizes the rapid shift in computer applications from simple data processing to machine learning as a result of the massive amounts of data available through sensors and the internet [3]. The concept of machine learning illustrates that computers have the potential to develop over time. The author conducts research on machine learning and computer vision, and he investigates machine learning applications in computer vision and its future prospects.

In the suggested work, the author illustrated the usage of technology in banking operations as well as its problems/deficiencies. The study's major goal was to analyse the influence of security and simplicity of use on electronic banking services, and the study provides a statistical analysis using a distributed questionnaire to verify the effect of electronic banking and its difficulties [4].

Instead of a PIN, the author advocated a biometric authentication technique to access the ATM account. Facial traits are given top attention, and when combined with biometrics, they have shown to be the most effective identification and verification procedures. The author also mentioned the issue of unauthorized use of a valid login code. To address the issue in the proposed model, the author developed a facial features recognition approach that compares the saved picture in the database to the one recorded at the ATM machine, with additional new photos used to train the model for greater accuracy [5]. The suggested model was implemented using OpenCV, and the Haar Cascade Classifier was utilized to detect the faces in the picture, with identification performed using the Local Binary Pattern. The author conducted a full comprehensive survey of protocols for the Internet of Things in this paper [6]. These procedures were classified depending on their intended setting. The author also conducted threat models, countermeasures, and formal security verification comparisons of authentication protocols and taxonomies for IoT in terms of network model, security goals, computing complexity, and communication overhead. Open concerns are recognized, and new study areas are offered based on the current survey.

The author proposed a one-of-a-kind physiological biometric validation and face recognition approach to replace ATM cards and Personal Identification Numbers [7]. In addition, the author included an OTP option, which provides security and frees the user from examining PINs. SMS Gateway generates a 6-digit OTP and sends it to the enrolled mobile phone. After entering the significant OTP, the customer can select one of the several banks to execute bank transactions. The user will be warned if any fraudulent access attempts are made.

The author's suggested work aims to improve the security of ATM transactions by combining a facial recognition system with an RFID tag. For the authentication procedure, the facial image of the specific individual was recorded and matched to the one kept in the database. If any unauthorized access is detected, an alert message is issued to the user [8]. In this work, the author creates and built a Smart Mirror that displays information such as the city's weather and news and headlines based on the location. The author created the model using a Raspberry Pi3, which will gather real-world machine data and send it to the Raspberry Pi for processing. [9]. The work was based on a Raspberry Pi board with expanded OpenCV capability. Initially, the system searches for a face until it is flawlessly identified. The procedure is repeated three times in a row, and an alert message is delivered to the user if the face is not correctly recognized [10].

The primary goal of this review is to provide a wide overview of convolutional network applications [11]. The author illustrates the benefits and capabilities of Deep Learning in research owing to its capacity to overcome the shortcomings of standard methods. The limits of the Convolutional network were also examined and highlighted by the author. A review of published methodologies for payment card fraud detection is provided, with a focus on methods that use AI and machine learning. It is argued that a cognitive computing method would be a desired study route, while fostering data philanthropy in the industry. The primary issues with applying artificial intelligence to identify fraud are outlined [12]. Commercial banks can reduce non-performing loans, boost payment security, streamline compliance-related duties, and enhance customer focusing by applying artificial intelligence (AI) to their operations [13]. AI use in commercial banking might alter company operations and client interactions, perhaps bringing up some new avenues for study in behavioral finance.

The author presented a unique automated evaluation system for facial image quality that will be aimed at picking better face pictures for improved face recognition. The results show that the suggested face image quality metric network works end-to-end and distinguishes between "excellent" and "bad" photographs [14]. The article includes a potential energy function-based face occlusion validation technique that uses a Gaussian function to approximate the head-shoulders Omega form [15]. In addition, the author developed a fast and robust head tracking algorithm in a Bayesian framework that uses gradient and shape signals. The model's performance was demonstrated using real-

world data. The author presented a system that uses a password authentication mechanism and biometric identification technology to improve the security of traditional ATM models [16]. If the identification is verified, a four-digit code is created and transmitted to the client's cell phone. There are certain safeguards in place to protect the ATM terminal from fires and robbery.

A thief might be apprehended inside the ATM center itself [17]. A microcontroller, a solenoid valve, and a GSM module are used to transmit an alarm message. The door will be locked until the security worker who wants to access the ATM room enters a password. The proposed study's main objective is to eliminate ATM stealing by utilizing two sensors to expose vulnerabilities in the current system [18]. ARM controller based embedded system is used to process the real-time data. The suggested approach is primarily based on the vibrations created by ATM machine and a camera during a heist. The proposed work shows state-of-the-art recognition performance in terms of robustness and reliability. The gathered features are recorded in the database and perhaps even used to train a model. To carry out these operations, a cloud-based deep feedforward network is employed [19].

The author performed a survey on current advancements in computer vision algorithms and hardware implementations [20]. In this survey, the writer explained Deep Learning techniques including image classification, object detection, and image segmentation, and also implementing and optimizing deep learning-based computer vision algorithms on GPU, FPGA, and other new generations of hardware to enable real-time operations. The researcher undertook an analytical analysis on the model to ensure that there are enough banknotes accessible to satisfy the needs of the bank's clients in a timely way. In the study, the author performed research on ATM functioning using cash recycling technique, which includes documentation of collection, deposits, and withdrawal of cash [21].

III. COMPUTER VISION DEPLOYMENT ON RASPBERRY PI

Computer vision is utilized in a wide variety of real-world applications, including optical character recognition (OCR) to read handwritten postal codes, difficult machine parts inspection in manufacturing facilities to maintain quality assurance, and identifying flaws in steel castings using X-ray vision. The automatic retrieval of information from pictures is known as computer vision. 3D models, object identification and recognition, classifying and searching information, picture morphing, and de-noising are examples of such information. The Raspberry Pi is one such mobile device that holds an integrated camera port; there are a wide range of applications that may be accomplished with the Pi camera. Face recognition flowchart is shown in Figure 1.

We will use the OpenCV, face recognition, and Imutils packages to train our Raspberry Pi on a series of photographs that we'll gather and serve as our dataset for facial recognition; train_model.py will be used to evaluate

the photos in the dataset and generate a mapping among names and faces in the file, encodings. Pickle.

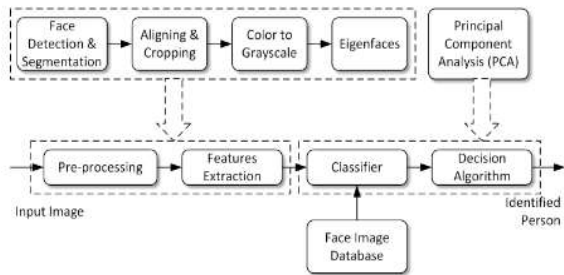


Figure 1. Flow Diagram of Face Recognition Algorithm.

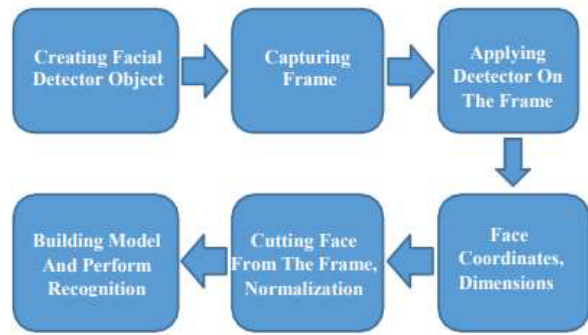


Figure 2. Block diagram of the workflow of face recognition

IV. IMPEMENTATION RESULTS OF MULTIVIEW FACE RECOGNITION.

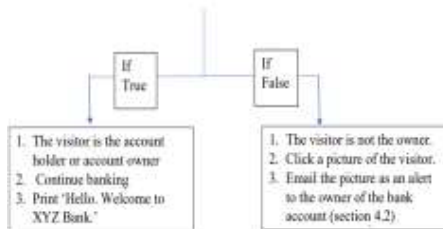
1. create the database to the user or account holders.
2. database of users is taken in different angles at least 20 frames.
3. Extract encodings of every image in the database and store them in a list in the same order the corresponding images are stored in the database.
4. Turn on the camera.
5. Detect the face of the person that has come for banking, in the camera.
6. Extract the encoding of the visitor's face.
7. Compare the visitor's encoding with all the encodings of the owner's images, stored in the list earlier. (Returns True if the encoding matches with either of the saved encoding. Returns false otherwise). Store them in a list.
8. Also find the Euclidian distance between the visitor's encoding and all the encodings of the owner's images, stored in the list earlier. (Returns values which are Euclidian distances).
9. Store the Euclidian distances in a list. Find the position of the least Euclidian distance in the list.
10. Check if the value (in the list got in the 7th point) corresponding to the position got from the above 9th point, is true or false.



Figure 3. Data set creation for first user.



Figure 4. Dataset creation for second user.



11. Extract encoding of every image in the

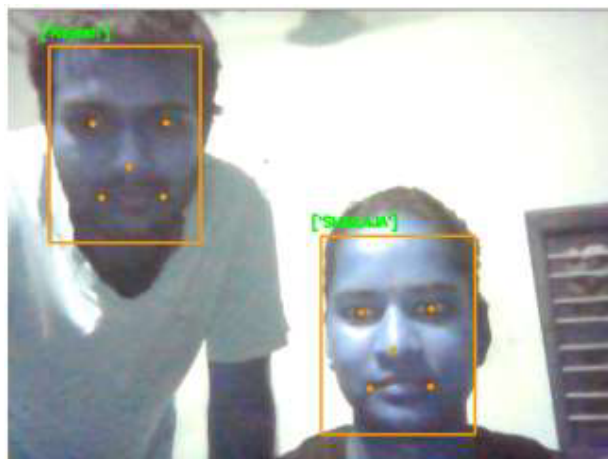


Figure 5. Live feed and recognition with names for both users with names printed.

Table 1: Peer comparison of research works.

Researcher	Parameter	Accuracy (%)	Application
Navy Saxena (2021) [1]	Neural Networks and Speech Processing	87.5% in Facial Recognition 84.62 in speech recognition	Home safety
Mohsin Karovaliyya (2015)	Principal Component Analysis, MD5 message-digest algorithm	89.5%	ATM Security
Raju (2020)	Raspberry Pi, OpenCV, Haar frontal face	83.22%	Intruder Detection
Praveena (2021) Srithar (2021)	OpenCV, Haar Cascade Classifier,	-	ATM Security Card less ATM
Zhang (2017)	Bayesian framework, AdaBoost Algorithm	98.64	ATM Surveillance
Castiglione (2021)	industrial Internet of Things, Orthogonal Planes descriptor, deep feedforward network	97.7	Person Identification
Shailaja.K(2022) Prof. Dilna.U(2022)	Application of Computer Vision for Multi-Layered Security to ATM Machine	85.7%	Multiview live video face recognition

V. FUTRE SCOPE:

This technique or idea may be utilised for fraud identification and thief detection, and it can be further developed in this regard. By using a facial recognition alarm or by transferring the thief's information to the investigation sector or the police.

VI. CONCLUSION.

A growing number of bank account holders are choosing to conduct digital transactions using Automatic Teller Machines (ATMs) as a result of recent technological advances in financial infrastructure and government laws (ATMs). Scammers take advantage of this by posing as ATM operators in various locations around the country. It is possible that computer vision will be employed to create multi-layered security in order to address this problem. It is possible to verify the validity of customers by using the ATM pin in conjunction with an OTP and facial recognition technology. According to the findings of the literature research, there are still security weaknesses in the security models of ATM machines. With the ubiquitous availability of the internet and powerful tiny computing devices such as the Raspberry Pi, the suggested multi-layered security may be accomplished. The Raspberry Pi is a low-cost computer vision platform that is easy to use and well-suited for this purpose. Some of the study in this area is compared in Table 1 with another research in the same field.

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Embedded system Based Anytime Medicine Vending Machine

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Abstract—It is fundamental to give suppository to the older in stretch. Whenever medication candy machine is planned explicitly for clients who take prescriptions without close proficient oversight. It soothes the client of the blunder inclined errands of directing incorrectly medicine at wrong time. The significant segments of this drug distributor are a miniature regulator interfaced with an alpha numeric keypad, a drove show, an engine regulator, an alert framework, a various pill compartment and container. The general activity is to simplify the client to set the timings to apportion different pills at required timings. The alert framework is intended to give two sorts of signs – one by lighting a drove and the other by giving a blare sound. The client needs to press a catch to get the pill and reset the alert catch. The subsequent caution is to show the ideal accessibility of the pills in the compartment to caution the client to top off the distributor with the necessary amount of pills. The significant target is to keep the gadget basic and cost productive. The product utilized is dependable and stable. Older populace can be profited with this gadget as it maintains a strategic distance from costly in-home clinical consideration.

Keywords— medication, medicine, microcontroller, dispenser.

I. INTRODUCTION

Regardless, existing drug allocators are not furnished with far off gadget the executive's capacities. Thusly, clients should deal with their drug allocator without anyone else. In addition, considering that clients of medicine containers are commonly in the more established age bunch or are for the most part patients with persistent sicknesses, significant examinations tough to be done for accomplishing the enhancements referenced previously. In this paper, a savvy drug container with a serious level of versatility and far off sensibility is proposed and developed. The proposed keen medicine allocator permits numerous clients to utilize a solitary prescription container, in this way giving adaptability to the gadget. It additionally permits clinical staff and heads, rather than end clients, to oversee prescription containers, in this manner prompting cost effectiveness and safe cycle of the gadget. Prescriptions for every tolerant are put away in a drug cartridge and a cartridge is put in a medicine gadget plate (MDT). One brilliant medicine gadget has fundamentally one MDT, yet it tends to be expanded relying upon the quantity of patient (six MDT 's greatest). The medicine plan configure3d in the distributor is refreshed distantly by clinical staff laborers. Additionally, the framework settings, installed programs, and functional mistakes are overseen distantly by framework executives [1]. In the mean time, the keen medicine distributor rectifies a patient's prescription state and sends the

adjusted information to the drug checking worker when an unusual state is identified by the shrewd medicine container, the gadget and the worker trade a few man agreement messages. Thusly, it tends to be gathered that the shrewd prescription container requires more regular message transmission than the current drug gadgets. This causes genuine limitation for prescription allocators which work on restricted band width networks[2]. To beat this imperative, the open versatile collusion (OMA) gadget the executives (DM) convention is applied. This convention is viewed as a true worldwide norm for cell phone the executives. OMA DM can give a fitting answer for the administration of the medicine gadget since it was initially intended to oblige restricted transmission capacity organizations. The commitment of this broadside is the introduction of a savvy prescription allocator. The proposed distributor enjoys three upper hands over current medicine gadgets. To accomplish a serious level of versatility, the prescription administering plate can be appended in progression, and in this way, a solitary distributor can uphold different clients. To accomplish a serious level of far-off sensibility and to diminish the executives' expenses and endeavors, far off administration strategies are planned and carried out[3]. These techniques work with updating of the prescription timetable designed in the distributor.

Table. I: DIFFERENT MEDICATION ERROR

Type of medication error	
SL.NO	Errors.
1.	Prescribing Errors.
2.	Omission Error.
3.	Wrong Time Error.
4.	Improper Error.
5.	Wrong Dose from Errors.
6.	Wrong Dose Preparation Errors.
7.	Wrong Administration Techniques
8.	Deteriorated Drug Error
9.	Monitoring Error.
10.	Unauthorized Drug Error.

II. LITERATURE SURVEY

Conferring to survey administered by patients protection consultant of India, 74% of total demise count within the hospital is caused thanks to overindulge or under measure of the medicines table.2 stands in provision for the above statistic[4].

TABLE II REPORTS OF DIFFERENT MEDICATION ERRORS.

Top five medication error event types associated with wrong weights(n=448)		
Event type	Total	% of total reports (N=479)
Wrong dose/overdose	208	43.4%
Wrong dose/underdose	102	21.3%
Intravenous	47	09.8%
Extra dose	12	02.5%
other	79	16.5%

Clinical investigators checked on 479 occasion reports submitted to the Indian patient security authority from June 2004 through the highest point of November 2008 that's explicitly referenced drug blunders coming about because of breakdowns in the cycle of getting, archiving, and additionally conveying patient loads[5]. The stunning news from the measurement is that of the 479 reports, 448 (93.5%) address the five commonest medicine blunder occasion types, with the chief usually announced even Being incorrectly portion/more than dose (43.4%) and wrong portion/under dose (21.3%). that's explicitly referenced drug blunders coming about because of breakdowns in the cycle of getting, archiving, and additionally conveying patient loads [6-9]. The stunning news from the measurement is that of the 479 reports, 448 (93.5%) address the five commonest medicine blunder occasion types, with the chief usually announced even Being incorrectly portion/more than dose (43.4%) and wrong portion/under dose (21.3%).

III. PROPOSED SYSTEM AND IMPLEMENTATION

The pill distributor will be created with off-the-rack innovation for the arranging and execution of the task. the top objective isn't to foster any new technologies identified with current made gadgets. Maybe, the objective is to style a unit with an identical fundamental usefulness, aside from a way less expensive cost. The framework is totally evolved utilizing Arduino regulator and some necessary segments are interfaced to Arduino UNO. GSM module is utilized to send the message to the approved individual. Signal is utilized to make caution sound the alert tone is created when the time is set. The time is set previously utilizing the RTC module, when the time is arrived at the signal will male alert sounds. RTC module is utilized here in view of the genuine time and date. Utilizing the GSM module, we will send the message to that approved individual. A GSM modem or GSM unit is an equipment gadget that employs GSM cell phone innovation to give an information connect to a distant organization. From the perspective on the cell phone organization, they are basically indistinguishable from a common cell phone, including the requirement for a SIM to recognize themselves to the organization [10,11]. The Arduino GSM safeguard permits an Arduino board to interface with the internet ,send and get SMS, and settle on voice decision utilizing the GSM library. The safeguard will work with the Arduino out of the case. The keypad that we are utilizing has 4 lines and 3 segments. Underneath each key is a switch. Each switch is associated with different switches in the line. Each line and sections ought to be

associated with the Arduino. Altogether, we have 7 pins that we will interface.

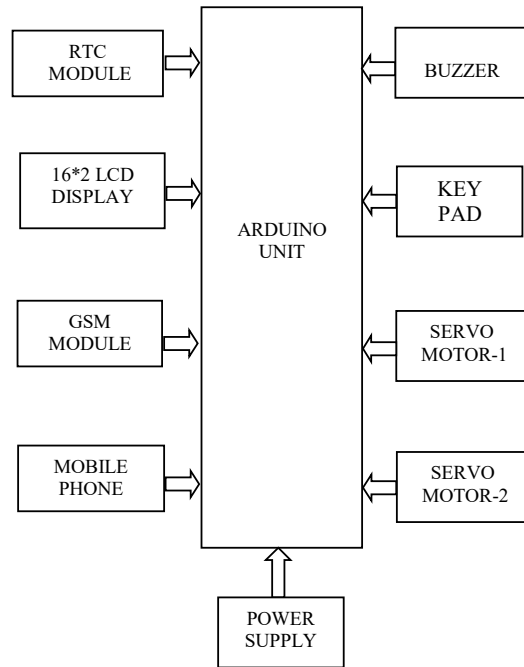


Fig 1. Block diagram of the System.

The model is assembled utilizing servo engines for administering the meds. The model of whenever medication candy machine is carried out with different equipment segments. The portrayal and point by point capacity of every part are:

A. Miniature regulator unit

Atmel' s ATmega328P, 8 cycle miniature regulator is utilized whose details are recorded in table 3.

TABLE III ATMEGA328P SPECIFICATIONS

Microcontroller	Atmega 328p-8bit
Operational Voltage	5v
Optional Voltage	7.0 -12.0v
Input Voltage Limits	6.0 – 20.0V
Continuoussignal InputPins	6 (A0 – A5)
Discrete signal I/O Pins	40 mA
DC Current on I/O Pins	50 mA
DC Current on 3.3V Pin	50 mA
Flash Memory	32 KB (0.5 KB is used for Boot loader)
SRAM	2 KB
EEPROM	1 KB
Frequency	16 MHz

B. RTC module

RTC suggests steady clock. RTC modules are basically time and date recalling structures which have battery course of action which without outside power keeps the module running. This keeps the time and date outstanding. So we can have exact time and date from RTC module whenever we need. DS3231 is a six terminal contraption, out of them two pins are not required to use. So we have generally four pins. These four pins are given out on inverse side of module having a comparative name[12].

C. LCD show

A LCD (Liquid Crystal Display) screen is an electronic show module and has a wide scope of employments. A 16x2 LCD show is key module and is normally used in various contraptions and circuits. A 16x2 LCD infers it can show 16 characters for each line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel framework. The 16 x 2 clever alphanumeric spot structure show is prepared for showing 224 one of a kind characters and pictures. This LCD has two registers, explicitly, Command and Data.

D. GSM module

A GSM modem or GSM unit is an equipment gadget that employs GSM cell phone innovation to give an information connect to a distant organization. From the perspective on the cell phone organization, they are basically indistinguishable from a common cell phone, including the requirement for a SIM to recognize themselves to the organization[13]. The Arduino GSM safeguard permits an Arduino board to interface with the internet ,send and get SMS, and settle on voice decision utilizing the GSM library. The safeguard will work with the Arduino out of the case.

E. Signal

This is a Small PCB Mountable 3V Active Electromagnetic Buzzer. It is incredible to add Audio Alert to your electronic plans. It works on 3V stock, utilizes a curl component to produce a perceptible tone.

F. Servo Motor

The Tower genius MG90S Mini Digital Servo is 180° turn servo. It is a Digital Servo Motor which gets and gauges PWM signal speedier and better. It gets ready refined inside equipment that gives incredible power, holding power, and faster updates as a result of outside powers. The great enhanced execution and dependability of our servos have settled on them the most loved decision of numerous RC specialists. They are stuffed inside a tight tough plastic case which makes them water and residue resistant which is a valuable component in RC planes, Boats, and RC Monster Trucks and so forth It prepares 3- wire JR servo attachment which is viable with footbag connector as well.

G. Keypad

The catches of every keypad are masterminded in lines and sections. The keypad that we are utilizing has 4 lines and 3 segments. Underneath each key is a switch. Each switch is associated with different switches in the line. Each line and

sections ought to be associated with the Arduino. Altogether, we have 7 pins that we will interface. The way that Arduino recognizes which catch is pushed on the keypad is by distinguishing the line and sections pin that is identified to the catch. Older and wiped-out individuals need to take prescription because of their illnesses. Regularly, they are recommended a few unique sorts of prescription, which should be taken in changing measurements. 25% of the old populace utilize at least four prescript particles consistently. Patients should monitor the right occasions where they should take these drugs. 55% of the old neglect to conform to drug regiments, and half of all solutions. filled are taken in correctly. Often times, age and infection negatively affect an individual detects, and it is a typical event for people taking drugs to experience the ill effects of absent mindedness, absence of fixation, and weakened hearing or sight. Studies show that 43% of everybody make mistakes in taking drug, 58% of the old make blunders in taking medicine, and of these blunders 26% are possibly genuine as indicated by their PCPs. Shockingly, older people whom live alone frequently have nobody to depend upon except for themselves. Keep ping track of medicine is a difficult and frequently risky assignment for these people. There is no explanation these days of innovation that a gadget can't be intended to help in this significant assignment. Our venture will tackle the physician endorsed surgeon action consistence issue, which is predominant among the wiped out and old.

