EAST POINT COLLEGE OF ENGINEERING & TECHNOLOGY

Jnana Prabha Campus, Virgonagar Post, Avalahalli, Bengaluru-560049

Accredited by National Board of Accreditation CSE,ECE & ISE

Department of Electronics & Communication Engineering

NGIEC - 2024

National Conference on Next Generation Intelligence in Electronics & Communication Engineering

9th May,2024

ISBN : 978-81-977986-9-6

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NGIEC 2024

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Department of
Electronics & Communication Engineering

National Conference
on
Next Generation Intelligence in Electronics and Communication Engineering

9th May 2024

NGIEC 2024

Bengaluru| Karnataka | India

Dedicated to our
Beloved
Honorable
Founder Chairman

Late Dr. S.M. Venkatpathi
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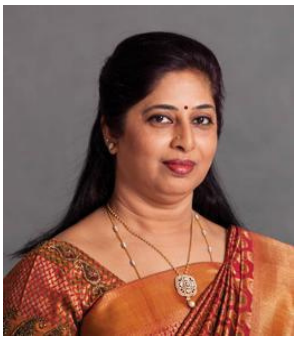

It is indeed our pleasure and privilege to host the National Conference on "Next Generation Intelligence in Electronics and Communication Engineering" (NGIEC) on 9th May 2024 at EPCET, Bangalore.

This conference provides a platform which brings Academicians and Research Scholars from across the country under one platform to discuss about their latest research ideas, results, potential applications in the areas of Electronics & Communication Engineering, Electrical & Electronics Engineering.

I extend my best wishes to entire organizing team and committee members in bringing out this proceeding on the occasion of the National conference. I extend my greetings and best wishes to all the participants and wish this conference a grand success.

B L Ramadevi Venkatapathi

EAST POINT COLLEGE OF ENGINEERING & TECHNOLOGY

Sri. S. V Pramod Gowda

CEO,
East Point Group of Institutions, Bengaluru, Karnataka, India

It is a great pride to host the National Conference on "Next Generation Intelligence in Electronics and Communication Engineering" (NGIEC) on 9th May 2024 at EPCET, Bengaluru.

The emerging technologies are the key to future socio-economic growth of any developing country and today's challenge is to build cost effective solutions using recent technological developments.

This conference offers a platform for Research scholars, Faculty and Students from across the country to present and discuss their latest research ideas which will go a long way in enriching the knowledge to generate new ideas and solutions for the upcoming challenges.

I wish the participants of this conference to come out with new inventions and innovative ideas which will contribute for the advancement of global technology. I wish all the success to the conference.

S V Pramod Gowda

EAST POINT COLLEGE OF ENGINEERING & TECHNOLOGY

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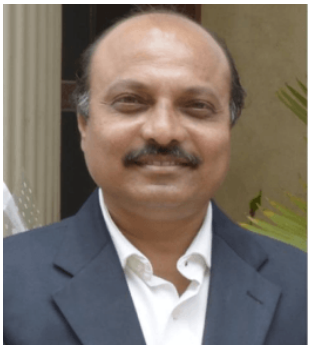
S V Rajiv Gowda

EAST POINT COLLEGE OF ENGINEERING & TECHNOLOGY

Dr Prakash S

Senior Vice President,
East Point Group of Institutions, Bengaluru, Karnataka, India



I would like to Congratulate the Department of Electronics and Communication Engineering, East Point College of Engineering and Technology for organizing the National Conference on Next Generation Intelligence in Electronics and Communication Engineering (NGIEC-2024)" on 9th May 2024.

The conferences are necessary to bring in culture of information exchange and feedback on developing trends in technologies. The Conference aims to bring different ideologies under one roof and provide opportunities to exchange ideas face to face, to establish research relations and to establish future collaboration.

The themes and sub-themes for this conference are indicative of relevant research areas to give the prospective authors innovative prepositions about the ambit of discussion. It is incredibly important to have such a range of Researchers and Engineers from industry and academia working together across diverse disciplines with different perspectives and unique ideas to discuss opportunities for advancements. I am sure the deliberations of this conference will be an enlightening and enriching experiences for all the participants.

I wish the entire organizing team and Committee members of NGIEC-2024 who have taken initiative in the direction of encouraging young Engineers, Researchers and Scholars I wish this conference a great success.

Dr Prakash S

EAST POINT COLLEGE OF ENGINEERING & TECHNOLOGY

Dr Mrityunjaya V Latte

Principal ,
East Point College of Engineering & Technology,
Bengaluru, Karnataka, India

It is a matter of great pride that the Department of Electronics and Communication Engineering, East Point College of Engineering and Technology is organizing the "National Conference on Next Generation Intelligence in Electronics and Communication Engineering (NGIEC-2024) "on 9th May 2024.