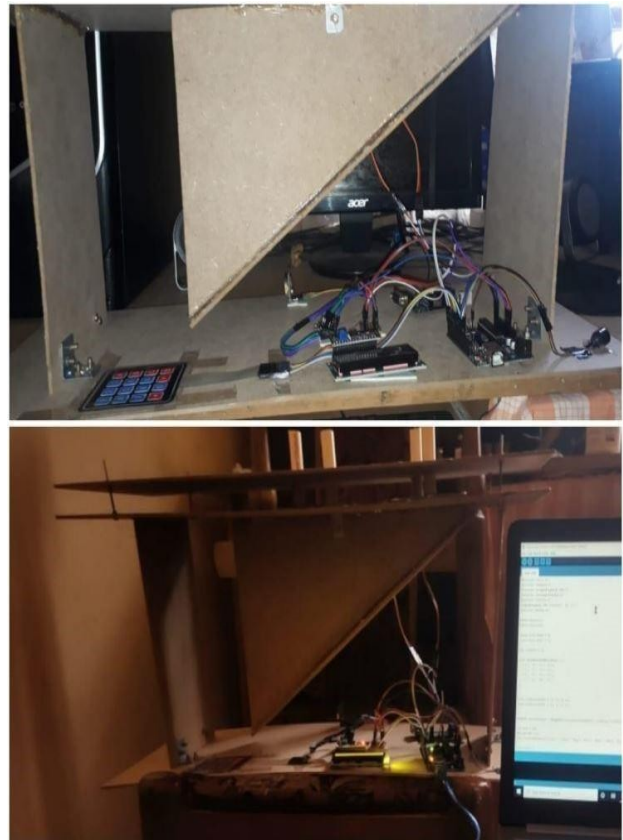


Fig 2. Implementation of the system.

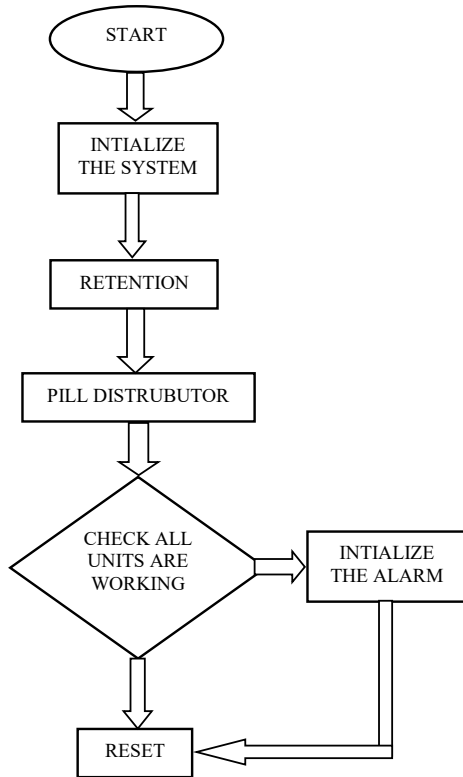


Fig. 3 Flow chart of the arrangement.

IV. CONCLUSION

In this venture, we have proposed the savvy prescription allocator to defeat the issues of existing drug containers like their non-expandability, burden, low dependability, and correspondence failure. The proposed distributor has the prototype in order to accomplish three upper hands over existing drug allocators. To accomplish a serious level of versatility, the drug apportioning plate can be connected in progression, and subsequently, a single allocator can uphold various clients. A serious level of distant reasonability and to lessen the board expenses and endeavors, far off administration techniques are planned and carried out. These strategies worked with refreshing of the drug plan con figured in the shrewd gadget. Further, framework settings, implanted projects, and functional mistakes can be distantly overseen by clinical staff and framework chairmen. After the effects of execution and check distribution the proposed distributor works normally and plays out the administration activities from the drug observing worker appropriately the savvy prescription gadget can be utilized to further development of medicine adherence. It forestalls ingesting

too much, wrongdoing, and under dosing. Be that as it may, it can't forestall deliberate nonadherence, for example, claiming to take drug or letting it out a while later. For future work, we intend to foster extra capacities that recognizes a patient's movements utilizing a camera sensor to check real consistence. We likewise plan to stretch out our strategy to relate the brilliant drug gadget to other individual wellbeing gadgets, for example, action screens

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Modeling and Simulation for Capacity Fade Prediction of Lithium-Ion Battery

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Abstract—This work shows the modeling and simulation-based health analysis for the lithium-ion battery. In the lithium-ion batteries health is the burning issue. In this work health is predicted for the lithium-ion single cell. The lithium-ion generic model is trained by the various number of charging and discharging cycles 100 cycle to 1000 cycles for the analysis. Lithium-ion battery voltage is predicted with aging at constant discharging rate 1C. The capacity of the battery compared with the SoC of the with time and voltage. Nominal 3.8 volt and 2Ah rated Lithium Ion NMC cell have been investigated for this work. This study exhibits the lithium ion battery health condition with higher use of the battery in the everyday day life. The simulation results show the overall capacity fading behaviour in the proposed work.

Keywords—Lithium Ion battery, aging, SoH, SoC, capacity, degradation

LIST OF ABBREVIATIONS

- Q_{BOL} = Capacity beginning of life
- SoH = state of health
- SoC = State of charge
- Q_{nom} = Nominal capacity
- V_{nom} = Nominal voltage
- CCCV = Constant current constant voltage
- $V_{EOD} = Q_{BOL}$ Voltage at the end of discharge
- V_{max} = Maximum voltage
- V_{min} = Minimum voltage
- $LiCoO_2$ = Lithium cobalt oxide
- DoD = Depth of discharge
- SEI = Solid electrolyte interface
- Q_f = capacity fading
- Q = Capacity

I. INTRODUCTION

Lithium-ion batteries have become the most usable batteries worldwide because of comparatively higher energy density and lightweight. Lithium-ion batteries having the various range of the nominal cell voltage range 3.6/3.8/3.85 etc [1]–[4], [6]. Another remarkable factor is higher charging and discharging efficiency 85 to 95 %. Lithium-ion batteries provide the higher energy density approximately 250–690 wh/l that makes the best choice for the stationary application to mobile application [5]. In the field of the energy storage batteries are the most

and feasible solution for higher application such as electrical vehicle and the traction. In this regarding there are several factors that affect the efficiency of the energy storage. Battery Capacity fading is the prime and noteworthy factor in batteries, that degrade the batteries with time. From the published literature, several studies have been investigated regarding the state of health and predicting the remaining useful life of the battery [7]–[9]. This work deal with capacity fade prediction of the lithium-ion battery. Capacity fading is the most internal issue and challenge in the batteries have shown in the figure [11], [12], [20]. The available energy that can be recovered instantly, the empty zone that can be refilled, and the unusable portion, or rock material, that has become inactive as a result of usage and ageing, are the three parts of a battery's energy storage. These three parts are depicted in Figure 1. Since there is less to fill as the battery's rock content increases, the charging time decreases. Faster charging times on faded batteries are noticeable, especially with nickel-based batteries and, to a lesser extent, lead acid batteries, but not always with Li-ion. With aged Li-ion batteries, the charging time is extended due to reduced charge transfer capability, which prevents the flow of free electrons [13], [14]. Many studies have been conducted on the capacity-fading (i.e., decrease in capacity) of a single battery. Two major causes have been identified. One example is lithium depletion. When charging, Li+ ions pass from positive to negative electrodes, and vice versa when discharging. While these reactions are nearly reversible, some Li+ ions are lost as a result of parasitic reactions. The power of a reconstructed hybrid battery made up of cycled graphite and pristine LiCoO₂ is the same as that of a pristine battery. The power fade can be expressed in three ways. The first is experimental, and it directly gives a corresponding response for power loss. In [15]–[17] for example, the effects of current, temperature, and depth-of-charge are considered, and Ah-throughput is now used instead of cycle number and some variables are integrated into electro-chemical models to simulate power fade [18], [19]. It requires a large number of parameters, but it can analyse a broad range of design parameters and operating conditions. The third is nature and is built on an analogous circuit [21].

Figure 2. represents battery degradation in this Figure battery state divided in two parts as active and dead state. Due to more use of life cycles of the battery, internal resistance

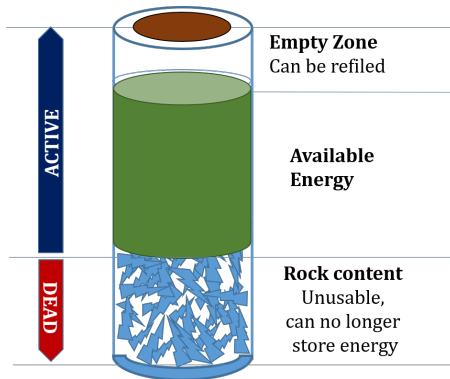


Fig. 1. Capacity fading in battery [5].

increasing with number of uses of battery. Internal resistance means that the cells and the batteries themselves contradict the current flow resulting in heating. Ohms are used to assess internal resistance.

II. METHODOLOGY

This section describe the proposed methodology for the work. Methodology divided in three parts , first part of the methodology is about the Lithium-ion single NMC cell modeling In this regards incremental open circuit voltage test have been applied for the varios temperature range such as 0 , 25 and 45 degree centigrade.The single cell model required the essential requirements as parameters property for the equivalent circuit model. For proposed work IRC equivalent circuit model have been adopted that and the parameters of the model is the dependent on the ambient temperature condition of the battery. Battery model have shown in the figure. Proposed battery model is only shows the SoC condition for each range of the temperature condition. Another part of the methodology is the prediction of aging of lithium ion battery model, in this regards a generic model have been adopted to predict the battery soc for various range of the charging and discharging cycle.

$$SoH = \frac{Q_{present}}{Q_{BOL}} * 100 \quad (1)$$

State of health (SoH) is the most defined as the total capacity of the battery pack today over the total beginning of life capacity. The state of health describes the effect experienced with cell phone battery charge is decreasing over time that can be explained by the state of health condition [22], [23]. It is also seen that brand new manufactured battery having a state of health of 100%, or It had zero charge discharge cycles, and its total capacity is basically equal to the beginning of life capacity, but after 300 or 600 charge discharge cycles after about a year or two use it's gone down to 70%, maybe even 60% state of health. it's very important to understand what this means because it gives you an understanding of how much time or how much energy you can discharge out of the system over time of a battery pack. The capacity of battery pack decreases over time. This is the effect of capacity

TABLE I
BATTERY DATA-SHEET

S.No.	Parameters	Specifications
1	Q_{nom}	2 Ah
2	V_{nom}	3.6 V
3	Standard charging condition	CCCV, 1 A, 4.2 V,
4	rapid charging condition	CCCV, 4 A, 4.2 V
5	Maximum discharge capacity	22 A at 25 degree Centigrade
6	V_{EOD}	2.5 V

TABLE II
END OF DISCHARGE VOLTAGE WITH VARIOUS CYCLES DISCHARGING AT 1C RATE $V_{max} = 4.1$, $V_{min} = 2.625$, END OF DISCHARGE SOC = 0

S.No.	Number of Cycles	End of discharge voltage or V_{min}
1	100	3.32V
2	200	3.27V
3	300	3.23V
4	400	3.19V
5	500	3.15V
6	600	3.18V
7	700	3.20V
8	800	3.22V
9	900	3.23V
10	1000	300

fade over time. Estimating the state of health of the battery depend on two important factor as impedance and equivalent series resistance (ESR). In a typically lithium ion battery ESR is approximately 20 milli ohms at the beginning of life at a certain temperature.ESR increases over time. Lithium ion battery parameters has shown in Table I.

III. RESULTS AND DISCUSSION

Figure 4. shows the lithium-ion battery state of charging condition affected due to aggressive use of the batteries. Battery charging and discharging cycles limited at 1C rate. For battery capacity fading prediction, several charging and discharging cycles applied and simulated. In this regard lithium-ion battery model trained with 100 cycles to 1000 cycles, each cycles taken as 10% SoC interval as shown in figure 4. A fully charged battery, discharged at the 80% DoD. The concept behind the 10% interval is to estimate the SoC with time by following the number of cycles. From the commercial available batteries datasheet it is mentioned that battery can be discharged with 80% DoD, but in real scenario batteries should not be discharge after 30% SoC. DoD and remaining useful life is the most important term in the battery research. Cycles represents the full charging and discharging condition of the battery.Figure 4b shows the fitting curve confidence interval.

Results and discussion explaining how the degradation occurs, what the specific degradation mechanisms are and their root causes. In this case, it is explained that how simple actions can limit the battery degradation which occurs within electric vehicle battery. Degradation is an irreversible loss of

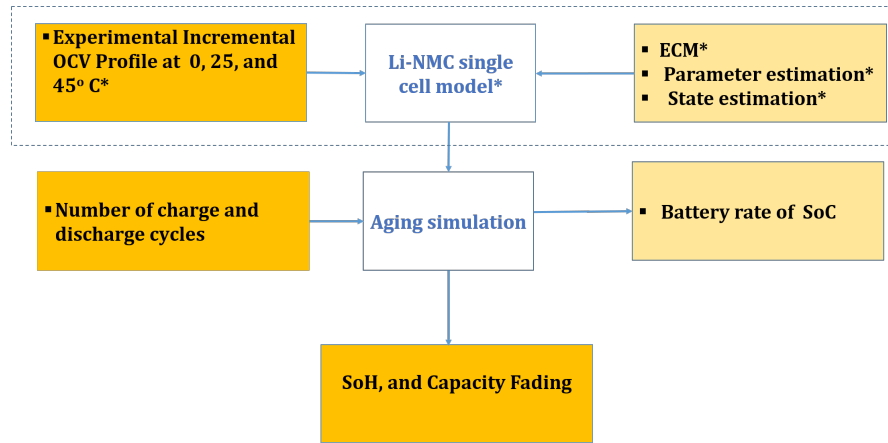


Fig. 2. Methodology.

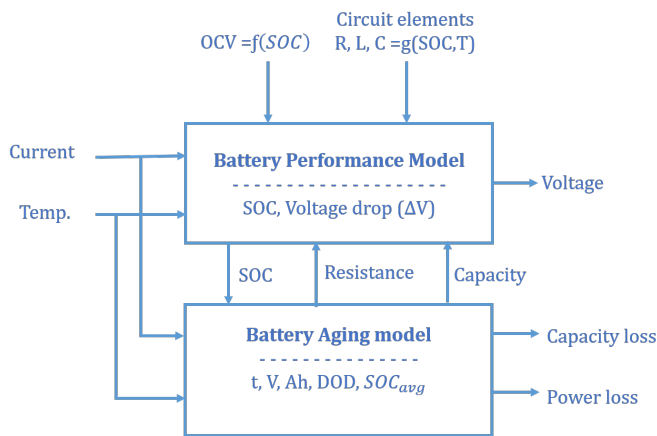


Fig. 3. Integration of battery aging model and battery performance model.

the ability of a battery to store charge or reduction of the rate at which electrical energy can be accepted or released from the battery. If we look at how battery capacity typically fades over time, we can see various distinct phases in FIGURE 4. The first is stabilization. Initially capacity fades quickly, but the rate of capacity fade rapidly decrease as the solid electrolyte interferes, , stabilizes and the anode becomes less reactive with the electrolyte. Although battery degradation is a nonlinear process. Following the various cycles. If usage conditions do not differ significantly capacity fades in a roughly linear manner until we reach the new point where the behaviour can change. Degradation mechanisms results shows an increasing rate of capacity loss, and ultimately cell failure occurs very quickly during charge during discharge. The measurable effects are usable capacity loss and resistance rise. In this phenomena, this work deal about capacity loss and resistance rise. From the results it is predicted that capacity loss will result in a reduction of usable energy, and hence a reduction in range. It may not immediately be obvious that capacity loss will also reduce the charge rate when replenishing a significant percentage of battery range during a fast charge.

In a practical scenario we can restore 80% of original certified range for electrical vehicle battery pack, through fast charging as capacity is lost, the average state of charge throughout the fast charge will be increased. Thereby, typically, leading to a reduced average fast charge rate. A rise in resistance results in a decrease of efficiency, increasing heat generation for a given power output, and increasing overall energy consumption. If the vehicle power output is limited by the power capability of the battery, a rise in resistance will also reduce peak power. This will initially be observed as an increase of state of charge, below which the power is rated, or a reduction of time that peak power can be maintained. The maximum charge rate will be reduced. First the energy cost per unit distance travelled, will increase over time. For this origin of this study is based on the t lithium-ion cell to explain how degradation occurs, Simulation results shows the characteristic for a single graphite anode particle, with single NMC cathode particle connected to an aluminium current collector. And these two particles are held apart by an electrically insulating ionically conductive separating material. We will incur degradation if we have a loss of anti-anode sites within which can insert lithium ions, or if we lose cyclable lithium from ourselves. If we have a loss of activity cathode sites within which we can insert lithium ions. If the movement of lithium ions becomes more difficult if electrical resistance increases. These items in FIGURE 5 represents degradation mechanisms. Degradation map shows how root causes of degradation linked to degradation and the degradation mechanisms these modes invoke, as well as the directly measurable effects of degradation, namely capacity loss and resistance rise through our capacity loss measurements, we can estimate the loss of cyclable lithium, as well as the loss of active anode material, and the loss of active cathode material. The loss of active anode and cathode material observed resistance rise as a greater power output per unit of active material will be required to deliver the same overall power output from our resistance rise measurements. It is the great challenge to estimation of lithium ions to move between the anode and cathode, and at the result, how

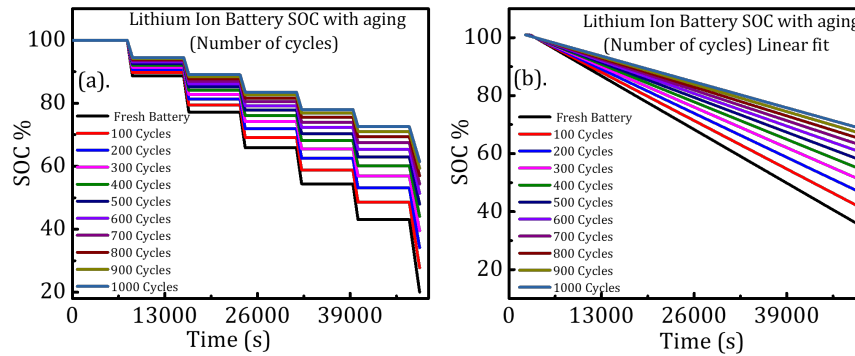


Fig. 4. Capacity prediction with extensive use of battery.

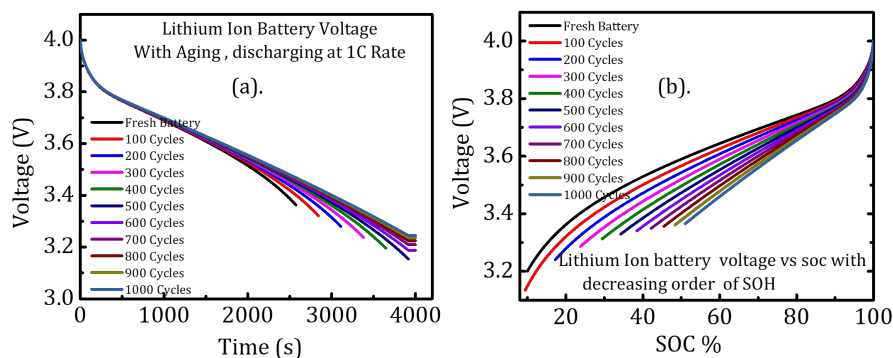


Fig. 5. Battery capacity fading with increasing the number of cycles.

much additional heat will be generated. A major factor in the degradation of lithium-ion cells containing graphite anodes, the vast majority of lithium ion cells is the solid electrolyte interface. The solid electrolyte interface (SEI) is a stabilizing passivating porous layer, which forms on the surface of the graphite anode upon exposure to the electrolyte, with which it is unstable, the SEI on the anode is much like the formation of aluminium oxide on the surface of aluminium. Aluminium is highly reactive with atmospheric oxygen. And when p aluminium is exposed to a typical environment passivating dual layer of aluminium oxide forms on the surface, preventing further reactions, the reaction between the anode surface and the electrolyte to form the SEI results in the consumption of electrolyte, including lithium, thereby resulting in birth loss of cyclable lithium and loss of active anode material. Over time, further reactions between the anode surface and SEI with the electrolyte result in the SEI becoming thicker and denser, which in turn makes it more challenging for lithium ions to enter and exit the anode. The increased thickness of the SEI also results in a reduction of porosity of the overall electrode at high state of charge and high charge rates, it is possible for the lithium ions to not fully dissolve it from the solvents in the electrolyte prior to entering the anode, resulting in damage to the load graphite structure. This can lead to parts

of the anode becoming more difficult or impossible to access, thus reducing active anode material and making ion transport more difficult, high currents, particularly when maintained for long time periods, resulting in significant mechanical stress within the anode, this mechanical stress can result in the anode particles cracking. When a particle cracks, an element of the anode can become detached, forming a non-electrically active material. Thus, it can be los useful anode capacity, as well as the lithium ions contained within that detached entered material. In addition, when a particle cracks afresh added material to the electrolyte, resulting in the formation of additional solid electrolyte interferes further consuming usable lithium ions, reducing active anode sides, and reducing kinetics, in particular systems. At high certain charge the anode can expand by up to 13%. And under these conditions the solid electrolyte interface itself can crack or decompose at high temperatures. During charge lithium ions are transferred from the cathode to the anode, at low temperature and high state of charge, the rate at which lithium ions diffuse from the anode surface to the centre of the particle. If the rate of lithium-ion transfer to the anode is greater than the rate at which lithium ions can diffuse away from the surface of the particle, lithium ions will accumulate at the particle surface and metallic lithium will form on the particle surface. At this

TABLE III
CELL LEVEL CAPACITY FADING IN LITHIUM-ION BATTERIES

Cyclic based Q_f	Log based Q_f
Aging of Negative Electrode	Reversible Q Loss
Degradation due to SEI Formation	Irreversible Q Loss
Anode Mechanical Failure	Effect of Temperature
Degradation from Lithium Plating	Effect of SoC
Aging of Positive Electrode	Morphology of Electrodes
Structural Factors	
Solid Electrolyte Interface (SEI) Formation	
Aging due to Degradation of the Electrolyte	

point, the lithium ions will preferentially bond with the lithium metal, rather than being inserted into the graphite anode, resulting in the formation of long spiky stems of metallic lithium. This results in significant loss of usable lithium from the electrolyte and these lithium metal drives can puncture the separator, enabling electrical conduction directly between the anode and the cathode, or in other words, create a short circuit. This will lead to a very large current flow and temperature rise within the cell, which will eventually lead to thermal runaway. This lithium formation will result in significant degradation and major safety issues to between zero and 100% SoC, the volume of the anode will change by approximately 13%.