This conference will benefit the Faculty, Students and Researchers immensely and widen the horizons of their knowledge in Engineering and Technology. Certainly, this type of conference not only brings all the researchers, students at one platform, but it also inculcates the research culture among the entire fraternity of Education in the country, thereby contributing to the development of nation.

I sincerely appreciate the effort of the Department of Electronics and Communication Engineering in providing a platform for students, academicians, researchers to share their ideas and research outcomes through the forum of this conference.

I wish all the best to the participating Research Scholars, students and faculty in this endeavor. My best wishes to the organizing team of NGIEC-2024.

Dr Mrityunjaya V Latte

EAST POINT COLLEGE OF ENGINEERING & TECHNOLOGY

Dr Yogesh G S

Vice Principal & HOD Dept of ECE,
East Point College of Engineering & Technology,
Bengaluru, Karnataka, India

"Unite, innovate and redefine the future"

It gives me immense pleasure to host the "National Conference on Next Generation Intelligence in Electronics and Communication Engineering (NGIEC-2024) " at our department on 9th May 2024. I am pleased to welcome all the dignitaries, delegates and participants for this National Conference.

I am sure that this Conference will provide a forum to distinguished Researchers from academia, Students and industry to interact and be involved in research and innovation. The conference provides a platform for Researchers to get networked and exchange the ideas on various area of Electronics & Communication Engineering, Electrical & Electronics Engineering, Interdisciplinary areas of Robotics, Internet of Things, Artificial Intelligence, Machine Learning etc.

The conference has peer reviewed process for all the articles to maintain the quality interactions and publications by taking feedback from reviewers.All these efforts undertaken by the Organizing and Technical Committees has led to an exciting, rich and a high quality technical conference program, featuring high-impact presentations for all attendees to enjoy, appreciate and expand their expertise in the latest developments in various areas.

I wish this conference a great success.It is my humble wish that the knowledge sharing among the researchers, scientists, engineers, students and educators continues beyond the event and that the friendships and collaborations forged will linger and prosper for many years to come.

I wish the conference all the very best and urge all participants to brainstorm on the various thrust areas of the conference.

DR YOGESH G S

EAST POINT COLLEGE OF ENGINEERING & TECHNOLOGY

Aloke Kumar Das

Keynote Speaker
Senior Member, IEEE Chair
CEDA, Bangalore
Fellow IEI Director, Lab and Lectures

It is a pleasure to note that the Department of Electronics and Communication Engineering, East Point College of Engineering and Technology is organizing the "National Conference on Next Generation Intelligence in Electronics and Communication Engineering (NGIEC-2024) "on 9th May 2024. Conferences of this nature provide a platform to young researchers, faculty members and industry professionals to present their research and development work and get feedback and suggestions to improve their quality of work.

In the present era, topics such as Robotics, Internet of Things, Artificial Intelligence, Machine Learning etc. have been witnessing fast developments both in the research and technology development directions. This Conference will provide an opportunity to exchange ideas on latest technologies and applications pertaining to above topics and thus serve very useful to students, researchers, and practicing industry professionals.

I take this opportunity to express my sincere appreciation to the organizing team of NGIEC-2024 in providing a platform for students, academicians, researchers to share their ideas and research outcomes I am sure the delegates will carry with them pleasant memories of the Conference.

I wish the delegates very productive technical interactions and wish the conference a grand success.

Regards
Aloke Kumar Das

INSTITUTE VISION

The East Point College of Engineering and Technology aspires to be a globally acclaimed institution, recognized for excellence in engineering education, applied research, and nurturing students for holistic development.

INSTITUTE MISSION

- **To create Engineering graduates through quality education and to nurture innovation, creativity and excellence in teaching, learning and research.**
- **To serve the technical, scientific, economic and societal developmental needs of our communities.**
- **To induce integrity, teamwork, critical thinking, personality development, and ethics in students and to lay the foundation for lifelong learning.**

DEPARTMENT VISION

The Department aspires to be a center of excellence in Electronics and Communication Engineering to develop competent and ethical professionals through holistic development.