IV. CONCLUSION

This work deal with capacity fading in lithium ion battery. Various of charging and discharging cycles have been trained for this study. This work is based on the modeling and simulation based study on the lithium ion battery. 3.8 V , 2 Ah nickel manganese cobalt oxide lithium ion cell investigated. Proposed work deal with the capacity fading in lithium - ion battery with the charging and discharging cycle. From the simulation results it has been proven that the delivering charge capacity is decreases with increasing the number of cycles.

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A Bluetooth Based Intercommunicative Product for Spotting Medicine in Pharmacies

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Abstract—Smart Technologies play a promising role in various applications in our daily life ranging from farming, education, governance, automobiles etc. Smart devices, wireless technologies and numerous mobile applications have made man to use technologies at their fingertips. Use smart technologies developed through wireless technologies for functioning which has made works easier. Most effective and appropriate healthcare is one among the foremost important objectives of data and communication technologies. This paper discusses how wireless Bluetooth-based technologies and android applications can be made useful in pharmacies/medical stores in spotting medicines which in turn helps in saving time. LEDs are connected to the spots where different medicines are kept. The quantity and the names of the medicines along with the spots where they are kept will be fed to the Arduino through a program. An android application or web interface which consists of the names of all medicines will be used for locating that particular medicine. Provisions will also be provided to add a new medicine to the previously mentioned list. This system is cost effective, less power consuming, user friendly and can be used in wide variety of applications where spotting becomes a tedious job.

Keywords— *Wireless Bluetooth; Android Applications; Spotting Medicines, Cost effective, User friendly.*

I. INTRODUCTION

Wireless technologies have brought out many significant changes in the present-day world. It has also influenced the life style of people and has helped improving the quality of life. Now a days, smart devices have become the need of the hour just because of its monitoring capacity, flexible usage, less maintenance, less power consumption, saving time and energy, faster and timely outputs, safety, security and entertainment [1]. Smart devices collect required data/signals independently and send to remote application servers to provide required services (location-based services or any other personalized services). Here, data that is collected from various sources (smart devices) is categorized and prioritized for smooth transfer of data and also for the future analysis of the data. Interaction between smart devices and mobile and web applications makes it much more attractive, user friendly and flexible as it is compatible with all the mobile and web platforms. The paper describes about the usage of such wireless technologies that helps in spotting medicines in pharmacies. Pharmacy has readily accepted computerization, and innovative pharmacy information

systems are being developed. Pharmacists must carefully process, store, and track an outsized volume of drugs also [2]. Data transfer over a connected network saves time and money improving cost effectiveness. Applications of wireless technologies are going to be enhanced with the upcoming technologies. According to researchers, privacy and security services based on Bluetooth technologies are also going to increase as routers will continue to become more secure and smarter as used in Home Automation Technologies [3,4]. Router is the entry point of internet to any of the services that use IoT. This router has better advantages compared to the conventional router. The conventional router provides security for password protection, firewalls and makes the configuration available only to certain devices according to users' convenience. Whereas, the updated router has all possibilities of improving the security of the present router. This system can also be upgraded by IoT which in turn used in libraries for spotting books, in shopping malls and warehouses for spotting a particular product, in parking slots to find out a parked vehicle [5-7].

The paper is organized as follows: section I - Introduction, section II - Proposed System model for spotting the medicine, section III - Design Specifications section IV – Experimental Set up for Bluetooth based system for spotting medicine, section V- Conclusion, and References.

II. WIRELESS BLUETOOTH BASED SYSTEM FOR SPOTTING MEDICINES IN PHARMANCY

This proposed paper aims in providing a wireless Bluetooth- android based technology that can help in spotting medicines in pharmacies. LEDs are connected to the spots where different medicines are kept. The quantity of medicines and the names of the medicines along with the location will be fed to the Arduino through a program. An android application or web interface which consists of the names of all medicines will be used for locating that particular medicine. Provisions will also be provided to add a new medicine to the previously mentioned list. Thus, it's cost effective, less power consuming, user friendly and can be used in wide variety of applications where in small range of spotting the things become easy. The hardware system uses HC-05 Bluetooth module, Arduino UNO, an SMPS

based power supply circuit (acts as a source) and a transistor-based switching circuit that can turn on the LED lights according to requirement of a product by the user. The proposed technology can also be made using IoT, Wi-Fi GSM module which makes it still more efficient.

The primary objective of this project is to design and develop a system that can be used in spotting a particular medicine in pharmacies using the Bluetooth technology with the help of a user-friendly android application or a suitable web interface. The secondary objective is to develop a suitable power processing unit for the whole system in such a way that the common supply available for domestic purposes can be used for the working of the whole system.

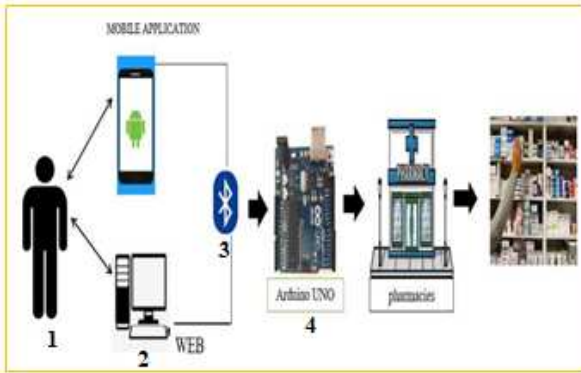


Fig 1. Bluetooth based System Model for Spotting Medicine in Pharmacies

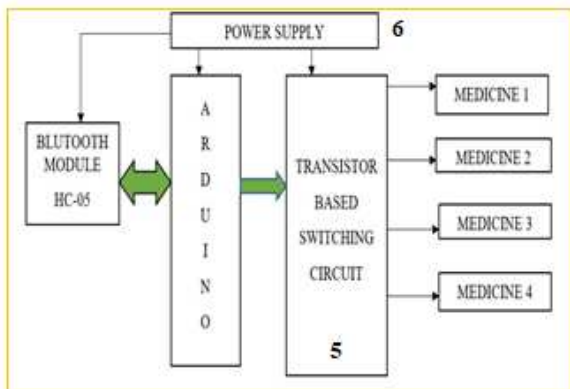


Fig 2. Functional Block Diagram for Bluetooth based Model for Spotting Medicine

The proposed system consists of the following modules shown in Fig.1 and Fig.2 in which 1. User, 2. Mobile application or any suitable web interface, 3. HC-05 Bluetooth module, 4. Arduino UNO, 5. Transistor based switching circuit, 6. SMPS based power supply as the source. In this system, Fig. 2 represents the functional block diagram of Bluetooth based medicine spotting system in which a DC bench supply can be the supply to power the whole system. Arduino UNO is microcontroller that is used. HC-05 Bluetooth module is used to connect the android or a PC to take inputs from the user. The microcontroller is the heart of the system that plays a major role in receiving the serial data from the Bluetooth module and providing required output.

The user/pharmacist will be provided with an android application or a suitable web interface according to his/her feasibility where all the data is fed into it. This network gets connected to the Arduino through Bluetooth or Wi-fi connection. A suitable indicator, probably an LED bulb or any such indicators can be placed near to each category of medicines for the purpose of indicating according to user's needs.

III. DESIGN SPECIFICATION

A. System Processor

Arduino UNO has a wide variety of applications in the present-day world. The Arduino Uno is an open-source microcontroller based on the Microchip AT mega 328P microcontroller and developed by Arduino.cc. The I/O pins that may be connected to different circuits or extensions may be either digital or analog in nature. The board is easily programmable with Arduino IDE (Integrated Development Environment) software. The board has 14 digital I/O pins and 6 analog I/O pins. Power supply to the board is provided with a type B USB cable or probably by an external source of 9V. Arduino Nano is a compact version of the same board. The pins of both UNO and Nano remains same. The DC current per I/O pin is 20 mA. The DC current for 3.3V pin is 50 mA. The operating voltage of the board is 5V. The clock speed of the board is said to be 16MHz. 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 the LED is OFF. The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX) as per the Pin specification shown in Table. 1. Introduction to Arduino UNO has moreover converted the fragmented and expensive robotics and microprocessor market to a less expensive and user-friendly applications due to which it is gaining high support from technical communities for research and development based of such controllers.

B. Bluetooth Module

The HC-05 Bluetooth module is a Bluetooth SPP (Serial Port Protocol), which means that it communicates with the Arduino with the serial communication process. One of the interesting features of this is that it can communicate with two microcontrollers like that of an Arduino. The module communicates with the help of USART at 9600 baud rates hence, it is easy to have an interface with any microcontroller that uses USART and default setting is shown in Table .2

TABLE I. PIN SPECIFICATIONS

Pins	Specifications
EN	To toggle between data mode and command mode.
Vcc	Powers the Module
Gnd	Ground Pin
Tx	Transmits Serial Data
Rx	Receives Serial Data
State	Connected to on board LED to check whether the Bluetooth is working properly

TABLE II. DEFAULT SETTINGS OF BLUETOOTH MODULE

Default Settings	Specifications
Default Name	HC-05
Default Mode	Data mode
Default Password	1234 or 0000
Default Communication	Slave
Default Baud Rate	9600

C. DC Bench Supply

Here an ATX PSU (Power Supply unit) that provides DC current for a computer in different voltage ratings is used to make a DC bench supply as represented in Fig.3 (a). The wires in an ATX power supply are color coded with different colored wires. The color coding of the wires present in this ATX power supply and its final modification images are shown Fig. 3 (b) & 3 (c).



Fig 3 (a). DC Bench supply

Orange	+3.3v	Brown	+3.3v Sense
Red	+5v	Purple	+5v Standby
White	-5v (Older PSU)	Green	Power On
Yellow	+12v	Gray	Power Good
Blue	-12v	Black	GND

Fig 3 (b). Colour coding representation for various supply voltage

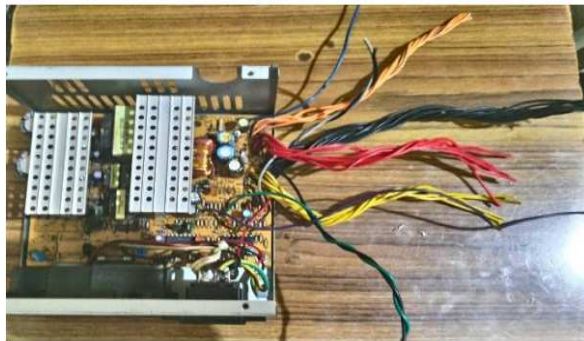


Fig 3 (c). Internal view of color-coding representation for various supply voltage

IV. EXPERIMENTAL SET UP FOR BLUETOOTH BASED SYSTEM FOR SPOTTING MEDICINE

The microcontroller acts as the heart of this system as it plays a major role in receiving the serial data from the Bluetooth module and providing the required output. In pharmacies, LEDs are connected to the spots where the medicines are kept. This acts as an indication that the pressed medicine is located at that particular spot thereby reducing the amount of time taken to search for that particular medicine. For eg: If the user is in search of a medicine named 'Ascoril', he/she could press the ascoril option in the application and thereby within no time, the LED near the medicine glows indicating that it is located at that position. The program for the whole system fed to the Arduino through the software Arduino IDE. A suitable Bluetooth controller application has to be installed in our smart phones.

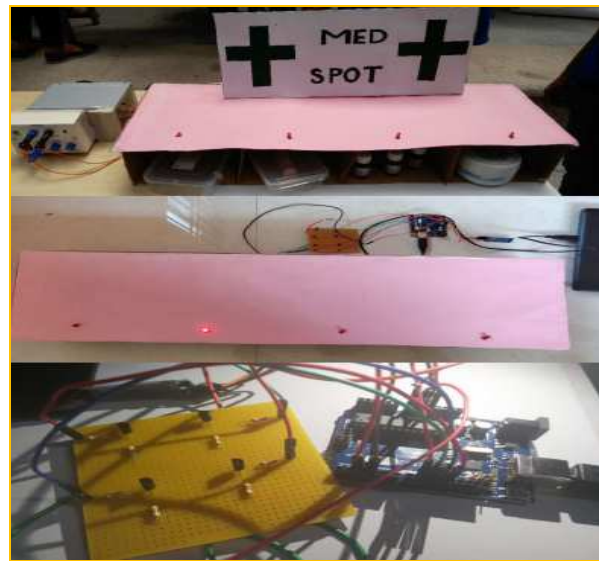


Fig 4. Experimental Setup for Complete System Model

The hardware prototype is as shown in Fig.4 wherein there is a DC bench supply for providing the power supply for the whole system. LEDs are placed at all the locations where medicines are kept. The names of medicines available are fed into the android application as shown in Fig.5. The user will also be provided with an option to change the medicine names and their locations accordingly. Along with these facilities, he/she can also add a particular medicine to the above list provided that there will be an indicator placed at the location where the medicine is going to be kept. The wireless range is considered to be of 10m distance. So, the region of operation of this particular system must be within a radius of 10m. The DC bench supply can provide voltage ratings of +3.3 V, +5V, +12V which is enough for the whole system to work as represented with color coding in Fig.3 (b). This system is cost effective as components used here are not expensive, user friendly as the application used here is very simple, time saving as much of the time spent in searching for a particular medicine is being reduced and will be having very less maintenance.

The names of all the medicines available will be fed in the application. When the power is turned ON, the LED on the Bluetooth module starts blinking. This means that

Bluetooth module is ready to get connected. The Bluetooth controller application is opened in our smart phones and is connected to the module. The default password for this connection would be either 1234 or 0000. When a particular medicine is required, the user could press the name of the medicine in the application installed in the smart phone. The Bluetooth module receives the data and communicates with the Arduino and makes the LED connected at the location of that particular medicine to glow. This acts as an indication that the pressed medicine is located at that particular spot thereby reducing the amount of time taken to search for that particular medicine. For eg: If the user is in search of a medicine named ‘Ascoril’, he/she could press the ascoril option in the application and thereby within no time, the LED near the medicine glows indicating that it is located at that position.

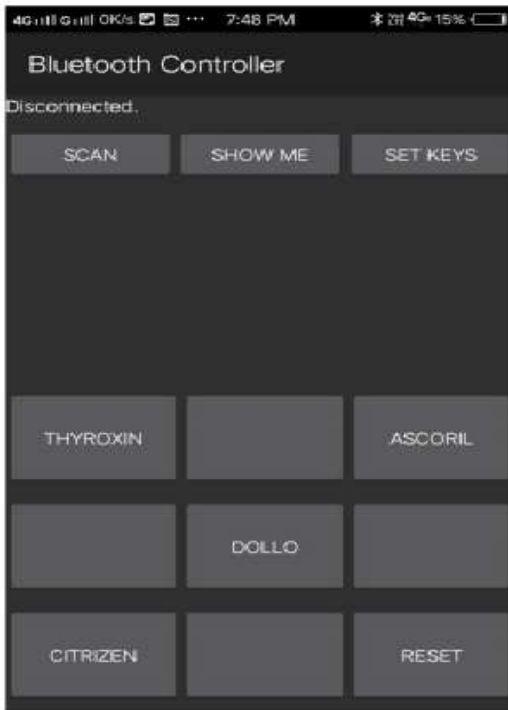


Fig 5. Bluetooth Controller Specifications for the user specific operation for medicines

V. CONCLUSION

In this paper, the wireless Bluetooth based intercommunicative system for spotting medicines in pharmacies is proposed and is successfully implemented. The system proposed uses Arduino UNO, HC-05 Bluetooth module, a transistor switching circuit and an android

Bluetooth controller for spotting which makes it cost effective. The wireless range is considered to be of 10m distance. So, the region of operation of this particular system must be within a radius of 10m. The proposed system will provide the following features:

- Cost effective, Time Saving Bluetooth based medicine spotting system powered by DC bench supply.
- Ability to identify the exact location/slot of any medicine required by the customer and is available at the Pharmacy.
- An additional feature to track the count of each medicine available at the store.
- The user will also be provided with an option to change the medicine name and location in the shelf.
- It will also enable the user to add a particular medicine to the list provided in case an indicator can be placed at the location where the medicine is going to be kept.

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Weather Parameter and Pollution Level Extraction using IoT for Various Traffic Nodal Points with Solar Charging

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Abstract— *Weather conditions become an extremely important parameter before the outset of major constructional projects at remote places. This paper proposes the design and development of weather station which is powered by utilizing renewable energy for such remote places where there is no electricity supply and has been developed for unmanned operations which would continuously render real time weather related data using Internet of Things i.e., IoT to provide graphical data of the weather conditions over a long period of time. The proposed device will measure weather parameters such as temperature, humidity, pressure, altitude and pollution levels with high precision and at very less power consumption to provide all the round 24 hours of active operation.*

Keywords— *Solar Powered Weather Station (SPWS), Solar Energy, Renewable energy, Internet of Things (IoT), Wi-Fi, Temperature, Humidity, Pressure, Altitude, Photo Voltaic (PV), Volatile Organic Compounds (VOC), Thing Speak, Blynk.*

I. INTRODUCTION

Developmental projects being on the rise globally at high pace and countries facing an unobtrusive competition with India being one of the adversaries, it becomes extremely crucial to surmount other competitors in a swift. The country ranking 139th in per capita GDP of 2018 and the factors affecting these being natural resources, technology, law, population, human capital and most importantly infrastructure [1]. Weather being one of the important aspects before any constructional or agricultural projects for the melioration of the infrastructure of the country to take place; it becomes very essential to get the idea if the place is good and habitable for number of reasons which would be specified depending upon the needs and requirements of the undertaking. Weather circumstances play a major role before construction of solar power plants, placing wind turbines or creating of dams, as the climatic conditions like rain, altitude, humidness, temperature turn to important parameters to make a note of as it would be extremely unwise to invest solar panels in a place where the temperature is ordinarily very low implying lack of required sunlight in the region or a place with very less rainfall for the construction of dams etc.

which would eventually result the failure of the entire project which would be uneconomical from every point of view.

Uninhabited remote places like barren lands, deserts, major hilly and mountainous regions need to be properly analyzed before used for any industrial or domestic purpose such as tall buildings, dams, power plants, airports but as it is difficult to be over-viewed for a long intervals of time like 6 months for the measurement of accurate weather conditions on an average and that too using hand held highly sophisticated weather measuring devices which are not only costly equipment's but also require continuous human intervention and survey to work which is loss of manpower and time. A SPWS is a great solution to this problem where weather preconditions play a very vital role before any developmental projects and needs to be measured over a long interval to obtain an excellent idea about the climate.

The system also has the ability to extract the pollution level of different remote locations as well as traffic nodal points. This pollution levels can be shown on a big panel nearby roads and highways which not only awareness but will also drive the people of different section of the society to use fewer private vehicles and more public transport which will definitely help in decreasing the pollution levels to a certain extent in highly polluted cities.

II. PROPOSED SYSTEM OF SOLAR POWERED WEATHER STATION USING IOT

A. Proposed System

The design and development of such a SPWS system outlined in this paper helps the user to get all weather related information very easily with a low-cost module. The SPWS is operated on solar photovoltaic panels which will continuously work on recharging the battery as the sensor collects the data about the different weather parameters of the area such as temperature, humidity, altitude and pressure. This weather data which is send data wirelessly from remote places using the application of the IoT to a website ThingSpeak.com and the weather data acquisition will be successful from any place on

the planet and not only that, this data can also be seen wirelessly using a graphical interface in an app called Blynk which is available for both android and iOS[2]. The approach towards the design of the system as shown in Fig.1 consists of three parts one is the battery charging circuit, second is the weather sensing module and the last is a Wi-Fi module which will help in transmitting the data over the internet. These three parts when integrated together forms highly efficient automatic weather station which works efficiently for long durations without any requirement of human intervention or maintenance even for long periods like 4 months to 8 months at a single stretch. The biggest advantage is that the entire framework works on a very low voltage of 3.3V making it easily implementable even in places minimum sunlight conditions. The proposed modern SPWS has the following applications-

- Real time weather data collection.
- Implementation at traffic nodal points for displaying live pollution levels.
- Creating ongoing weather changes and global warming awareness.
- Detection of disaster thunderstorms and notifications.

III. WORKING OF THE PROPOSED SYSTEM

A. Working

The TPU4056 charging module has been used in this project for regulating the solar panel generated voltage and of the charging a 3.7V 4000mAh 18650 Li-Ion battery. This is used power the Wemos D1 Mini Pro which is a highly capable wireless 802.1 based mini Wi-Fi board having on board ESP8266 Wi-Fi microcontroller which controls and manipulates the entire sensor related and sends it to the designated internet servers. The data is sent every 5 minutes, immediately after which the ESP8266 goes to deep sleep mode which leads to very less power consumption leading to longer battery life.

The BME680 sensor is used for sensing the weather parameters. It is a robust integrated environmental sensor which is specifically designed by BOSCH for applications requiring size and power consumption as minimum as possible. The sensor has been kept extremely small having dimensions 3.0 x 3.0 x 0.93 mm³. It can measure temperature, humidity, pressure and altitude and air quality index with extremely high precision. The operating range of this sensor for temperature measurements is from -40°C to +85°C, pressure from 300 hPa to 1100 hPa with a sensitivity error of ±0.25 % and can measure a broad range of air quality index from a range of 0-500 as shown in Fig.2 using its gas sensor to measure VOC [3].

The block diagram of this entire working of the system is given below-

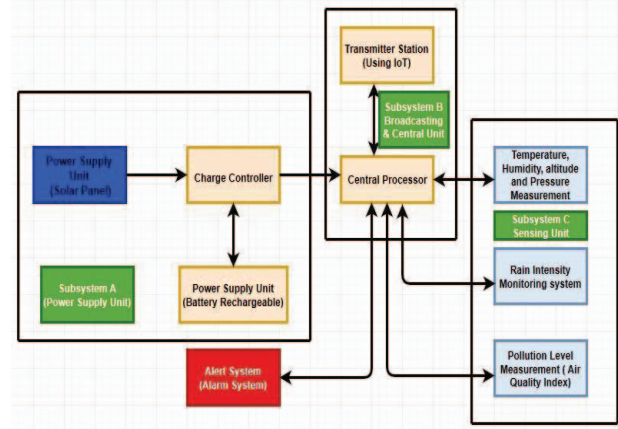


Fig. 1. Block Diagram of SPWS

Air Quality Index Levels of Health Concern	Numerical Value	Meaning
Good	0 to 50	Air quality is considered satisfactory, and air pollution poses little or no risk.
Moderate	51 to 100	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
Unhealthy for Sensitive Groups	101 to 150	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
Unhealthy	151 to 200	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
Very Unhealthy	201 to 300	Health alert: everyone may experience more serious health effects.
Hazardous	301 to 500	Health warnings of emergency conditions. The entire population is more likely to be affected.

Fig. 2. Air Quality Index Chart for BME 680 by Bosch

B. Methodology

The proposed system consists of three subsystems namely, Subsystem A, B and C. Subsystem A consist of power supply unit which consists of Solar panel, Charge controller and battery thus providing the system with two-way powering. Subsystem B is the central processor and Broadcasting unit. This subsystem the main unit as it runs the intelligent algorithm, which analysis the data collected and then transmits it to the meteorological department. Finally, the subsystem C consists of the sensing unit. The sensing unit extracts the weather and pollution data which is then send to central processor for analysis using the algorithm. The system is designed such that it is powered using solar and rechargeable battery using charge controller. First when the system is initialized the algorithm starts the data extraction. System is developed in such a way that the weather and pollution level data are collected simultaneously. Temperature, humidity, altitude and pressure data are extracted then the central processor analysis it before sending it the meteorological department. The data extracted is also displayed on the screen of the device and on public domain website for the people to access. Once the collected data is analyzed it is

checked for predefined parameters. After the data is analyzed using the algorithm, if it is found to be not safe or satisfying then first the alarm is sounded in the nearby area and the results are transmitted to the meteorological department for further analysis. Finally, the system is protected using an algorithm which stops any unauthorized user to manipulate the proposed system. Hence the proposed invention helps in keeping the climate change with respect to a particular area and pollution levels on check which would help in taking necessary actions in reducing the harmful effects and there by promote healthy life. The flowchart of the proposed system is shown below. The flowchart of the proposed system is shown below.

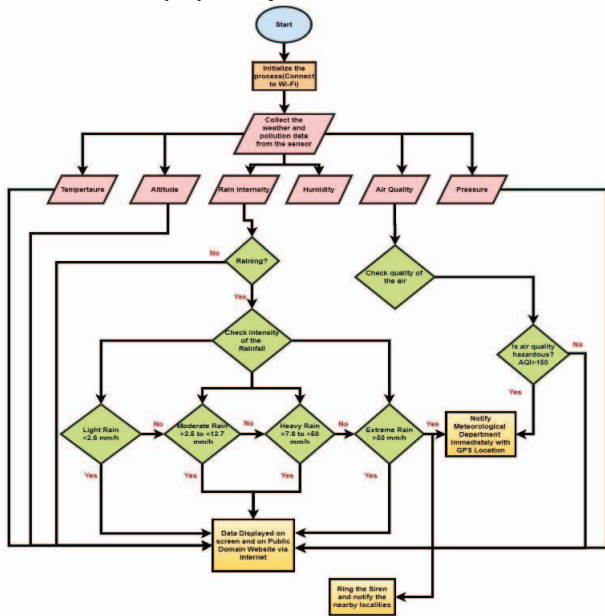


Fig. 3. Flow Chart of the Proposed System

IV. TEST RESULTS OF HARDWARE PROTOTYPE

Thing Speak™ is a platform for IoT based applications where a user can not only share his data online but also analyses it in the platform service that allows us to aggregate, visualize and analyze live data streams in the cloud. Thing Speak provides instant visualizations of data posted by our devices to the Thing Speak. Thing Speak also allows data analytics in MATLAB® which can be processed for further analysis.

The test results as displayed in ThingSpeak.com and Blynk app are as shown below-

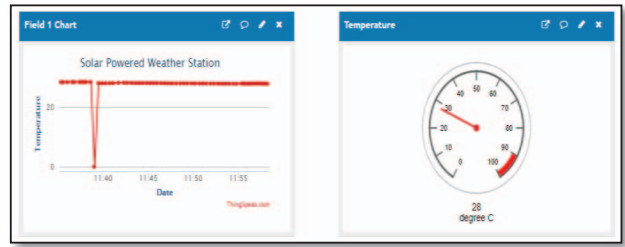


Fig. 4. Temperature Vs Time Plot (ThingSpeak)

The Fig.4 shows a graph depicting the real time temperature plot of the location where the sensor was placed for the particular duration of time. The temperature is plotted against y-axis and the time at the location when the reading was taken is plotted in x-axis.



Fig. 5. Pressure Vs Time Plot (ThingSpeak)

Fig.5 shown above is a pressure vs time graph. The pressure measured by the sensor is in the y-axis and the time when the reading was taken is in the x-axis. Pressure is a very important weather data for understanding the circulating winds around the globe, weather forecasting, navigation, shipping, future forecast for wind disasters. [4]



Fig. 6. Altitude Vs Time Plot (ThingSpeak)

Altitude in meters with respect to the sea level pressure which is 1013.25 is calculated and accurate reading of the height of the location where the sensor is placed is plotted with respect to time in y-axis and x-axis respectively. This is shown in Fig.6 above.



Fig. 7. Humidity Vs Time Plot (ThingSpeak)

Humidity is important as it provides the moisture content in the air and it affects our daily life in several ways like more sweating, dehydration, feeling of uncomfortable due to excessive humidity in the air. Fig.7 shows the plot of humidity in percentage versus the time at which it was measured has been plotted in the graph.



Fig. 10. Air Quality Index

The Fig.10 shows the air quality levels outside. The BME 680 has a gas sensor which can read VOC. A level between 0-50 is good, 51-100 to be little bad, 101-150 to be unhealthy to sensitive groups, 151-200 is unhealthy for everyone in that area, 201-300 is very unhealthy and above 300 is hazardous and very dangerous.



Fig. 8. 1/Rain Intensity Vs Time Plot (No Rain Condition)

The weather station showing the rain intensity between 1 to 1000 in Fig.8. 1000 would mean a clear sky and anything less than that could be drizzle, light rain or a heavy rain. Lesser the value in the graph higher the intensity of the rain. The rain indicating lamp if off showing that it is not raining outside.



Fig. 9. 1/Rain Intensity Vs Time Plot (ThingSpeak) (Raining Condition)

The Fig.9 graph shows a less value of 433 which means a heavy rainfall is going on in that location and the rain indication lamp being on indicates that it is raining outside.

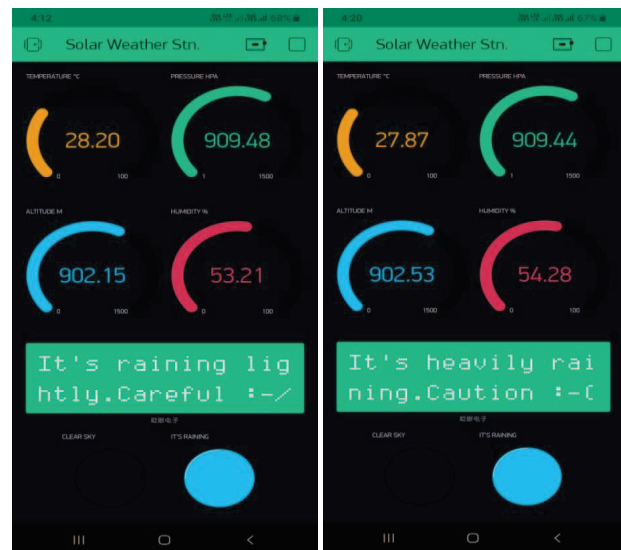
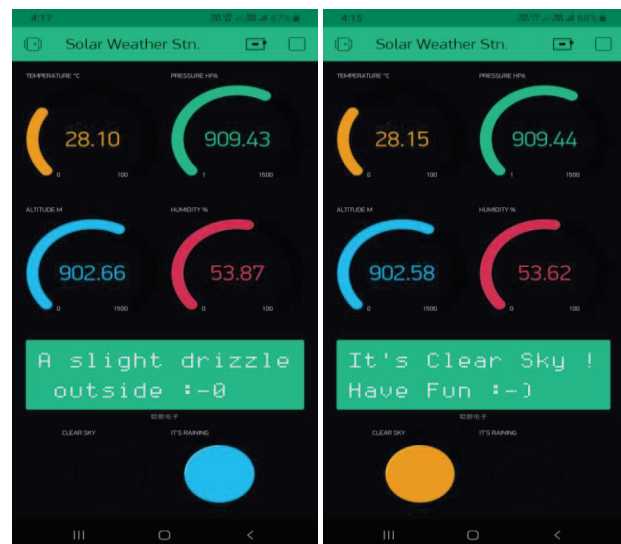




Fig. 11. All Weather Parameters in Blynk app

The Blynk is a Platform for IOS and Android users to control Arduino, Raspberry Pi and the likes over the Internet. It is highly used in IoT projects and applications. It provides the user a dashboard where we can build a graphic interface for our project by simply dragging and dropping widgets which we would like to use.

Here we have created the graphical user interface using the inbuilt options available inside the app. Fig.11 shows the different levels of rain and the air quality index showing the pollution levels at that exact place. The data is sent to the Blynk servers using the Wi-Fi module and the data is displayed and updated continuously every 5-minute intervals during which the ESP8266 is in deep sleep mode.

V. CONCLUSION

With the ongoing climate change, pollution level has been on the rise in various places. Thus, it has become a very necessity to track the weather and pollution level parameters to spread the awareness of the ongoing damage to our environment. The project idea is kept seamlessly simple and low cost so that it can be implemented anywhere like houses, near highways or traffic nodal points and mainly focuses on gathering the weather data. The system has an advanced and smart method of weather and pollution level parameter extraction using IoT for various traffic nodal points with solar charging which continuously make the people aware about the harm they are doing by using vehicles and rather use transport facilities and EVs to help reduce the pollution levels.

ACKNOWLEDGMENT

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Block Chain: The Security Provider

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ABSTRACT

The Internet of Things is a major sensation of the 21st century, it is going to influence almost every day-to-day item we use. need to make IoT devices secure from getting misused from intruders, as It will be included more in day-to-day life. Security technologies that subsist are just not sufficient to deal with this problem of security. Block chain has proved to be as the possible solution for creating more secure IoT systems in the future. In this particular paper, firstly a survey of the block chain technology and its enactment has been explained, then we have discussed the groundwork of IoT which is based on Block chain network and eventually a model has been provided for the security of internet of things using block chain. Index Terms—Internet of things, Block chain, Security, Devices, Network. Existing security innovations are sufficiently not to manage this issue. Square chain has arisen as the conceivable answer for making safer IoT frameworks in the future time. In this paper, initial an outline of the blockchain innovation and its execution has been clarified; at that point we have talked about the foundation of IoT which depends on Block chain organization and finally a model has been accommodated the security of web of things utilizing blockchain.

List Terms — Internet of things, Block chain, Security, Devices, Network.

I. INTRODUCTION

Block chain innovation is currently getting a lot of consideration from programming researchers since it has been created. Fig 1 shows the fundamental mainstays of blockchain innovation in web world. As a matter of fact, it can alter and streamline the worldwide foundation of the innovations associated with one another through web. It has for the most part two fields that will be impacted by it which are:

- By making a decentralized framework, it eliminates the guilty pleasure of focal workers furthermore, gives distributed connection.
- It can make a completely straightforward and open to all data set, which could bring straightforwardness to the administration and decisions.

Blockchain innovation fundamentally has 4 columns, first, Consensus, which gives the confirmation of work (PoW) and checks the activity in the organizations, second is record, which gives the total subtleties of exchange inside networks. Third, Cryptography, it ensures that all information in record and organizations gets encoded and just approved client can unscramble the data and fourth is keen agreement, it is utilized to confirm and approve the members of the organization. IoT is developing extremely quick and making its essence felt in pretty much every field of innovation. Nonetheless, with its quick development, it has made itself more inclined to digital assaults. Presently there is an earnestness to make IoT safer [1]. Web Of-Things (IoT) alludes to an inexactly coupled, arrangement of

different heterogeneous what's more, homogeneous gadgets having the force of detecting, preparing, and network abilities [2]. Webs of Things have been talked about suitably with

semantic touch in the IoT vision [3]. The current situation for making a free from any danger vehicle is to bolt your vehicle consequently or physically. We become sure of its wellbeing and security [4]. Our future age vehicles would have all sensors-based gadgets and simultaneously associated in to the framework [5]. The vehicles with these gadgets make our vehicle shrewd yet would they say they are protected? This is the appropriate inquiry which forces us to compose a more protected design for making our vehicles dependent on IoT gadgets free from any and all harm and associated with the Internet each time [6]. The motivation behind this examination paper is to give direction to the utilization of square chain innovation, through cases to make a safer and trustable IoT model.

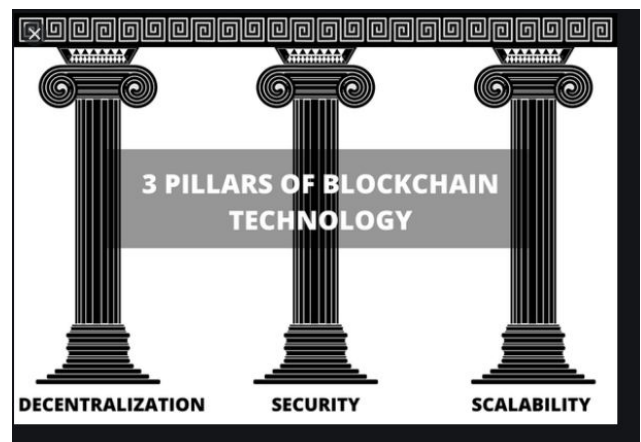


Fig.1. Pillars of block chain technology

II. CONCERNS WITH IMPLEMENTATION IOT

IoT [7], has various applications, for instance: in making shrewd homes, Smart City, Improving Health, Autonomous Vehicles, and so forth Some IoT gadgets are presently accessible in the market like Wearables, Smart Thermostat Systems, Air Conditioners, and fridges that

utilization Wi-Fi for far off checking. Aside from every one of these advantages, IoT has some genuine issues, which ought to be figured out before it gets carried out, similar to the advances on which the establishments of IoT have been set up have a few bugs, so if programmers get admittance to the framework through these bugs, then they can bargain the security of the client or even can make hurt them. In this manner prior to carrying out IoT, the security of these frameworks ought to be fortified and made liberated from any bugs. Keeping the IoT gadget secure is perhaps the most troublesome undertakings to achieve. In making these gadgets modest, little and simple to utilize numerous security approaches are undermined which builds the hazard of safety break. In figure 2 shows the scientific classification of the IoT security.

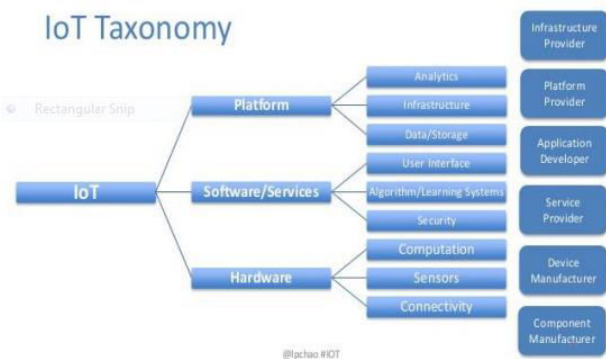


Fig.2. Taxonomy of IOT technology

III OVERVIEW OF BLOCKCHAIN TECHNOLOGY

Block chain is a kind of decentralized database, which keeps record of every transaction made on a network. Rather than having a conventional central database, it has a ledger distributed over a network where different nodes are connected. This network can be public, like the internet, which can be access by any person around the world or it can be private, where only the authorized person of the organization can access it. Block chains decentralized cryptographic model allows users to trust each other and make peer-to-peer transactions, eliminating the need of intermediaries. This technology is not only affecting the way we use internet, but the global economy has also being revolutionized [2].

A. Components of a Block chain

Block chain mainly has 4 components which form its complete infrastructure. Fig.1 shows the component of block chain.

- **Network of Nodes:** All the nodes connected over the internet maintain all of the transactions which is made on a block chain network aggregately. The protocol verifies the transaction's validity, obviating the need for a trusted third party to validate the transaction [3]. When a transaction is done, its records are added to the ledger of past transaction, this process is known as 'mining'. Other nodes in the network must verify the proof of work.

- **Distributed database system:** The database [8], which is composed of blocks of information, is copied to every node of the system. Each block contains the following data in itself: A list of transactions; a timestamp; Information, which links it to the previous chain of the blocks.

- **Shared ledger:** Every time a transaction is made, the ledger is updated. It is transparent because it is open to the public and uncorruptible.

- **Cryptography:** It binds the data with the very strong crypto mechanism, which is not easy to track or tampered by unauthorized users.

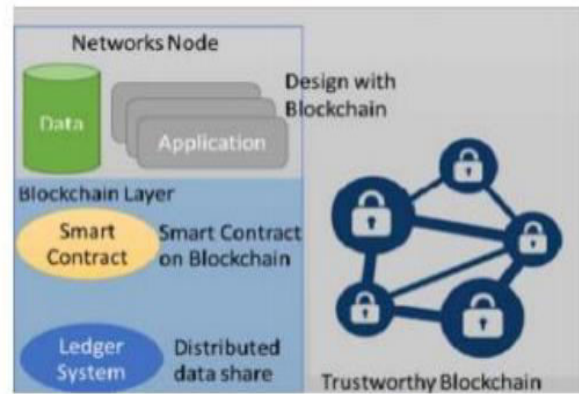


Fig. 3. Blockchain Networks and its Components

B. Constructing a block chain

A new digital transaction is made which is then converted into a cryptographically protected block. Members of the blockchain network having high computation power (Miners) compete with each other to validate the transaction by solving difficult coded problems. First one to solve receives a reward (In case of bitcoin block chain, the miner would get bitcoins). Then the validated block is time stamped and is added to the chain in Universal Review Volume VIII, Issue V, MAY/2019 ISSN NO: 2277-2723 Page No: 582 chronological order. The acceptance of block by nodes is expressed when it creates another block in the chain, using the hash of the earlier accepted block [4].

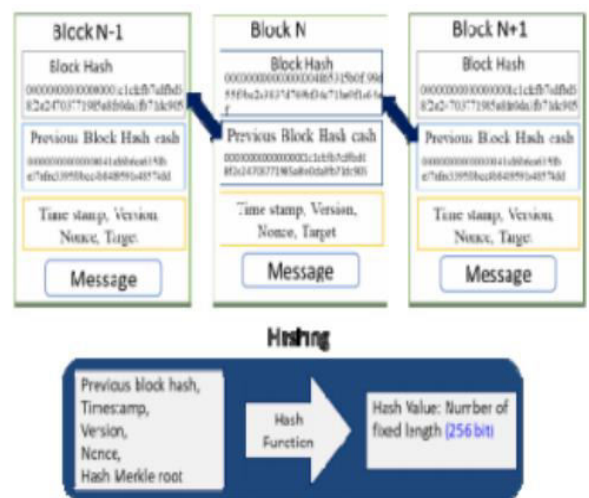


Fig. 4. Block Structure

C. Implementing a Blockchain

Block chain can be mainly deployed in 3 domains [1].

- **Public:** Un-permissioned area, each and every node can send or read transaction and can take part in the consensus process without the requiring any permission. Bitcoin and Ethereum come under this category.
- **Consortium area:** It comes under partial permission; only defined nodes can take part in the consensus process. The permission to read or send may be made public or may be provided only to few allowed nodes.
- **Private:** It is the permission area, only the organization to whom the network of blockchain belongs can write transaction to it. Analyzing of transaction may be public or confined to few nodes depending upon the requirement. In most sectors, this type of system is used.

IV. BLOCKCHAIN BASED INTERNET OF THINGS

Before we look into the security feature of IoT using block chain technology, first we understand the pattern of IoT-based on block-chain technology.

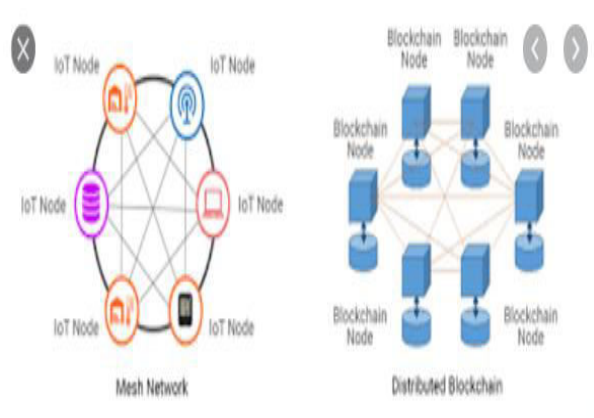


Fig 5: Blockchain network for IOT

A. Communication Model

In this model, mainly three of the fundamental functions of block chain network are used.

- Peer-to-peer messaging
- Distributed data sharing.
- Autonomous coordination with the device.

However, unfortunately, it has some limitations, which make it tricky to implement:

1) **Slow Processing:** Generally, low-end CPU are available which makes it hard for processing, as computations in block chain require high CPU and memory to work properly.

2) **Small Storage:** As the number of transactions increases, the size of the ledger grows. Companies like IOTA [9], which creates block-chain small sensors, are proposing novel ways that result in a reduction in hardware needs by simplifying the mining process. In this context, the following building has been depicted: below (fig. 5), this is a block chain network with the execution of technology like: mining, ledger or registering, encryption, so on. Here, block chain nodes are the members of the network and each of them is participating actively in the transaction process. They might be personal computers, enterprise servers, or cloud-based nodes, and they use mining to validate transactions. Clients are the IoT devices; they do not store the distributed ledger. APIs allow blockchain clients' block-chain nodes to communicate with one another. Transactions are generated by IoT devices and transferred to blockchain nodes for processing and storage in the distributed ledger. IoT and blockchain connectivity can be established via mHTTP REST APIs. They're unique to each blockchain node [5]. To avoid any "man-in-the-middle-attack" which can affect transaction details or can cause a double-spend, a complete trust must be established between clients and the nodes they are connected with. Messages sent between numerous IoT devices contain data that is immediately integrated in transactions sent to block-chain nodes by devices that participate in exchanges [10].

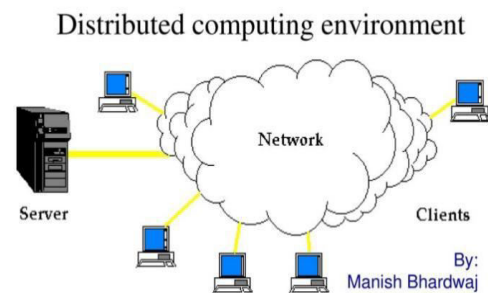


Fig 6: Distributed Data Share Architecture

B. Connecting multiple blockchain networks

With the recent researches, it has been predicted that future is going to be constructed by multiple blockchains, with each having different features and providing different services. Here, Blockchain network may be a home network, enterprise or the internet. Message formats and communication protocols between devices are out of the scope of blockchain implementation: it refers to machine-to machine communication [11]. If artificial intelligence is added to the IoT environment that is connected to a blockchain network it creates a Decentralize Autonomous Organization (DAO), DAO refers to an organization that runs without any human intervention [12].