DEPARTMENT MISSION

- **To impart quality education and provide a conducive environment for innovation and Research.**
- **To develop skills to meet scientific, technological, and socio- economic needs.**
- **To inculcate professional ethics, teamwork, leadership qualities, and lifelong learning.**

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"ENHANCING FISHERY SUSTAINABILITY THROUGH IOT-ENABLED ENVIRONMENTAL MONITORING"

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***Abstract*— Since there are already 7.7 billion people on the planet and this number is rising daily, there is a corresponding rise in the demand for food. Vitamins, minerals, protein, nutrients, and micronutrients are all abundant in fish. It plays a significant role in consumers' diets, particularly in developing and impoverished nations. It's a difficult task. farmers to supply the market with wholesome seafood. One way to close the gap between the availability and demand of sea food is through aquaculture. Aquaculture production in controlled environments has increased significantly, but losses from manual equipment and poor management are still very high. Accurate and up-to-date information is essential for farmers to evaluate and optimize their output potential. Farmers are raising aquaculture utilizing conventional methods and practices. Farmers measure and manually monitor the aquaculture's water quality, water level, oxygen level, and stress level using a traditional method. In this work, we presented a smart aquaculture model based on the Internet of Things that will monitor the water quality (pH, temperature, turbidity, and fish motion detection) for aquaculture. This work monitors and controls aquaculture in real time using a low-cost, short-range wireless sensor network module. Additionally, a water recycling system is suggested to lower the quantity of aquatic waste products. This system uses a serial port to monitor water conditions continually, which lowers internet use, transmits data often with minimal latency and error-free, and guarantees the survival of aquatic life. guarantees the growth's quality and raises aquaculture's financial gains. Additionally, the device tracks the motions of the fish in the pond.**

Keywords—*UIV sensor, aquaculture, PH, turbidity, and the Internet of Things,*

I. INTRODUCTION

Aquaculture include the breeding, growing, harvesting, and seaweed, algae, and fish farming, among many other activities. Another definition of it is breeding species, which grow in an aquatic habitat under carefully monitored circumstances . One of the most dependable and environmentally friendly methods for providing high-quality protein for people is aquaculture. Due to higher food convergence, this procedure is more efficient than other types of agriculture. Globally, aquaculture has gained popularity. Asia makes up 40.1 percent of the world's overall fish production and 88.5 percent of the world's total aquaculture production . Aquaculture performance has been rising faster in South Asia, particularly in the previous 15 years. Among the seven According to UNFAO, all of the Southeast Asian nations—Indonesia, Malaysia, Myanmar, the Philippines, Cambodia, Malaysia, Thailand, and Viet Nam—rank among the top five in terms of aquaculture volume, with Cambodia's productive inland fisheries coming in at number one. Currently, fisheries in Pakistan only account up 0.4% of the country's GDP, and the industry's over 350 million dollars in exports seem to be at pause. Pakistan, in contrast to other South Asian nations, is not living up to its full potential. Bangladesh contributes approximately 3.69 percent of the GDP, whereas India makes up approximately 1.70 percent. The development of aquaculture has received 54% of all investments made in the fisheries sector in Bangladesh. Comparing commercial aquaculture technology in Pakistan to other sectors like agriculture, it is trailing behind. Comparing commercial aquaculture technology in Pakistan to other sectors like agriculture, it is trailing behind. Farmers deal with numerous issues, such as water rescores, hand water testing, abrupt changes in climate, lack of government involvement, etc. Manual testing is exceedingly challenging, in contrast to the daily observation of the behavior and health of thousands of aquaculture individuals . Other issues include poor site selection, inadequate record keeping, water quality, and incorrect management strategies. Conventional methods of assessing water quality has established a fixed point monitoring system and is unable to alter the dynamic of aquaculture water quality monitoring . In Pakistan, aqua farmers now rely on manual water parameter testing. As a result, fish mortality rates rise and growth rates fall. of the fish, and a significant disadvantage is the increased time commitment. Operators of fish ponds must deal with the difficulty of continuously checking the water and adjusting it so that quality is not compromised. The approach presented in this article will let fish farmers use IoT to monitor fish ponds. incoporating internet and sensor technologies with a

An easy-to-use interface for smartphone applications, desktop applications, and web services allows for real-time fish pond monitoring; the system database greatly lowers the possibility of losses and boosts productivity. Additionally, a GSM modem is utilized, which lowers internet usage. The primary problem in the field region is the internet. Internet access is required when using an Android or web application; otherwise, a GSM modem will send a notice when a parameter exceeds a predetermined range. The suggested method would use a water filtration plant to raise the water's quality. By implementing the suggested system, we will lower costs, boost fish yield, and reduce loss and boost aquatic life's