Fig 7 : Blockchain strength

V. WAYS TO STRENGTHEN IOT SECURITY WITH BLOCKCHAIN TECHNOLOGY

Points that have to be considered to establish a secure IoT using technology. Fig. 7 shows the strength of blockchain those are built to secure IoT environment.

A. Secure communication

In some cases, IoT devices have to communicate for the purpose exchanging data required to process a transaction and to store it in a ledger. These ledgers can also be used to store encryption keys to make the exchanges more confidential. IoT device sends an encrypted message using the public key of the destination device, which is then stored in the block-chain network. The sender then asks its node to get public key of the receiver from the ledger. Then the sender encrypts the message using public key of the receiver, in this way, only the receiver will be able to decrypt the sent message using their private key [13].

B. Authentication of users:

The sender digitally signs the message before sending them to other devices. The receiving device then gets the public key from the ledger and uses it to verify the digital signature of the received message. We have described the digital signature work at below:

- First, the sender calculates hash of a message that is then encrypted with its private key.
- The digital signature along with the message is transmitted.
- The receiver then decrypts the digital signature using the public key of sender stored in the ledger to obtain the hash value as calculated by the sender.
- The message is valid only if the calculated hash and the protected hash of the message are same.

- The trust on retrieved messages is improved if the digital signature of each message is stored into the ledger.

C. Discovering legitimate IoT at large scale

As conclusively more than millions of IoT devices are to be connected on the same network with each other, there is an urgent need to come across devices at large scale level and to determine legal or authorized and unauthorized nodes [14]. As soon as a new IoT device starts, it first asks root servers to give a list of trusted nodes in the network. The device subsequently registers with a node, and the information exchange begins. It receives information from other nodes and sends its information to other peers on network. DNSSEC, whose roles is to protect against the techniques which is used by hackers or intruders, has to be administered to secure name resolution of root servers by circumvent any spoofing attacks. In public network, this enlistment method can be easily used without any certain constraints. For private network, it has to be made sure that only the legitimate devices can be added to the block chain network. For this, the root servers must authenticate the device before providing it the nodes list. Every communication must be authenticated and encrypted properly to maintain integrity the following criteria can be used to accomplish this and secrecy [15]. The following criteria can be used to accomplish this:

- Credentials already installed on the device during setup: There should be a safe process, which could be a part of blockchain implementation, which could generate these credentials.
- Credentials could be given by the owner of the IoT device: It initializes the process of device enrolment into the security server to get the credential for IoT.

D. Configuring IoT Blockchain technology helps a lot in establishing a trusted and secure configuration for IoT devices. Approaches that seem relevant here are:

- Properties of IoT like Configuration details and the last version firmware validated can be hosted on the ledger. During bootstrap, the blockchain node is asked to get its configuration from the ledger. The configuration is required to be encrypted in the ledger to prevent the discovery of IoT network topology or its properties by analysis of the information stored in the public ledger.
- The hash value of latest configuration file for every device can be hosted in the ledger. Using a cloud service, the IoT device will have to download the latest and trusted configuration file after every fixed interval of time (say every night). Then the device can use the blockchain node API to retrieve and match the hash value, which is stored in the blockchain. This would allow the administrators to remove any bad configurations regularly and reboot each and every IoT device in the network with latest and trusted configurations. Fig.7. shows a series of IOT devices interconnected with each other on a network. Securing them with a blockchain network makes the system

decentralized, in which there is no single authority which can approve any transaction. Each and every device will have a copy of the ever-growing chain of data. This means that whenever someone wishes to access the device and do some transaction, then all the members of the network must validate it. After the validation is done, the performed transaction is stored in a block and is sent to all the nodes of the network. All this make the system more secure and impossible for the un-authorized sources to breach into the security.



Fig. 8. Blockchain Secured IoT Devices

VI. CONCLUSION

We have offered recommendations for the usage of blockchain technology in this post, using examples to create a more secure and trustworthy IoT model. We determined that the internet of things will not be a complete member of a blockchain network due to the high-end hardware requirements. The internet of things, on the However, the internet of things will undoubtedly benefit from the blockchain technology's functions, which will be made available via APIs provided by network nodes or specialized intermediaries. The internet of things might be made much safer by incorporating these features. The new and emerging blockchain technology's cybersecurity point has been examined. As we all know, Bitcoin is a cryptocurrency that is built on blockchain technology, and research effort in this area is mostly focused on this technology. However, in this post, we will discuss how blockchain technology can be used to secure data transmission between internet-connected devices. For this, we've provided an overview of blockchain technology, discussed and proposed blockchain as a solution for IoT security, and discussed and proposed blockchain as a solution for IoT security.

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Synergetic Observation of Soil Water Movement Pathways and Expression of Deficit Using Data Mining Techniques

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ABSTRACT

Data Mining is conventionally greater domain for various aspects in commemorate with knowledge extraction. In other dynamic facets of Data Mining is not only extraction creating knowledge as prediction which helps to create inner intelligence for decision making overall this area of computer science is in demand because of its application in various adoptive level of humans. We move further to think how generously this can be used to find soil water movement pathways and deficit of rainfall prediction. As on date many people are working in and around of crop yield or soil properties, finding patterns of soil deceases, method of cultivation, Land classification and survey these are only few. One of the major contributions is working with machine learning algorithms for finding the contributory factor of water movement pathways where deficiency can be classified and treated with water management techniques. Water is most demanding and needy substance of human life on the earth. We use technology but forget the farmers to empower them with modern tools for agriculture. As various applications of research scholars have coined the word use of Data Mining in Agriculture known as Agricultural Data Mining. The work in this paper deals with soil water movement pathways for selected areas of Bangalore rural and deficiency prediction based on natural movement of water using efficient data mining algorithms.

Keywords - Agricultural Data Mining, Soil classification, Fertility, Machine Learning Algorithms. Data sciences.

I. INTRODUCTION TO DATA MINING

Data mining word emerged as buzzword for the millennium and this can be taken into account as technique used from extracting useful and needy information from large sets of data for finding non trivial solution which can be either explorative nature or predictive nature. Data mining is always considered as one of the practical learning stage and implementation step in finding the patterns of from large amount data known as KDD. Here when we refer the large sets of data means it can relate to any subject or fields of interest where research is to be carried out. In other aspect of thought process collective can be preprocessed to transform into useful data for appropriately so that in can be input or rendered into different file formats. In general preprocess may include cleaning data, finding appropriate attribute or selecting appropriate attribute as data label, summarization of data elements, transformation of flat files into data sets, etc. Overall Data is transformed into the computer readable format for analysis purpose. Considerate amount of Data warehouse is also treated as best data blocks for larger data storage units. Historical storage of rain falls from last 10 years can be considered for analysis. Similarly, day to day data can be considered as operational data and can also use for analysis. In our case metallurgical department collects

various rain falls of seasons and records as data sets this can also be used for any future predication of rain falls.

Data Mining uses various techniques such as clustering, classification, machine learning, support vector machines (SVMS), Regression, Association rules etc. In extending of working data modules these data sets use various adoptive algorithms to implement in tandem. Following illustrative diagram gives idea of data mining methods.

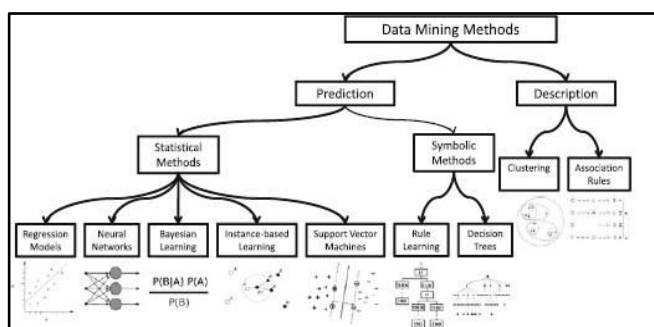


Figure 1. Schematic representation Data Mining methods (courtesy: Intelligent systems library of textbook no 72 by sylvador Garcia,Julian luengo and francisco herera)

As indicatively Data Mining in Agriculture is an emerging domain of computer science and it is attracting many research scholars, Data Scientists, and Data mining experts to study more relevant issues of agriculture and combine their work into applications. The relevant applications can be further formulated to enhance the potential growth of their crop or create awareness for making more productive decision for managing their crops efficiency by increasing crop yield. In my opinion Data mining in agriculture can support farmer's information about various risk involved and how to create proactive methods for avoiding various hazards. There are array of techniques that many papers deals with it. However in this paper we are dealing with just classified data of soil water movement pathways and finding the deficit for predicting the sample data with test run using weka(Waikato tool for Exploring Knowledge and Analysis) tool of classification algorithms.

II. GLIMPSE OF CLASSIFICATION APPROACH IN DATA MINING

Classification is always we consider it as one of the challenging and major techniques deployed in data mining. While other can also be part of techniques such as clustering. In synonymous sometimes we interchange the classification with prediction. In real scenarios both are different classification refers to predictive of categorical values in predictive build models. In predictive model it is continuous. Such as fundamental of data mining text books always gives an idea of prediction like whether to play or not to play of outside is rainy. In this classical example we assume play is the class attribute. Based on our constructive parameters like play if yes or play with no the decision tree will be generated for indicative model on prior information as label of data sets like prediction to play or not.

K-Nearest Neighbors: This algorithm entirely divides the data set into two possible portions which are known as training set and test set. These sets in turns usually divided in the ration of 70:30[not as standard], 70% being assumed to be training set and 30% being assumed to be the test set. Then the algorithm uses the training set to adopt to train the model for accurate prediction. To check and validate the accuracy of the developed model it is later applied to the test set and a confusion matrix is built to show case how many records belongings to a particular attribute/ or labeled field have been correctly predicted.

Classification algorithms include: k-Nearest Neighbors, Naïve Bayes, ID.3, CART (Classification and Regression Tree), CHAID (Chi-Square Automatic Interaction Detector) and MARS which extends the learning decision trees in order to handle numerical data more précised values. K-nearest is however the most widely used classification algorithm which has its application in Concept building Search and Improved Systems.

Random Forest is a decision tree algorithm in classification of Data Mining which classifies the instances or records in the form of a tree. A large number or volume

data sets of classification trees are made in random forest approach. By default, the number of trees made by this algorithm is 100 to 500 but these can be increased or decreased or set as threshold as per requirements of the implementer. Every tree takes each of the instance or observation as input and then gives the output as leaf node by going through the different rules made by the tree based on pre training. The most common and discussed outcome for each observation is treated as the final output. A new observation is fed into all the trees as nodes and taking a majority vote or binning for each classification model. An OOB error known as Out-of-Bag error is estimated for the cases or samples which were not used as prior in building the decision tree. OOB is estimated as percentage.

III. IMPORTANCE OF SOIL WATER MOVEMENT PATHWAYS

We know that water is most important for human and as well as plant on the earth. It is necessary for all walks of life. The need of fresh water on sustainable basis is equal to precipitation which on an average 66 centimeters for the worlds geographical land surface. The soil which is located at the atmosphere and intersecting lithosphere interface, it always plays an important active role in determining the amount of precipitation that runs of the usage land mapping which in turn stores for future needs. As on records and general discussion 70 percentile of water source is always evaporates from plants and soils on holding land and which returns to atmosphere as vapor. In overall soil plays an important role in water retention and storage. The data of research or intention of our research understanding the role In the hydrological cycle and intelligently managing the water resources legitimately.

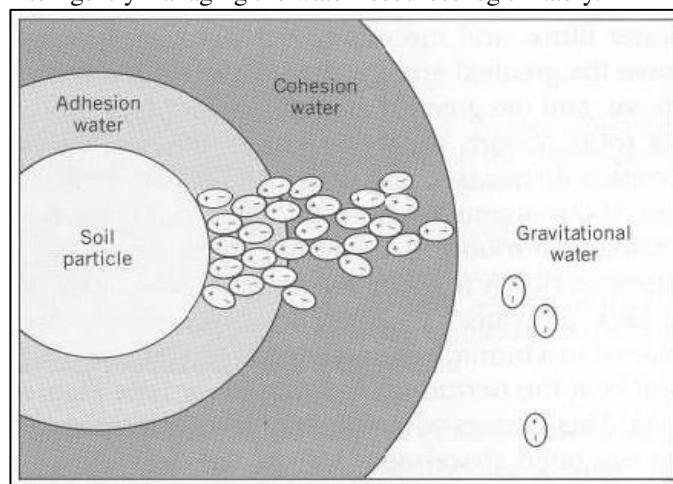


Figure 2. Schematic representation of various forms of soil water (source: Fundamental Principles of soil Science by Henry D Forth)

A. Adhesion water

In referring water platelets and other components, these water molecules (H₂O) are electrically neutral and charge within the molecules are asymmetrically distributed. As a result of this discussion water molecules are strongly bounded as polar and attract to each other with valence through H bonding. In atmospheric soil particles

combines both electrically negative and positive. In summation available many oxygen atoms are exposed on appearance of soil properties. In conjunction the positive poles of water molecules attract available negative water molecules resulting with strong adhesive forces. If single drop of water falls onto some cascaded dry soil encountered soil particles immediately absorbs and spreads themselves over the surface of soil particles to form a layering of water. This layer in general or film of formation of several water molecules in thick nature called as adhesion water. Some scholars have comprehension that innermost layer of water molecules exists as a form of crystalline structure which resembles as ice cubicles. Adhesion water is always shows the lowest energy level and most immobile water molecule which in return not useful either plant roots or microorganisms.

B. Cohesion Water

Molecule forces automatically reduce inversely and logarithmically along with distance from the surface of the water particle. However, when it reaches to the subsequent layer attraction of the particles is always less than the outermost layer. Water if it retained in soils just because of intrinsic cohesive forces. This is known as cohesion water. Around 20 to 25 molecules absorb water to soil particle surfaces with increase distance from the soil particles. At certain threshold water may slowly move towards roots that plant wilt because of scarcity of water. Then these plants as it reaches to wilted indicator placed in humid chambers to trace the exact wilting point.

C. Gravitational Water

Generally, in rainy season too much water flows into soil where claypans very slowly permeable subsoil permits water to store and retains but it never helps crops to yield as washes away with soil. As the rain continues water generally accumulates above the claypans from the bottom upward. This zone is called water zone of remaining period. The aeration pores are removed by draining out water because of force of gravitation. Gravitational water generally considered as detrimental creates oxygen deficiency.

D. Energy and Pressure Relationships

There is direct relation we can establish very easily between the water and pressure among water particles. Pressure can be easily found out but the energy in water more or less depends on the force of water.

E. Pressure Relationships in Saturated Soils

In classic example if we take beaker of 100 cm bottom size and water depth to be noted to 20 cms and it weighs around 200 grams the pressure p of the water at the bottom of beaker is equal to

$$P = \text{force/area} = 2000 \text{ g}/100 \text{ cm}^2 = 20 \text{ g/cm}^2$$

This in another way we can say at the 20 cm pressure is more and drastically it reduces to when 10 cm of level. This means water pressure decreases with distance by creating pressure of around 14.7 lb/in

F. Pressure Relationships in Unsaturated soils

Taking extension of above example if we insert a small diameter glass or capillary tube and insert into the water of beaker then due of adhesion of water molecules move towards interior wall of the tube. Generally due identification of cohesive forces between water molecules causes all other water molecules to move upwards. This experiment will clearly indicate that at even height of 20cm above the water surface the pressure remains the same. In this case its indicative that if two soil cohesion occurs due to equilibrium condition then pressure remains unaltered. Then we can draw the conclusion that

1. Water in unsaturated soil remains negative or under tension
2. It decreases the water pressure with increase distance with above the free surface of water molecules

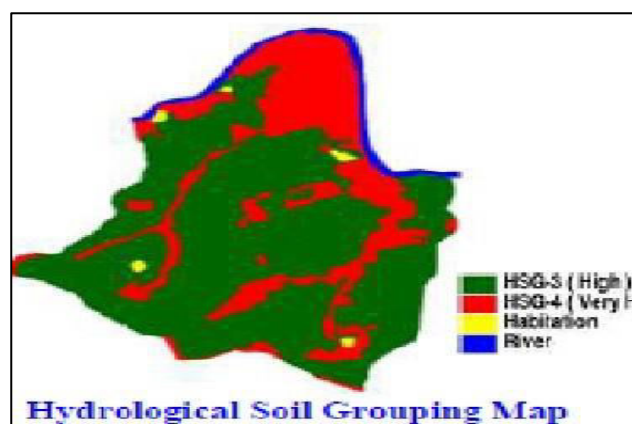


Figure 3. Hydrological soil Grouping Map of satellite image helps to find out the various water pressure (Image courtesy: Land Use and Survey Reports Bengaluru)

IV. SOIL WATER POTENTIAL

One of most discussion for finding pattern of classification is finding the energy of water in general we refer as soil water potential. The flow of water remains issue to research as either it reaches to bottom, or reaches to root or it reaches to above the tandem of flow all remains potential point to calibrate the soil water potential. Technical definition dictates that soil water potential is defined as the amount of work that must be carried out per unit quantity of water to trade in or move reversible without losing the energy of the soil either friction or isothermally. Symbolic notation of soil water potential is ψ . Total water potential as ψ_t and is made up of sub missive potential with gravitational metric and osmotic chamber.

A. The Gravitational Potential

The Gravitational potential of water is always defined due to the position of water which is available in gravitational field. It is always important to in water saturated soils. Primarily concern of gravitational is a potential movement of water through saturated soils or movement of water from high level points of cognition to low level passage.

B. The Metric Potential

The metric potential is generally referred when soil is unsaturated and contains no gravitational force among the water molecules then laterally water is moving from soil to plant roots. Here again the forces among the moment either adhesion and cohesion. These forces are closely affected by the size and nature of primary soil particles and peds of the soil. The resulting pattern among arrangement of surfaces and spaces which owes to soil structure and texture of the soil called as matrix. The culmination among the soil matrix and water potential termed as matrix potential. The analogues of nature are water is when rain falls on dry soil it automatically moves from pure source of water particles to soil. No specific energy or cohesive forces are required. In some cases, metric potential varies with content of soil water. The dry soil confronts with water molecules and becomes wet tendency of water releasing energy is more.

C. The Osmotic Potential

Sometimes osmotic potential creates havoc as it is caused by the forces involved in reacting and absorbing water molecules by ionic nature as it hydrates from the dissolution of soluble salt in reacting and creating osmotic potential. In other words, osmotic potential is defined the force of work that has been carried out in pulling the water molecules from the ionic or hydrated ions. The osmotic nature always deals with how effectively reduces the water uptake by roots, seeds and microorganisms. However, effect on water movement within the soil can be created as diffusion mechanisms to distribute water plates in equal to contribute equal soil distribution from one portion of the soil to another portion of the soil.

D. Measurement and Expression of water Potentials

We have conducted various soil measurement tests using andrino [tool] based circuit for water potentials or bucket testing measurements on sample soil. As gravitational potential is always measured distance between the referred soil surface point to the surface of water saturated soil or water table surface it can measure with scale or digital counter. Water reference column set for reading frequency expressed as bars that are approximately equal to atmospheres of scalable soil. Generally indicative bar is equivalent of 1020 cm of column of water in measurable quantity. There are several ways measuring tests can be carried out like vaccum gauge potentiometers etc. At equilibrium of measurable air pressure of 15 bars is equal to matric potential of -15 bars



Figure 4. Soil water potentiometers for measuring the matric potential (courtesy: Soil water movement procedure by H.Horde)

V. SOIL WATER MOVEMENT IN SELECTED PENINSULAR

In natural vegetation water movement generally occurs from soils to plant then from plant to roots as water goes from higher precedence to lower precedence of flow. In synonymous we can say higher energy water regions to lower water energy regions. The potential difference between two points is always been referred as potential gradient (t). The velocity of water direction is also implicit with soils ability to transfer water or hydraulic conductivity (k). It is like bandwidth of internet more data flows with higher the baud rate. Here water more flows with larger pores then the smaller pores. Therefore, we can frame the definitive equation like velocity of flow V is equal to the water potential gradient of time t with hydraulic conductivity k. mathematically we can express

$$V=kph$$

In other way ability of the soil to transmit water is determined by flow of its nature and size of water particle and water pores through which water flows. In this case K is constant conductivity and is related to pore size of water particle flows. In the case of saturated soil water content is easy and moves fast.

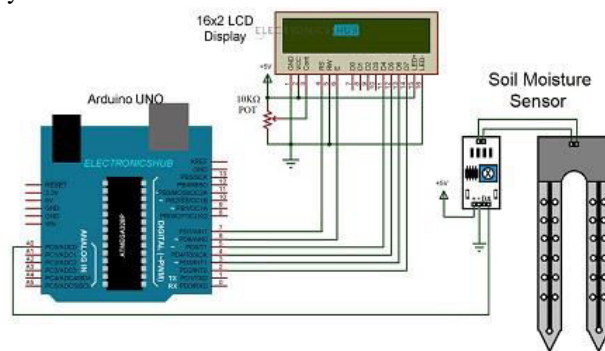


Figure 5. Soil moisture sensors to identify the density of pores and strength of water molecules (Image courtesy: Journal on Advance techniques of Agricultural Sciences by ICAR India)

A. Water movement in Saturated Soil

As we discussed in this paper potential gradient (ph) is the difference in between two referred potential water points. These points further if we divide by the distance which covers in cms or mtrs. Then h of water saturated soil and gradient f is inversely related to the flow through the soil which we refered. Therefore, it can be framed an equation like

F=h/d and now we can rewrite the equation V=kXh/d

Consider the quantity of water indicating Qw that passed through a soil or pipe depends upon the area of cross section and time taken to travel therefor the equation is

Qw=kh/d At. This equation in soil science referred as Darcy equation of water flow for potential movement. He was first person studied flow of water through medium of pores?

B. Water Movement in Unsaturated Soil

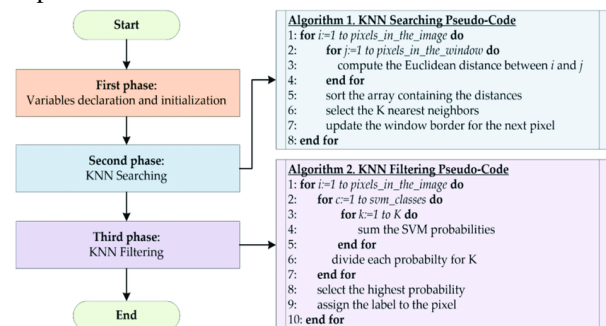
If water is allowed to drain out from saturated soil then water cycle immediately dries as it moves much faster with larger pores. If this process continues and draining slows down pores becomes smaller and after sometimes it becomes smaller due to dryness in soil. As gravitational forces are always dominant which attain the field capacity of the soil. In 1937 Dittmer a great soil scientist played an important in defining how unsaturated soil settles much faster than saturated soils. The person who found the wilting of the plant due to lack of water.

C. Water Movement in Stratified Soil

The most discussion part of soil and very generic nature is stratified soil. These soils have many layers or horizons with different specified physical properties resulting with various facts on hydraulic conductivity.

D. Building Data Mining Model for Deficiency Prediction.

One of the biggest challenges is to build the model which produces the results on validating certain term of slope. After collecting data on soil slope, we wanted to test on KNN algorithms which gives an idea of how segmented slopes needs to identify for deficiency prediction. Following representation gives of algorithm implementation.



VI. DATA SETS OF SOIL WATER CONTINUUM

Collection of data is carried out in rainy season of June to September of 2020. To collect data, we taken help from

Land usage mapping and panchayat members staff including PDO and Tahsildar of different zones.

Sl.No	Sampling place	No of Mapping Units	Total Area(Ha)	Total Area(%)
1	Nagenhalli	12	494	34.2
2	Harohalli	10	3564	18.6
3	Gantiganahalli	8	3320	34.2
4	SNhalli	9	14003	25.6
5	Avalahalli	12	2750	28.5
6	Sane	5	963	10.1
7	Hasarghatta	12	690	14.2
8	Rajankunte	16	558	31.2
9	Byatha	9	2460	16.3
10	Dibbur	12	1003	12.1

(Indicative of Sample Size only)

Table 1: Number of mapping units under different soil series

Sl.No	Depth Classes	Total Area	Area(%)
1	Shallow soils(d2)	4961	16.64
2	Moderately deep soils(d3)	9454	31.72
3	Deep Soils(d4)	9435	31.66
4	Very Deep Soils(d5)	2492	8.36
5	Misc	3463	11.62
Total		29805	100

Table 2: Distribution of area(ha) under different depth classes

Sl.No	Slope classes	Total Area (Ha)	Total Area (%)
1	Very gentle slope with terraced slope (0-3%)	494	34.2
2	Very gentle slope (1-3%)	3564	18.6
3	Gentle slope (0-5%)	3320	34.2
4	Gentle slope (3-5%)	14003	25.6
5	Moderate slope (5-10%)	2750	28.5
6	Strong slope (10-15%)	963	10.1
7	Gentle slope (3-5%)	690	14.2
8	Moderately steep slope	558	31.2
9	Steep Slope (25-33%)	2460	16.3
10	Misc	1003	12.1
Total		29805	100

Table 3: Data Indicators of Distribution of area under different slope classes

Sl.No	Erosion Classes	Total Area	Area (%)
1	Soil Erosion [e1]	3814	12.80
2	Moderate Erosion[e2]	18502	62.08
3	Sever Erosion[e3]	4026	13.51
4	Misc	3463	11.62
Total		29805	100

Table 4: Data Indicators of distribution of area under different erosion classes.

Sl. No	Sampling place	Range of pH		Range of Ec		Range of ESP	
		Value	Rating	V	R	V	R
1	Nagenhalli						
	Surface	6.58	Acidic	0.05	norm	1.24	Non salin
2	Harohalli	5.74	Acidic	0.01	norm	2.55	Non salin
	Subsurface	6.71	Alkaline	0.03	norm	0.70	Non salin
3	Gantiganahalli	4.86	Acidic	0.05	norm	1.75	Non salin
	Subsurface	5.28	Alkaline	0.02	norm	0.47	Non salin
4	SNhalli	7.65	Acidic	0.01	norm	0.87	Non salin
	Subsurface	6.16	Alkaline	0.04	norm	0.91	Non salin
5	Avalahalli	4.87	Acidic	0.01	norm	0.92	Non salin
	Subsurface	7.06	Alkaline	0.02	norm	1.23	Non salin

Table 5: Tabular distribution of series with soil and water health parameters



Figure 6. Agrosat Image captured for Land capability classification map with extracted above data table

VII. TOOL USED

In this paper we used Weka [Term can be expanded like Waikato Exploring Knowledge Analysis] was used for conducting and running tests on various data sets. Basically, this tool helps various statistical analyses within the specified environment. Graphical GUI compatibility is good and more suitable to use and apply various data pre-processing and applying Data mining Algorithms. In our case data collected is not massive a small amount data is processed for available data of water profiles. Following some advantages, we come across and few are

- 1) An effective data handling in pre-processing and converting csv into ARFF formats.

- 2) Various filter Algorithms that filters unwanted data into purged chamber for running sample data

VIII. RESULTS

K-NN is used to predict as expected soil water profiles and suitable characters we labeled to know which soil is suitable for which crop for production. Confusion matrix for K-NN analyses is done like prediction range with high, low and medium.

Predictions	High	Low	Medium	Class Error
K-Means	18	12	6	0.100000
Optimized K-Means	3	5	8	0.142856
Random forest	3	2	5	0.084231

Table 6: Confusion Matrix for various Algorithms run and its class Error indication table

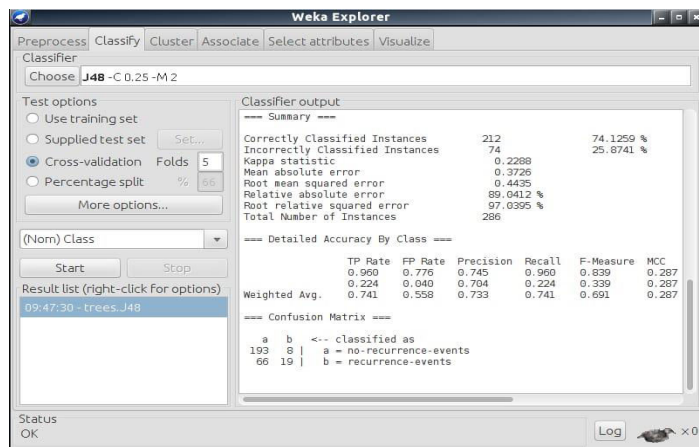
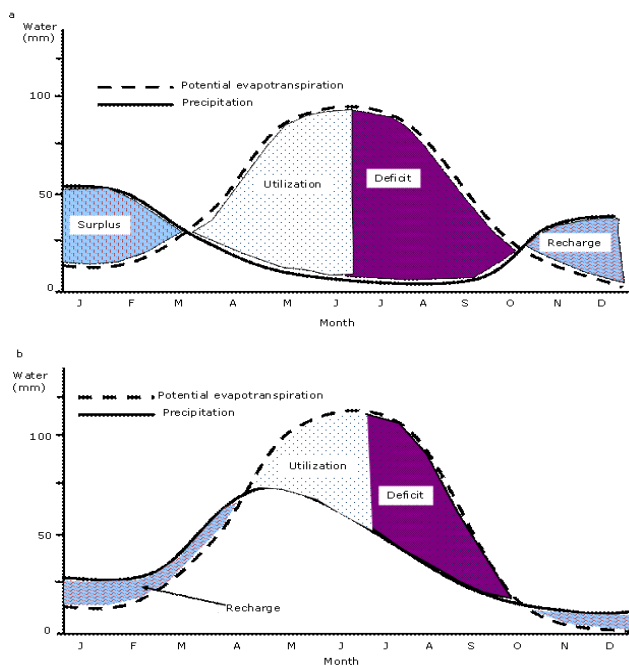


Figure 7. Screen template data exploration with weka



In many occasions slope prediction gives an idea to generalize the possibility of awareness among the different pattern of plants and what extent the loss can be received the following diagram represent the same ,

IX. CONCLUSION

In overall we can say analysis showed by the models made by random forest and KNN algorithms performance is very indicative as per our expected result. However, there are many gaps which we need to identify the rationalization of various attributes and labeling test data on sampling of water profiles. There are some misconceptions about handling agricultural data that it never produces accuracy of prediction but in our case, we are bit relieved as profile prediction and level of water potential in slope area is accurate and deficiency traced and recorded for the correction. Finally, we conclude random forest can be better than the KNN algorithms.

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Prediction of Agricultural Crop Yields Using Deep Learning Techniques

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ABSTRACT

Manual agricultural system deals with a large dataset and a large quantity of information method. To forecast crop and crop yield, a variety of techniques and approaches are used among that neural network is used to predict advanced system types that contain a large amount of data. A study of the use of the substitute neural network (ANN) for crop yield prediction is projected in this survey paper. This paper provides an overview of artificial neural networks. Parameters such as pH size, nitrogen, carbon, rainfall, temperature, soil, and phosphate are used. The crop yield is predicted using an Artificial Neural Network. This paper demonstrates the importance of system strategies such as Artificial Neural Networks.

Keywords — Artificial Neural Networks, Soil, PH, Phosphate, Nitrogen, Temperature, Rainfall

I. INTRODUCTION

One of the primary goals in agriculture is to get the most crop yield for the least amount of money. Detecting and resolving issues with crop yield indicators early in the rural field will result in increased yield and earnings. Massive-scale meteorological events can have a totally green effect on agricultural development by reading the weather styles of a particular area. Farmers may use crop yield forecasts to minimize losses when adverse weather conditions arise. Predictions can also be used to maximize crop prediction when the weather is favourable for farming.

Predicting crop yields in plants such as pulses, wheat, rice, sugarcane, and onion has always piqued the interest of Argo meteorologists, as these studies are crucial to a country's economics. It's an intelligent machine that uses meteorological data to make more precise predictions. There are many yield prediction models and applications available today, and they are divided into two groups: Crop Simulation Models (a) Statistical Models (b) Statistical Models (c) Statistical Models (d) Statistical Models (e) Statistical Model (e.g. CERES). Artificial Intelligence (AI)-based applications such as Artificial Neural Networks (ANNs) and Genetic Algorithms have recently proven to be more effective than conventional approaches in solving problems. Artificial intelligence can be used to make working models from complicated manual systems with several inputs simpler and more accurate. The creation of various crop yield prediction models using ANNs is the subject of this review paper. A farmer can use an Artificial Intelligence-based successful climatic factor-based Crop yield prediction very effectively if it is done correctly. Furthermore, a consumer may use Artificial Neural Networks to find the most powerful factors on crop yield. To deal with such a

scenario, "Artificial neural networks" (ANNs), a highly scalable solution, are rapidly emerging.

The feed-forward back propagation artificial neural network is the most commonly used ANN. The system has been used to model and forecast crop yields using a variety of predictor variables, including soil type, PH, Nitrogen, Temperature, Rainfall, Phosphate, Potassium, Organic Carbon, Calcium, Magnesium, Sulphur, Manganese, Copper, Iron, and Humidity. We looked at ANNs with zero, one, and two secret layers. MSEs have been used to determine the optimal number of hidden layers as well as the optimal number of units in each hidden layer.

II. LITERATURE SURVEY

[1] B. J. I. et al. created an application to forecasting rice yields in the planning phase using easy and precise estimation techniques. This research aimed to see whether an artificial neural network model could accurately predict rice yield for a typical climatic condition in the mountainous area. Analyse the efficiency of an artificial neural network model concerning several developmental parameters. Compare and contrast the efficacy of multiple linear regression models and artificial neural network models.

Year-round air temperature prediction models were constructed using Ward-style ANNs for prediction horizons of 1 to 12 hours, according to [2] B.A. Smith et al. During the winter, the ANN design modifications listed herein provided improved accuracy over previously established, winter-specific models.

[3] Mirschel et al. majestically launched an advanced hybrid of conventional non-linear regression techniques

for crop yields and specialist information databases, which was designed to forecast the spatial distribution of yields for a variety of arable crops such as winter wheat, winter barley, winter rye, winter triticale, spring barley, oats, potato, sugar beet, winter oil-

seed rape, and silt. The YIELDSTAT took into account several yield-inducing characteristics derived from weather, soil, relief, and management data, as well as long-term varying atmospheric CO₂ concentrations and the tendency due to advances in breeding and Argotechnology. They were evaluated successfully against the backdrop of recent yield findings from the German Federal State of Thuringia. It's worth noting that the YIELDSTAT accurately reproduced the observed results at all three scales, across all crops and scales.

III. PROPOSED SYSTEM

3.1 ARTIFICIAL NEURAL NETWORK

Artificial neural networks (ANN) are computational structures that process data in a manner similar to biological neural networks found in animal brains. Such Computational have the ability to learn from their interactions and perform tasks.

An ANN is made up of several small computing units called processing units that are linked in a complex communication network similar to that found in the human brain. An artificial neuron is a name given to each of these processing units. It is made up of input signals that have been given specific weights. The summation of the input weights and the output signal is computed by the processing function f . The ANN approach's main goal is to solve problems in the same way that a brain does. The aim of this paper is to discuss the ANN Approach for crop yield prediction in the agriculture sector.

As a result, the following neural network architectures will be examined in this paper:

- BACKPROPAGATION
- FEEDFORWARD

a) FEED FORWARD

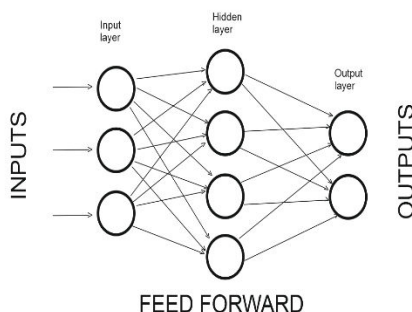


Figure 1: Feed Forward Propagation

These are networks that do not have feedback loops and therefore are referred to as feed-forward networks or perception networks. The flow is one-way only.

A node sends information to another node from which it has not received any. The input layer is represented by the nodes on the left. These neurons in the input layer distribute the inputs and do not perform any computations. Weights are allocated to each of the inputs.

The data is passed from the input nodes to the nodes of the first hidden layer, then the outputs from the hidden layer are passed to the next layer, and so on until the output is generated.

b) BACK PROPAGATION

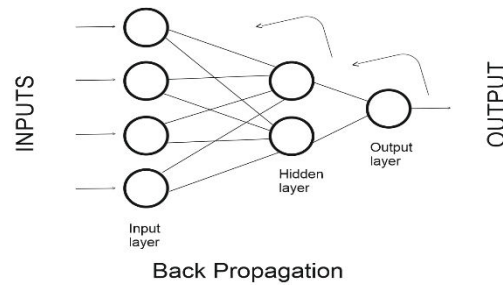


Figure 2: Back Propagation

This form of a neural network is known as a "backpropagation" neural network because of the way it is trained. Backpropagation is a method for supervised learning. The network must be given sample inputs as well as desired outputs when using this technique. Following the computations, the desired outputs are compared to the real outputs for specific input. The backpropagation training algorithm compares the target outputs to the real outputs, measures error, and changes the weights of the different layers backward from the output layer to the input layer accordingly.

The three steps of back propagation neural network training are as follows.

Phase 1: Feed Forward Phase

Phase 2: Back Propagation of Error

Phase 3: Weight Updating

3.1.1 INPUT LAYER

The data is presented in a vector format, with each pixel representing an attribute to be considered. The desired output is given in addition to the input in order to test the neural network's accuracy.

3.1.2 HIDDEN LAYER

Weights and thresholds are used in this layer to improve the attributes. This layer performs two different operations. Multiplication of weights and attributes is done first, followed by summation of all the results. Second, the output is generated using an integral over sigmoid function.

3.1.3 OUTPUT LAYER

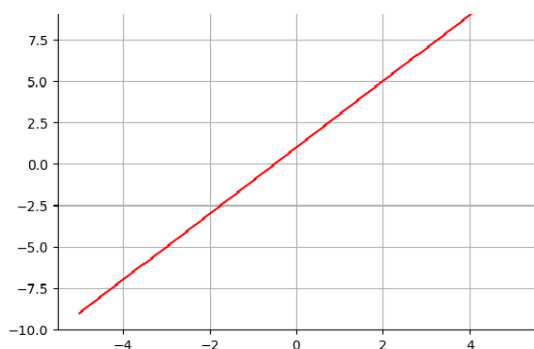
In order to achieve accuracy in the neural network, a contrast between the desired and real performance occurs in this layer. If there is a lot of dissimilarities, the feedback is sent to the hidden layer. Furthermore, the weights and attributes are permuted and combined in order to improve precision.

3.2 ACTIVATION FUNCTION

The hidden layer's next step is the activation feature. The Activation function is a function of the weighted number $y=f(x)$, which is the output of a neuron (y).

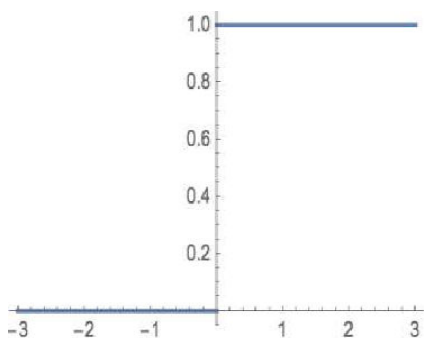
The activation function is used to predict the output in a format with values ranging from 1 to -1. The following are the various activation functions:

3.2.1 LINEAR FUNCTION



$f(x)=a+x$, where a is a bias

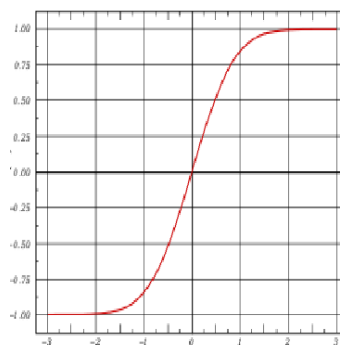
3.2.2 HEVISIDE STEP FUNCTION



$f(x)=\begin{cases} 1 & \text{if } x \geq a \\ 0 & \text{otherwise} \end{cases}$

3.2.3 SIGMOID FUNCTION

To use sigmoid functions, the values must be between 0 and 1. Any event's probability ranges from 0 to 1, with a minimum of 0 and a maximum of 1. As a result, when it comes to predicting the likelihood of such events, the sigmoid function is the highest. The sigmoid function's derivative can be found. The sigmoid function's derivative is a curve that connects two points.



3.3 CROP YIELD PREDICTION DESIGN FLOW

The following steps are involved in designing the proposed model system:

- Data Gathering and Preparation
- Create a model that predicts the outcome
- Classification
- Fertilizer recommendation for the crop

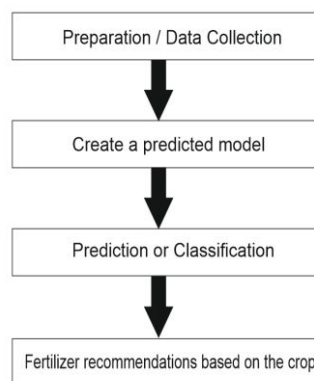


Figure 3: Flow of Design

3.4 PROPOSED SYSTEM FLOW CHART

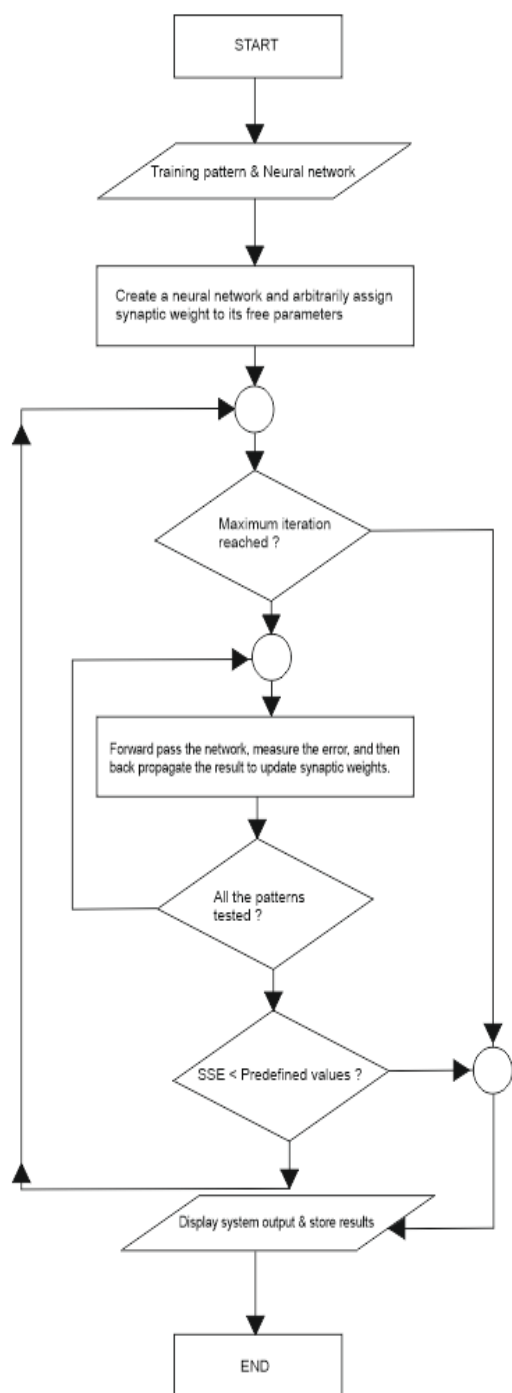


Figure 4: Flow Chart

3.5 PROCESS OF LEARNING NEURAL NETWORK

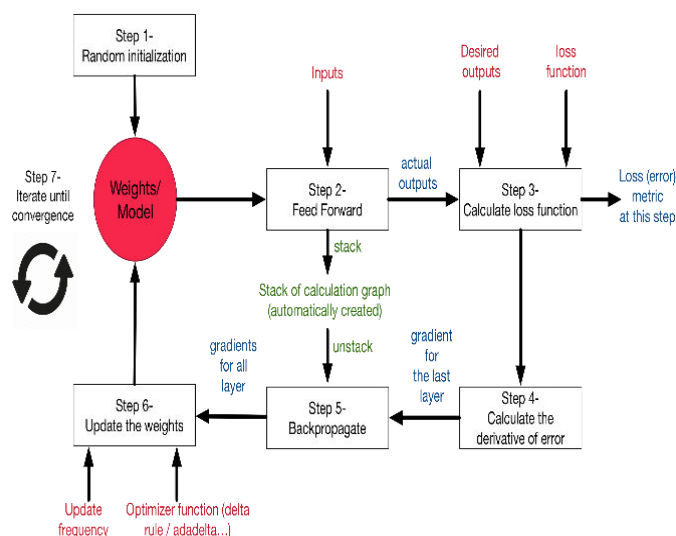


Figure 5: Neural Network Step by Step

IV. CONCLUSION

We're attempting to create a scheme that will aid the agricultural sector by using a 21st-century solution (ANN). Our research attempted to predict how a simple machine learning algorithm will alter the image of our country's agriculture. Our country has been heavily reliant on agriculture for a long time and has yet to make significant progress in bridging the gap between agriculture and technology. Our generation is now in a position where everyone is up to date on current events. As a result, it is past time for us to set our sights on a better future. In the agricultural sector, our government has already taken several positive steps. It is past time to go digital in this industry, so that not only the government, but also stockholders and society, will profit from it. To incorporate a digital agriculture framework for the best crop selection and yield prediction, we just need to take one small step. For crop prediction, ANN is a useful method.

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Comparison of Supervised Machine Learning Algorithms for Predicting Liver Disease

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ABSTRACT

Chronic Liver Disease (CLD) is the main cause of death worldwide, affecting a large number of people. This is a serious illness caused by a variety of factors that affect the liver Obesity, undetected hepatitis, and alcohol abuse are just a few examples. This is the cause of aberrant nerve function, blood in the cough or vomit, renal failure, liver failure, jaundice, liver encephalopathy, and many other symptoms. The diagnosis of this condition is both expensive and time-consuming. As a result, the purpose of this research is to assess the efficacy of various Machine Learning algorithms in order to lower the high cost of chronic liver disease diagnosis through prediction. We employed six different algorithms in this study: Logistic Regression, K Nearest Neighbors, Decision Tree, Support Vector Machine, Nave Bayes, and Random Forest. Different measurement approaches, such as accuracy, precision, recall, f-1 score, and specificity, were used to assess the performance of different categorization algorithms. For LR, RF, DT, SVM, KNN, and NB, the accuracy was 75 percent, 74 percent, 69 percent, 64 percent, 62 percent, and 53 percent, respectively. The research revealed that the LR had the best accuracy. Furthermore, the current study primarily focused on the use of clinical data for liver disease prediction, and we used our research to investigate several ways of expressing such data.

Keywords — Machine Learning, Liver Disease, Supervised Learning, Classification, Tree, Support Vector Machine, Naïve Bayes, K-Nearest Neighbours, Decision Tree, Random Forest, Regression.

1.INTRODUCTION

The liver is the body's largest organ, and it is responsible for processing food and releasing poisonous substances. Viruses and alcohol consumption both cause liver damage and bring a person to a life-threatening situation. Hepatitis, cirrhosis, liver tumours, liver cancer, and a variety of other illnesses affect the liver. Liver is one among them. Cirrhosis is the leading cause of death in the United States. [1]. As a result, liver disease is one of the world's most serious health issues. Every year, around 2 million individuals die from liver disease around the world. [2]. Cirrhosis claimed the lives of one million people in 2010, according to the Global Burden of Disease (GBD) research, which was published in BMC Medicine. Millions of people are affected by liver cancer. [3]. For the prediction and diagnosis of liver disease, machine learning has had a considerable impact on the biomedical area[4-6]. Machine learning promises to improve disease identification and prediction, which has piqued the biomedical community's interest. Additionally, they improve the objectivity of decision-making procedure[16]. Medical problems can be easily solved with machine learning techniques, and diagnostic costs can be decreased. The main goal of this research is to improve the accuracy

of prediction and lower the cost of diagnosis in the medical field. As a result, we employed various classification algorithms to determine whether patients had liver disease or not. Six machine learning approaches, including LR, KNN, DT, SVM, NB, and RF, were used, and their performance was evaluated from various angles. such as precision, recall, and f-1 score. Furthermore, the receiver operative characteristic was used to compare the results (ROC). The rest of the work is organised as follows: Chapter 2 discusses the dataset, data preprocessing, and methodology. The classification algorithms are described in Chapter 3. Measurement of Classification Techniques, Analysis, and Discussion are all covered in Chapter 4 of the report. of the Performance Evolution and the Results Finally, there's Chapter 5. The final portion is presented.

2. MATERIALS AND METHODOLOGY

2.1. Data Collection

We use a dataset from the UCI Machine Learning Repository in this experiment. Furthermore, the initial dataset was obtained in the northeastern Indian state of Andhra Pradesh [7]. There are 583 liver patients in this dataset, with 75.64 percent of male patients and 24.36 percent of female patients. This dataset contains 11

specific parameters, of which we chose 10 for further analysis and 1 for further research as a target class argument. Such as,

- I. Age: Age of the patient
- II. Gender: Gender of the Patients
- III. DB: Direct Bilirubin
- IV. TB: Total Bilirubin
- V. Alkphos: Alkaline Phosphatase
- VI. Sgot: Asparatate Aminotransferase
- VII. TP: Total Proteins
- VIII. Sgpt: Alamine Aminotransferase
- IX. AG Ratio: Albumin and Globulin Ratio
- X. ALB: Albumin
- XI. Selector field used to split the data into two sets. (labeled by the experts)

2.2. Preprocessing Of Data

We analysed the data of 583 liver patients in this study, with 416 samples from liver patients and 167 samples from non-liver patients. Figure 1 shows the ratio of total liver patients. Furthermore, 441 male samples and 112 female samples were taken from the liver patient's dataset for examination (Fig. 2).

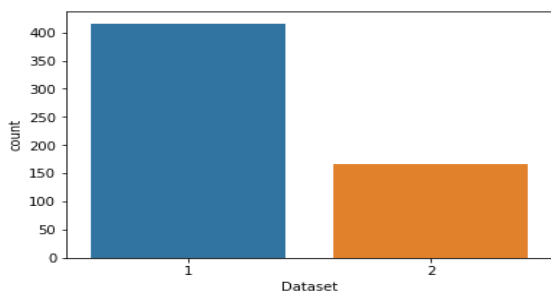


Fig. 1: Count Plot shows the ratio of liver patients.

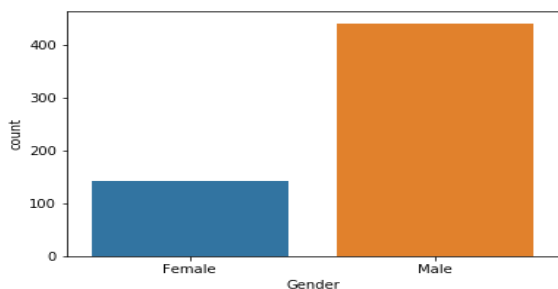


Fig. 2: Count Plot shows the ratio of gender of liver patients.

Figure 3 shows a heat map that appears to contain some connected factors. The correlation between some of these columns is minimal. As a result, some of the characteristics were eliminated in order to improve the prediction of liver disease.

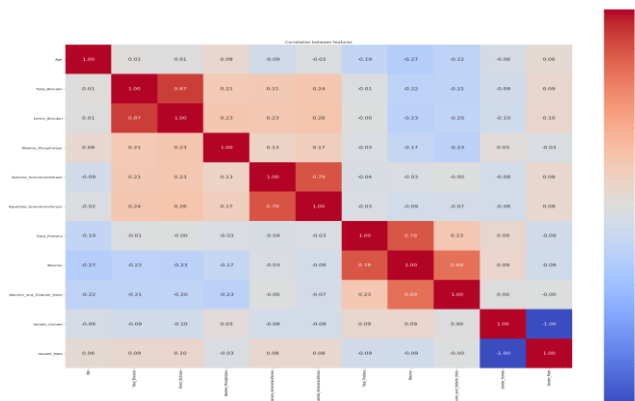


Fig. 3. For the liver dataset, a heat map was created to examine for connected columns.

2.2. Tool and Language

We used the jupyter notebook as a tool and Python 3.7 as a programming language in this research.

3 DESCRIPTION OF THE ALGORITHMS OF CLASSIFICATION

3.1. Logistics Regression (LR)

In the mid-twentieth century, calculated regression was mostly used in natural research and applications [8]. Logical Regression can cope with a wide range of numerical and non-numerical variables. It also includes a standalone parallel processor. Item with a value between 0 and 1. Strategic Regression examines the relationship between the component elements by polling probability (p) based on an underlying logistic model perform the following is the regression equation:

$$(1)$$

3.2. Random Forest (RF)

Random forests, also known as random choice forests, are a type of ensemble learning methodology for classification, regression, and other tasks that works by creating a large number of distinct models. At training time, decision trees are used to determine which class is the best Classification method (classification) or mean forecast (regression) of the individual trees. For decision trees' proclivity for overfitting to their training set, random decision forests are ideal. There has been an instant connection between the combination trees and the outcome it can achieve in the forest of trees. To make increasingly accurate and effective predictions, The random forest adds an extra layer of irregularity to the equation stowing [10].

3.3. Decision Tree (DT)

The supervised learning algorithms include Decision Tree calculations [12]. A decision tree approach, unlike other supervised learning algorithms, can also be used to solve regression and classification problems. Using Decision Tree, the main thought process is to create a training model that may be

used to forecast class or estimate objective characteristics by incorporating choice standards based on previous data (training data). In Fig. 4 we have shown a sample picture of decision trees.

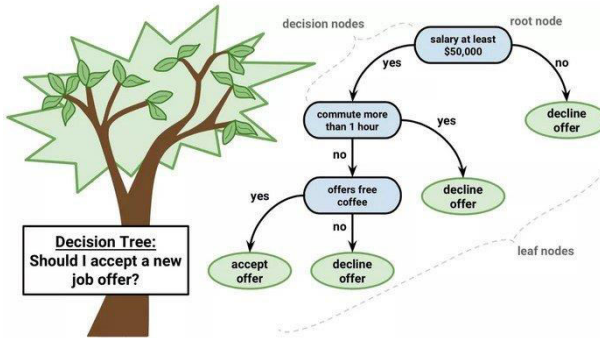


Fig. 4: Sample of the process of Decision Trees.

3.4. Support Vector Machine (SVM)

SVM is a supervised learning calculation. It can be used for both grouping and relapse concerns, but it is more commonly used for characterisation issues. SVM works well for some human services problems and can understand both linear and non-linear problems. SVM grouping approach is an attempt to divide a dataset into two classes using a linearly separable hyperplane [5-11]. Finally, the model can accurately predict the goal groups (labels) for new cases. Training for SVM Classification Type 1 entails the minimising of the error function:

(2)

In contrast to Classification SVM Type 1, the Classification SVM Type 2 model minimizes the error function:

(3)

3.5. K-Nearest Neighbors (KNN)

In Machine Learning, KNN is one of the most fundamental occasion-based classification algorithms. In any case, the KNN makes a stab at the idea that comparable cases should be grouped together[14]. A KNN sorts an example to the class that is most decided among K neighboring. K is a limitation for adjusting the classification algorithms [17].

3.6. Naive Bayes (NB)

One of the most fundamental, effective, and widely used AI approaches is Naive Bayes.

It is a probabilistic classifier that classifies utilizing the speculation of restrictive freedom with the pre-trained datasets [15]. From now on, Naive Bayes classifiers are processes for determining the traditional arrangement of grouping issues, such as spam detection.

In addition, it's a good suit for medical difficulties in general. Bayes' Theorem calculates the probability of an event occurring given the likelihood of a previously occurring event.

The following equation expresses Bayes' theorem mathematically:

$$P(A|B) = \frac{P(B|A) \cdot P(A)}{P(B)}$$

(4)

4 RESULT AND DISCUSSIONS

4.1. Measurement of Classification Techniques

In this work, we used some realistic estimations to measure the test execution of various categorization algorithms. Various evaluation methodologies, such as accuracy, f1 measure, sensitivity, specificity, and accuracy were used to measure the categorization techniques' performance. As a result, the confusion matrix determines the exhibition evaluation variables. True Positive (TP): The prediction result correctly identifies a patient as having liver disease. False Positive (FP): A patient's liver illness is wrongly identified as a result of a prediction. True Negative (TN): The prediction result accurately rejects a patient's diagnosis of liver disease. False Negative (FN): The prediction result mistakenly eliminates the possibility of a patient having liver disease. Using the prediction model, the precision provides the contrast between sound and patient capacity ratio. The true positive, true negative, false positive, and false negative is used to determine the precision of classification.

(5)

The affectability test determines the patient's ability to identify themselves from their liver condition. It mostly demonstrates the test's positive results. It additionally is known as Recall and True Positive Rate (TPR).

(6) Particularity is demonstrating the disease's detrimental consequences. It reveals the degree of the patients' undiagnosed sickness. It's also known as the True Negative Rate (TNR).

Specificity=

Positive predictive value is another term for precision. It shows the percentage of correctly anticipated positive outcomes using classifier algorithms.

Precision=

F1 uses a combination of accuracy and recall to assess the model's precision. It calculates a model's FP and FN proportions.

F1= (7)

4.2. Analysis of the Result

In this experiment, we looked at a variety of analyses to see how well the six-machine learning classifier performed on the liver illness dataset. In terms of accuracy, LR had the best performance (75%), while NB had the weakest performance (53%). In terms of precision, LR comes out on top achieved the greatest score of 91 percent, while NB had the lowest score of 36 percent. When it came to sensitivity, SVM had the greatest score of 88 percent and KNN had the lowest score of 76 percent. In terms of f1, Logistics Regression was the top performer. NB had the weakest performance of the group, with a score of 53%. When it came to specificity, DT had the greatest score of 48 percent and LR had the lowest score of 47 percent. When these measurement criteria are compared, the LR classification approach outperforms the other classifiers in predicting chronic liver disease. . The confusion matrix of prediction results is shown in figure 5. The performance comparison of six supervised machine learning techniques is presented in figure 6.

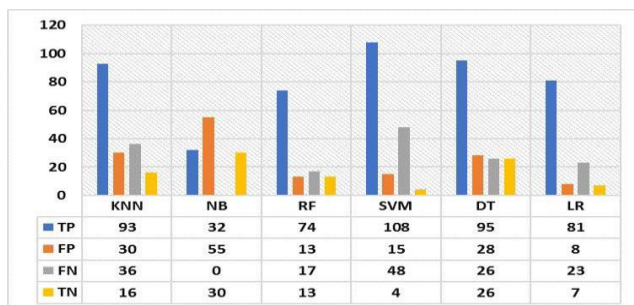


Fig. 5: The Confusion Matrix of prediction results.

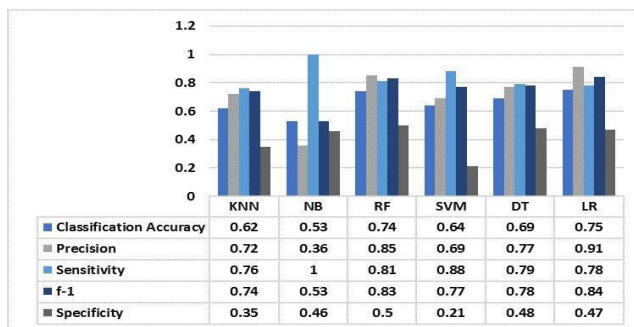


Fig. 6: The performance comparison of six supervised machine learning techniques.

The Receiver Operating Characteristics (ROC) are shown in Figure 7.

The performance of machine learning algorithms is represented by the ROC curve, which is based on the true positive rate. These classifications have a true-positive rate (TPR) and a false-positive rate (FPR) in the end result. Moreover, SVM achieved the highest AUC (area under the curve) for ROC.

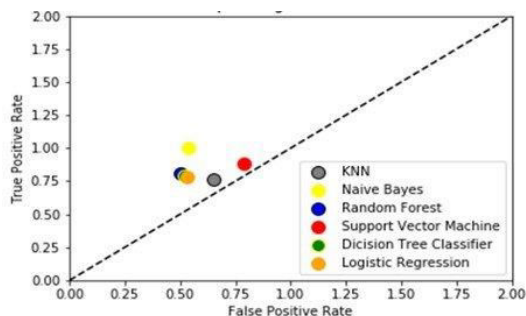


Fig. 7: Receiver Operating Characteristics (ROC).

5 CONCLUSION

The main goal of this project is to develop a reliable diagnosis method for patients with chorioc liver infection by combining six different supervised machine learning classifiers. We investigated the performance of all classifiers on patient information parameters, and found that the LR classifier has the highest order exactness (75%). NB is reliant on the F1 metric to predict liver disease gives the lowest precision (53%). The outperform classification process will now be used for the decision support system and chronic disease diagnosis. The app will be able to predict liver illness in advance and provide advice on how to stay healthy. This application can be unexpectedly profitable in low-wage countries where there are few medical foundations and professionals. A few bearings for future work in this topic can be found in our research. More algorithms can be chosen to create an increasingly exact model of liver illness, as we just looked at some popular supervised machine learning methods. Prediction and performance can both be improved over time. Furthermore, this discovery is poised to play a vital part in health-care research as well as therapeutic approaches to prevent liver infection.

ACKNOWLEDGMENT

The authors express their gratitude and delight to all of the researchers involved in this study.

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Diabetes Disease Prediction using Machine Learning Ensemble Method

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ABSTRACT

Machine learning incorporates AI, and is used to solve many problems in data science. The machine reads patterns from existing databases, and then inserts them into an unknown database to predict the outcome. Classification can be a powerful machine learning method commonly used for prediction. Some classification algorithms provide satisfactory accuracy, while others provide restricted accuracy. This paper examines a method called ensemble classification, which is often used to improve the accuracy of weak algorithms by combining multiple categories. Tests for this tool are performed using a diabetic database. A comparative analytical approach was performed to find out how the ensemble process is often used to improve diabetes prognosis. The goal of this paper is not only to increase the accuracy of weak classification algorithms, but also to implement an algorithm on a medical database, to demonstrate its ability to detect the disease at an early age. The results of the study indicate that integrated strategies, such as the random forest, are effective in increasing the predictive accuracy of weak classifiers, and have shown satisfactory effectiveness in identifying the risks of diabetes. A seven-point increase in the accuracy of the weak classifiers was achieved with the help of an ensemble classification.

Keywords: Machine Learning; Classification; Random Forest; Ensemble Classification; Weak Classifiers.

INTRODUCTION

Diabetes is a chronic disease that has the potential to cause health care problems worldwide. According to the International Diabetes Federation 382 million people are living with diabetes worldwide. By 2035, this could double as \$ 592 million. DM can be a disease caused by high blood sugar levels. A variety of traditional methods, both physical and chemical tests, are available to diagnose diabetes. However, early diagnosis of diabetes is a difficult task for medical professionals due to severe dependence on a variety of factors as diabetes affects human organs such as kidneys, eye, heart, nerves, foot. By shedding new light on common questions. An important function is to assist and make predictions on medical information. The ultimate goal of this project is to develop a system that can enable the early diagnosis of diabetes in a patient with better accuracy by combining the results of various ML methods. Therefore, this project uses one among the study methods of ensemble classification called random forest to predict the risk of diabetes in hazardous substances. It also attempts to increase the accuracy of predicting the risk of diabetes using a strategy called ensemble.

LITERATURE SURVEY

[1] Ayman Mir, Sudhir N. Dhage. (2018). Diabetes Disease Prediction using Machine Learning on Big Data of Healthcare. In this research project, four variables based on the machine learning algorithm namely Naive Bayes, Support Vector Machine, Random Forest and Simple CART were used to test the WEKA tool for predicting diabetes. The construction of the four dividers is thus compared based on training time, testing time and accuracy. Another method of performance measurement

was a standard accuracy measurement that included TP measurement, FP measurement, precision, recall, F-Measure. The full functionality of the Random Forest to predict diabetes is better than the Naive Bayes, the Vector Support Machine and a simple Cart Cart. The effectiveness of the proposed model is therefore clearly expressed in all the stated test results.

[2] S Somannavar, R Deepa, M Deepa, V Mohan, M Datta (2015). India's Simplified Diabetes Risk Assessment for Undiagnosed Diabetes Articles. The aim of this study was to develop and validate a simple Indian Diabetes Risk Score for undiagnosed diabetes in India. Risk factors were taken from the Chennai Urban Rural Epidemiology Study (CURES), an ongoing study of infectious diseases in people representing Chennai. Phase 1 of CURES employs 26,001 people, from whom every tenth article is requested to participate in phase 3 diabetes screening using the World Health Organization (WHO) 2 hour venous plasma glucose criteria [i.e. ≥ 200 mg / dl]. The response rate was 90.4% (2350/2600). The Indian Diabetes Risk Score [IDRS] was developed based on the results of several systemic regression analysis. Internal verification was performed on the same data. IDRS used four risk factors: age, obesity, a family history of diabetes and physical activity.

[3] Rajawat, P. S., Gupta, D. K., Rathore, S. S., & Singh, A. (2018). Medical Data Prediction Analysis using the Hybrid Machine Learning Technique. How to learn a Hybrid Machine to guess if a person is at risk for diabetes. Hybrid Technique comes out with 81.33% accuracy which is better than SVM, ANN, KNN. The hybrid process with

MLP, RF, and XGB is used as base classifiers. The voting method is used over base classifiers. The proposed hybrid process has done much better than previously used techniques but there is still room for improvement. Other strategies can be explored to improve performance results.

[4] Rasheed, Jamil, A. Yahyaoui, A., J., & Yesiltepe, M. (2019). Diabetes Guarantee Decision Support System Using Mechanical Learning Methods and Advanced Learning Methods. This paper has performed comparative analysis of machine learning and in-depth algorithms based on studies to predict diabetes. The results showed that RF was more effective in the diagnosis of diabetes across all cycles of trials that produced a complete accuracy of the diabetes forecast to 80.67%. The predictive accuracy of SVM has reached 65.38% while the DL method generates 76.81% in our database. In the future we would like to improve the implementation of the feature by using the default method of extracting the feature and finding the appropriate model to improve the prediction accuracy.

[5] Ramzan, M. (2016). Comparing and evaluating the performance of WEKA separators in critical diseases. This activity examines disease classification using three different machine learning algorithms with the WEKA Tool. The results we compare in terms of time taken to build the model and its accuracy. WEKA is an effective and superior method of data mining. This work demonstrates that Random Forest is an excellent disease classification separator with the WEKA tool because it works well on large databases. Next time we will apply different partitions to different data sets and evaluate the performance of each separator. Naive Bayes, J48 Decision Tree, Random Forest is used to compare critical disease predictors using the WEKA tool. The Random Forest

#	Column	Non-Null Count	Dtype
0	Pregnancies	768 non-null	int64
1	Glucose	768 non-null	int64
2	BloodPressure	768 non-null	int64
3	SkinThickness	768 non-null	int64
4	Insulin	768 non-null	int64
5	BMI	768 non-null	float64
6	DiabetesPedigreeFunction	768 non-null	float64
7	Age	768 non-null	int64
8	Outcome	768 non-null	int64

emerges with high accuracy hitting both Naïve Bayes and J48.

METHODOLOGY

A. Data Source

The data is gathered from UCI repository which is known as Pima Indian Diabetes Dataset. The dataset has many attributes of 768 patients.

B. Class Imbalance Problem

SMOTE: Synthetic Minority Oversampling Technique

SMOTE is an oversampling method where the synthetic selected samples are produced for the minority

class. This algorithm is used to overcome the over fitting issue posed by random oversampling.

C. Proposed System

To develop a web application where:

For diabetes prediction:

1. The user enters the data manually with attributes such as their Age, insulin level, BMI, and etc.
2. The data collected from user through the application is further processed using the machine learning model.
3. The prediction for the individual instance of data is done.
4. The predicted result is displayed on the web application.

For risk calculation of diabetes:

1. The user enters the 4 parameters – person physical activity, person’s family history, age and abdominal obesity.
2. The data collected from the user through the application is used by the python program to calculate the risk of diabetes.
3. The calculated score is displayed on the web application

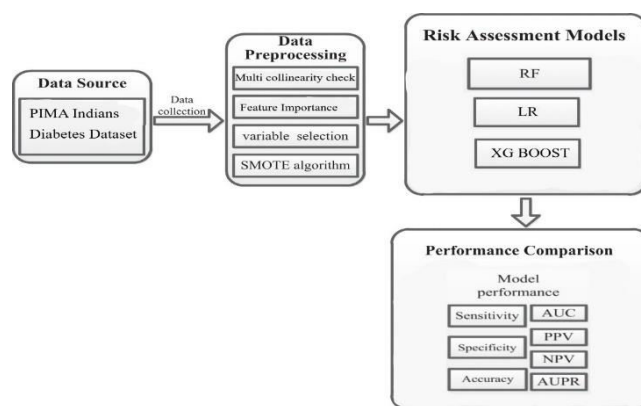


Fig: Proposed Architecture

The following figure depicts the approach that has been applied to perform the comparative analysis in order to recommend the best algorithm for building classification model in order to predict the diabetes disease.

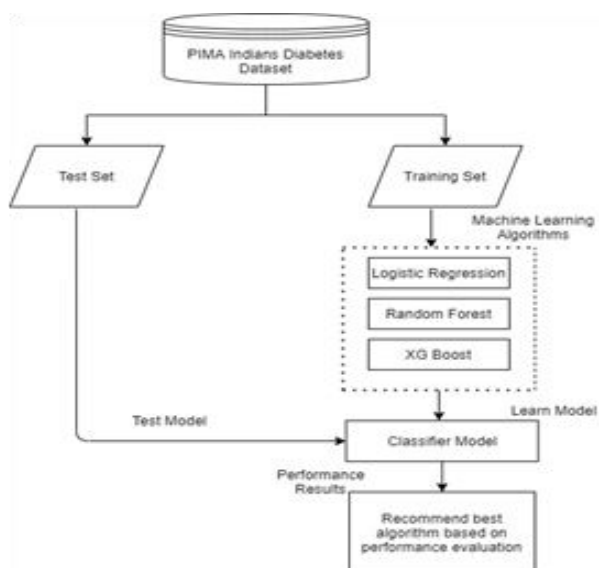


Fig: Proposed Methodology Flowchart

Stepwise Procedure of Proposed Methodology

- Step 1 – Perform data preprocessing on the input dataset of diabetes disease.
- Step 2 - Split the dataset by 80% to divide dataset as Training set and Test set
- Step 3 - Select the machine learning algorithm i.e. Random Forest, Logistic Regression and XGBoost.
- Step 4 - Build a classification model from the selected machine learning algorithm based on training set.
- Step 5 - Test the classifier model for the selected machine learning algorithm based on test set
- Step 6 - Perform Comparison Evaluation of the experimental performance results obtained for each classifier.
- Step 7 - After analyzing based on various measure conclude the best performing algorithm.

D. Description of Algorithms

Ensemble methods are the classifier combination methods that combine multiple machine learning techniques into one powerful predictive model.

The two categories of ensemble methods used are:

1. Bagging

Bagging method creates the classifiers parallelly. The base learners in bagging are independent of each other and results in the decrease of variance. It bootstraps the subsamples and then aggregates the results over the weak learners, hence the name Bootstrap Aggregation.

1. Random Forest

Random Forest is a bagging ensemble technique that utilizes decision tree as the base learner. The sample of records is created using row sampling with replacement and feature sampling. Each of the decision trees is

provided with the set of records for training. For a given test data, majority vote is performed on the predicted results and the cardiovascular disease prediction is done.

2. Logistic Regression

Logistic regression (also known as logit regression) is a statistical representation that in its basic form uses a logistic function to model a binary dependent variable.

3. Boosting

In boosting technique, the base learners are created sequentially and combined to form a strong learner to increase the accuracy. The objective here is to train the weak learners successively, each trying to rectify the formerly misclassified records.

a. Extreme Gradient Boosting

XGBoost provides the gradient boosting framework that braces many languages like C++, R, Python, and Java. The proposed work is developed using python programming. XGBoost is a good candidate for cloud integration. The pros of using xgboost are cache optimization, speed, portability, regularization, and auto pruning

E. Model Performance Measures

1. Confusion matrix:

For binary classification, it is a 2 x 2 matrix. It describes four important properties of any model. These properties are used as input to various performance measures.

- a. True Positive (TP): The number of instances correctly predicted as a patient.
- b. False Positive (FP): The number of instances incorrectly predicted as a patient.
- c. True Negative (TN): The number of instances correctly predicted as healthy.
- d. False Negative (FN): The number of instances incorrectly predicted as healthy.

		Predicted	
		0	1
Actual	0	TN	FP
	1	FN	TP

2. Performance Measures:

- a. Accuracy: The proportion of correct predictions form an overall number of predictions. Mathematically, this can be stated as:

$$\text{Accuracy} = (TP + TN) / (TP + FN + TN + FP)$$

- b. Sensitivity or Recall: The proportion of correct positive classifications from instances that are actually positive. Mathematically, this can be stated as:

$$\text{Sensitivity} = TP / (TP + FN)$$

- c. Specificity: The proportion of correct negative classifications from instances that are actually negative. Mathematically, this can be stated as:

$$\text{Specificity} = TN / (TN + FP)$$

RESULT & DISCUSSION

This project intends to design and implement a web application for the prediction of diabetes disease, Risk factor for obtaining diabetes for undiagnosed diabetic patients and to analyze the effective performance of the applied ensemble techniques. Random Forest attained an accuracy of 90 percent. By solving the class imbalance problem, the prediction accuracy of the model was increased. The accuracy has been computed using the Confusion Matrix Metric and ROC Curve Metric.

Table 1 depicts the ensemble classification methods that are applied for diabetes disease prediction and their corresponding accuracies. It is inferred that the efficiency of random forest is high when compared to decision trees.

TABLE 1: Comparison of classification techniques

ALGORITHM NAME	ACCURACY
Random Forest	0.9065161868651518
Logistic Regression	0.8168451358615254
XGBoost	0.8495852868852459

CONCLUSION

In the proposed work, a web application is developed to predict the threat of diabetes disease and calculate the risk factor for diabetes for undiagnosed diabetic patients. It is perceived that the bagging algorithm, random forest renders highest accuracy when contrasted to other algorithms.

FUTURE WORK

Various web and mobile applications can be developed to diagnose other chronic diseases like cancer, cardiovascular, arthritis, etc. The work can be blended with IoT for real-time prediction. The diabetes disease

prediction can be done using artificial neural networks or through machine learning cloud platforms for improved accuracy.

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A Survey of Different Aspects of Neuromorphic Computing

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ABSTRACT

The expression "neuromorphic computing" alludes to a wide scope of cerebrum enlivened machines, frameworks, and models that contrast from the broadly utilized von Neumann machine engineering. This naturally enlivened technique created firmly connected manufactured neurons and neurotransmitters that can be utilized to display neuroscience speculations and tackle troublesome AI issues. A few specialists have as of late exhibited the abilities of Hopfield calculations in various enormous scope, notable equipment adventures, and have made an impressive achievement. We give a compact outline of neuromorphic figuring science and thought processes during its set of experiences in this paper. We arrange neuro-roused models, calculations and learning approaches, equipment, and gadgets, supporting advancements, and executions as neuro-enlivened models, calculations, and learning draw near.

I. INTRODUCTION

The primary flood of man-made consciousness (AI) was rules-based, copying traditional rationale to come to normal results inside a firmly characterized issue area. It was all around custom-made to assignments, for example, measure control and execution improvement.[1]. The new age is generally worried about detecting and insight, for example, examining the substance of a video outline utilizing profound learning organizations. Man-made intelligence would be reached out into fields that lead to human discernment, like insight and self-sufficient transformation, in the coming decade. This is vital for settling the "fragility" of AI arrangements zeroed in on neural organization preparing and deduction, which depends on strict, deterministic perspectives on occasions that need significance and sound judgment appreciation [2].

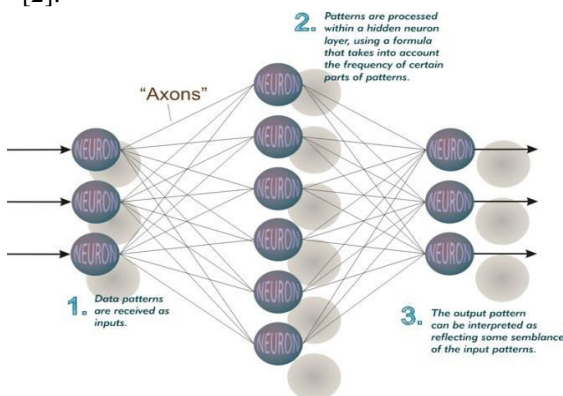


Fig. 1. Transformation of Neuromorphic computing.

Fig. 1. Shows the transforming of neuromorphic computing.

II. LITERATURE SURVEY

1. TRANSFORMATIONS ON NUERORPHIC COMPUTING IN 2017.

1.1. The human brain is the source of inspiration for neuromorphic computing.

Neuromorphic computing uses the architecture and dynamics of the human brain to produce energy-efficient hardware for information processing, allowing it to do very complex tasks [3]. The creation and utilization of neural organizations are essential for neuromorphic figuring. It attracts motivation from the human cerebrum request to make central processors that can consolidate memory and calculation [5]. Neurotransmitters permit direct memory admittance to the neurons that interact with data in the human mind. Biophysics and neural processing, just as the making of functional inconsistent message circuits for fake neural organizations, have spellbound electrical designers for quite a long time [2]. Working across an expansive scope of fields, from electron gadgets to calculations, is a test. Practical use of neuromorphic systems, on the other hand, will be employed in everyday life, and this alone makes them interesting. [9]. The human brain has a baseline energy footprint of around 20 watts, which allows it to process complicated tasks in milliseconds as a wonderful product of evolution. The act of transporting data from memory to a processor and back causes delay and consumes a significant amount of energy [4].

1.2. Developing computers that is inspired by the human mind.

Neuromorphic technology, then again, is nearer than you would anticipate. Past examination and guess, Intel's Neuromorphic Lab fostered a self-learning neuromorphic

research chip known as 'Loihi' from the outset. In September 2017, Intel launched Loihi, their sixth neuromorphic microprocessor, as a primary research processor. It has gone a long way since then. Lihi, Intel's selected name for the chip, means 'long' in Hawaiian, and is the newest — also referred to as youngest— active undersea volcano in the Hawaiian–Emperor seamount chain, a line of volcanoes off the coast of Hawaii. Now let's return to the chip. Loihi is a multicore neuromorphic processor with on-chip learning capabilities [3]. More than 2 billion semiconductors, 130,000 counterfeit neurons, and 130 million neurotransmitters are remembered for Intel's 14-nanometer Loihi processor. The Loihi microprocessor has several first-to-market innovations, such as customizable synaptic learning principles. The neuromorphic processor, according to Intel, is the next-generation Artificial Intelligence enabler [6]. The fig. 2. shows the brain inspired computing and important device.

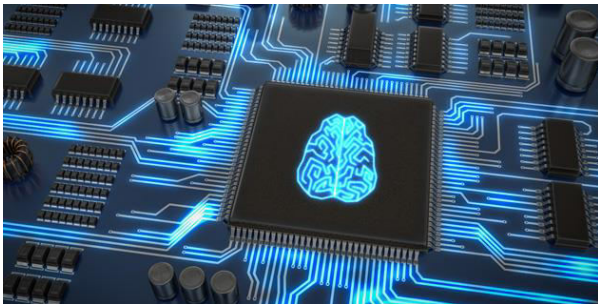


Fig. 2. Brain Inspired Computing & Device

2. TRANSFORMATIONS ON NUERORPHIC COMPUTING IN 2018.

2.1. Multi-memristive neurotransmitters in neuromorphic figuring.

Neuromorphic registering has arisen as a suitable way ahead in the advancement of the up-and-coming age of astute PC frameworks. It has been proposed that memristive gadgets with history-subordinate conductivity regulation may address synaptic loads in counterfeit neural organizations viably [6]. Although, maintaining high network accuracy requires precise regulation of device conductance across a broad dynamic range, which is proving difficult. Most neural organizations are carried out on PC frameworks with unmistakable memory and preparing units, which is one reason for their shortcoming [4]. There have been a couple of endeavours to create particular neuromorphic equipment that is enhanced for neural calculation execution [7]. In any event, the space capability of these handcrafted structures will be restricted due to the method they are regularly constructed utilizing regular silicon fundamental metal oxide semiconductor (CMOS) equipment, especially if in situ learning and non-capricious synaptic direct are necessary [9].

Synaptic effectiveness and plasticity are two important synaptic characteristics that memristive devices must imitate. The making of a synaptic yield contingent upon approaching neuronal movement is alluded to as synaptic viability [11]. The synaptic yield is delivered in non-spiking fake neural organizations (ANN) by increasing the

genuine esteemed neuronal action with the synaptic weight. The utilization of nanoscale gadgets to acknowledge synaptic elements in a conservative and force-effective way has shown guarantee [7]. These memristive gadgets store data in their opposition/conductance states and regulate conductivity dependent on their programming history. When the presynaptic neuron fires in a spiking neural organization (SNN), the synaptic yield is for the most part a sign corresponding to the synaptic conductance [9]. Synaptic adequacy might be estimated utilizing Ohm's law with memristive gadgets by estimating the current that courses through the gadget when an appropriate read voltage signal is provided. Synaptic versatility, then again, alludes to a neurotransmitter's capacity to change its weight, as a rule during the execution of a learning calculation. Potentiation alludes to an expansion in synaptic weight, though wretchedness alludes to a decrease. The loads in an ANN are regularly altered dependent on the backpropagation interaction. Nearby learning standards like spike-timing-subordinate pliancy (STDP) or regulated learning calculations like NormAD may be used in an SNN [11]. Synaptic versatility is created in memristive gadgets by conveying appropriate electrical heartbeats that influence the conductance of these gadgets employing different actual cycles.

2.2. The multi-memristive neurotransmitter thought is portrayed schematically.

The aggregate conductance of N devices represents the synaptic weight in such a synapse. The all-out powerful reach and goal of the neural connection are improved by using various gadgets to show synaptic weight [8]. An information voltage identical to neuronal movement is applied to all segment gadgets to accomplish synaptic viability. The complete of every gadget's bends. Just a single gadget out of N is chosen and customized at a time to execute synaptic versatility. The fig. 3. shows the complementary metal-oxide semiconductor.

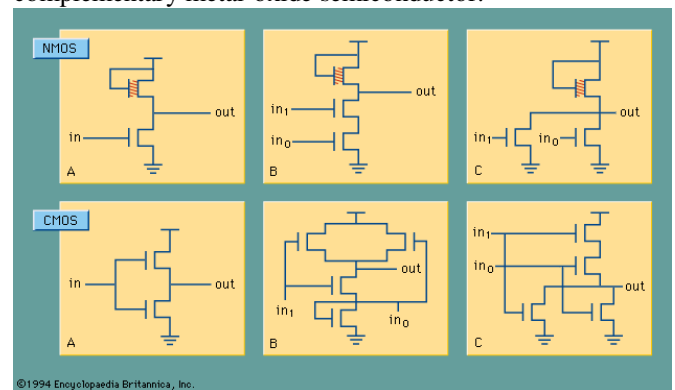


Fig. 3. Complementary metal-oxide semiconductor

3. TRANSFORMATIONS ON NUERORPHIC COMPUTING IN 2019.

In 2019 technology, such as GPUs and most AI accelerators, neuromorphic devices add a degree of parallelism that does not exist. Even-though, the present profound learning frameworks utilize standard field-programmable door clusters (FPGAs), focal preparing

units (CPUs), and design handling units (GPUs) to work with fundamental neuromorphic frameworks, processors are especially worked to play out these errands may change registering [6]. Artificial neurons and artificial synapses imitate the activity spikes that occur in the human brain, and neuromorphic chips perform all of this processing on the chip [12]. As a result, computer systems become smarter and more energy-efficient.

As of late advanced examination on neuromorphic registering, which is viewed as the equipment speed increase of cerebrum propelled processing, has been perhaps the most versatile insights and is generally utilized in an assortment of utilizations going from fundamental neuroscience exploration to design acknowledgment and man-made consciousness.

3.1. Issue in 2019.

This exceptional issue gives an inside and out take a gander at new materials at the bleeding edge of neuromorphic figuring. Inside the system of mind enlivened PC techniques, we analysed novel materials and novel applications for existing materials, going from spiking organizations to oscillator organizations to repository figuring to profound neural organizations [6]. Materials science, physical science, science, software engineering, and designing from an interdisciplinary methodology.

The flexibility of the human brain is also imitated. If a core stops operating, the neural network chooses a different path, much as the brain adjusts to bypass the neuron and form a new neural network in the event of synapse failure.

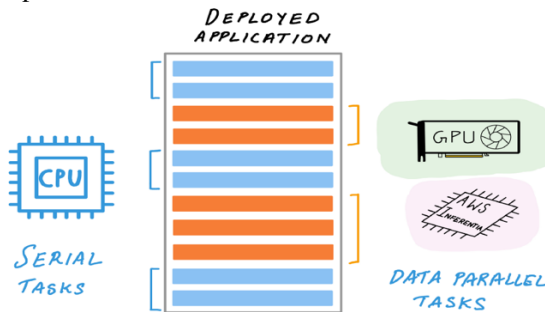


Fig. 4. Guide to AI accelerators for deep learning inference

4. TRANSFORMATIONS ON NEUROMORPHIC COMPUTING IN 2020.

Scientists have long been interested in the human brain's capacity to process large volumes of data while using very little energy. The brain ramps up computing when it senses a necessity, but it quickly returns to a baseline condition [10]. Such efficiency has never been conceivable in the world of silicon-based computing. Massive quantities of electrical energy are required to process big amounts of data. Furthermore, the situation becomes significantly worse when artificial intelligence (AI) and its relatives' deep learning and machine learning are included [10].

4.1. Functioning of Neuromorphic process.

Neuromorphic processing involves assembling counterfeit neurons that work on similar standards as the human cerebrum. Its fake parts send information along these lines to organic neurons, electrically throbbing just when a neurotransmitter in a convoluted circuit has assimilated sufficient charge to create an electrical spike [10]. It looks to repeat how the human mind works, which incorporates more than 100 billion neurons and neuromodulators that change shape contingent upon the main job.

It uses Spiking Neural Networks (SNNs), in which each "neuron" transmits its own signals to other neurons. It is designed according to the characteristic neural organizations seen in natural minds [5]. Every "neuron" in the SNN may fire autonomously of the others, and thusly, it sends beat signs to different neurons in the organization, changing their electrical states straightforwardly [11]. SNNs duplicate characteristic learning measures by progressively remapping the neurotransmitters between fake neurons in light of contributions by installing data inside the actual signs and their planning. Spike responses can be modified to reflect a range of values rather than a binary "0" or "1," providing an analogue flavor that is more in line with how the brain operates. Furthermore, because neurons only operate when they are stimulated, they do not consume energy continuously, conserving energy. As a result, it consumes significantly less electricity and weighs significantly less than today's personal computers.

While it appears to be a fascinating field to investigate, researchers have had little success due to the fact that human brains work differently from the conventional computer architectures that produce the present algorithms [7].

4.2. Areas of Application.

We are still in the early phases of implementing neural-inspired computing. While Intel and Sandia's cooperation intends to research AI in commercial and defense applications, there aren't many examples. Self-driving automobiles, categorizing vapors, detecting an individual's face out of a large number of random photos, and other applications have all been investigated [4]. Neuromorphic computers, according to researchers, will boost machine learning in more complicated sectors like remote sensing and intelligence analysis. It's also been used in numerical algorithms and computational physics simulations. Fig. 5. explains the evolution of neuromorphic hardware.

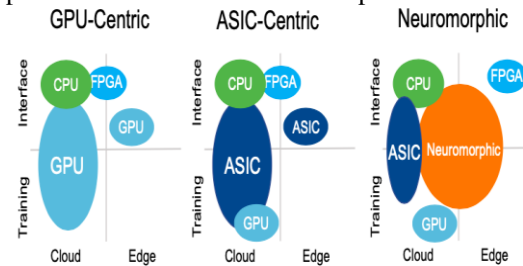


Fig. 5. Evolution of the neuromorphic hardware.

5. NEUROMORPHIC COMPUTING IN 2030.

What would Neuromorphic Computing make feasible in 2030?

Assuming we live in 2030, we can instantly connect with digital interfaces now. We can instantly communicate our schedules to smart assistants like Google Home or Alexa. Neuromorphic figuring, a juncture of neuroscience, microelectronics, and AI that emulates the human mind as a fake neural framework, has opened up a huge number of additional opportunities [6].

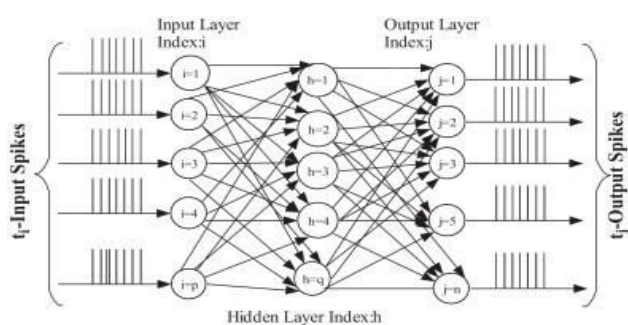


Fig. 6. Hidden Layers

The above fig. 6. shows that the hidden layers of neural frame work.

5.1. Medical Diagnosis.

To comprehend how Neuromorphic Computing works, we must first comprehend how the human brain works. Neurons, which make up billions of cells in the nervous system, make up the human brain. These neurons interact with one another by an encoded signal that is unique to each of them.

A neuromorphic device analyses data using artificial nodes that duplicate synapses, same as neurons interact with other neurons through synapses. In the end, neuromorphic computing is based on an organic electrochemical transistor that manipulates the input basis alterations to produce the output [5][4].

Neuromorphic circuits have quickly progressed from the lab to commercial applications by 2030. The true value of Neuromorphic Engineering is that it improves the accuracy of AI judgments that mimic unpredictable human behavior. Its goal is to fix all probable deep learning flaws as quickly as possible [6][9].

III. CONCLUSION

Not with standing the way that neuromorphic registering has gotten a ton of consideration lately, it is as yet viewed as a youthful innovation. At the equipment or programming level, most present arrangements centre around a solitary application, and the greater part of them are just equipped for dealing with few applications. Moreover, while numerous product-based neural organization applications have been carried out, the neuromorphic configuration has depended vigorously on equipment-based neural organization design. To apply a straightforward and speedy plan methodology to neural organization equipment that can enhance and create neuromorphic figuring frameworks, the necessities of the product computation measure should be efficiently bound

together. As a result, using neuromorphic chips, the system learns as it goes, much like people do. A new strain of peculiar assistants may arise, assisting people in learning tasks, a development with far-reaching economic and societal implications.

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