survival rate. There are many of chances to make fish farming better. Water quality is critical to success and directly affects fish output generation; in aquaculture farms, temperature, PH, dissolved oxygen, and turbidity are the most significant characteristics for all species . For aquaculture, drinking water treatment facilities, and other associated businesses, water quality is crucial since contaminated water not only causes losses of aquatic items, but they can pose serious risks to human health [8]. The most crucial factors for aquatic life are temperature, turbidity, pH, and dissolved oxygen. Each fish needs a proper habitat to flourish. We need to use the Internet of Things (i.e., sensors, controlling system, telecommunication system, mobile devices, and solar system) to accomplish the highest quality output. In order to begin, we cover a number of topics in this article, including an overview of aquaculture, issues that arise in the industry, solutions for those issues, and the advantages. In this, we go over a variety of studies on aquaculture systems, the opportunities in this field, and the topics that this work will focus on. The suggested system is presented in the Methodology chapter along with a thorough explanation of the hardware and/or software. The Experimental Results section displays the characteristics, a few pictures, and the outcomes that were achieved using the system. We're thinking back on this work to wrap things up. For this task, we outline the benefits and recommend the next stages of the work.

II. Literature Review

Initially Water quality was monitored using conventional techniques, where samples were collected and sent to a chemical laboratory. hazardous material analysis laboratory. The system's downside is that all processing, including measurements, system maintenance, and control, is done by hand. However, the manual method took a lot of time. A few earlier research included the models used for water monitoring, such as forecasting and integrated models , however these systems were unable to collect data in real time or conduct online monitoring. Thus, it may be stated that these models are IoT is one of the rapidly expanding technologies of the past few decades, however it's not ideal for monitoring fish. Identification, tracking, monitoring, and localization of objects are the goals of the Internet of Things , along with communication and device interconnection. Numerous devices are designed for real-time monitoring in remote places, thanks to the development of novel sensor technologies, wireless telecommunication technology, and data transmission technology . Numerous research have addressed the impact of fluctuations in water quality on the growth of aquatic life . Most investigations made extensive use of sensors , however

The cost of managing these sensors is high, but the majority of papers focus on a small number of sensor types, such as PH, DO, temperature, turbidity, and water level . They also offer solutions to the problems because not all of the parameters are stable enough to monitor on their own; in fact, if one parameter is unstable, it can cause other variables to become unstable , which is why these parameters are chosenThe suggested architecture makes use of several sensors, including motion detection, turbidity, PH water level, and temperature. Arduino is used to configure these sensors. Uno for underwater sensing and measurement observation. The authors' prior suggested methods for storing output data included cloud databases , which increased the architecture's cost due to its high internet usage. To reduce this consumption The computer system functions as a server host to compute and handle the output values supplied by the sensors. This allows for easy management of the data and least internet cost retrieval for the user.. The former uses the local database to help with analytics and to take proactive action when necessary. the majority of models with concentrate on transmitting the sensor data, but in our model we also address the factors that affect fish growth and offer an appropriate solution if a parameter exceeds the bounds indicated in Table 1 below. Our primary goal is to cut back on internet usage. The primary issue in field regions is internet access. To mitigate this, we are lowering internet consumption and using GSM modems to deliver messages in the event that internet access is unavailable. Additionally, we are using desktop and Android applications for the formersDeclining water quality is becoming a major problem on a global scale. The usage of fresh water resources will eventually gain significant importance and become a fundamental issue . The life of the fisheries aquaculture water is directly correlated with it. Fish health is immediately impacted by very low water quality, which leads to a reduction in fish productivity. Water quality is determined by measuring many parameters such as ammonia, turbidity, corban dioxide, nitrite, and nitrite concentrate. However, temperature, pH, dissolved oxygen, turbidity, and water level are crucial factors to consider.

III. Parameters

Physical Water Quality Parameters of Aquaculture The way water is used affects its structure, which changes according to climatic trends. The objective of effective management of fish culture is to regulate this structure to yield optimal outcomes. Farmers must understand the There are chemical and physical components that affect water quality, such as dissolved oxygen and pH, as well as temperature, turbidity, and water level.

A. Temperature

The most significant factor that greatly affects chemical and biological processes is temperature. The chemical and With every 10°C increase in temperature, there was an increase in biological reactivity. It is a known truth that fish are cold-blooded creatures that adjust their body temperature in response to external weather conditions. Although temperature is maintained and managed within the appropriate range, it is dependent on the species of fish. Higher temperatures stimulate the metabolism of eating fish to speed up, as does their respiration and overall movement. This is because the temperature varies depending on the depth of the water. If the temperature rises, more dissolved oxygen will be required .

B. Turbidity

Turbidity is the second physical component. The type of turbidity is indicated by the color of the water. A clean water color indicates a low biological production.

Consequently, because it is not sufficiently productive, fish do not thrive there. Algae is the cause of the green hue, and clay is the cause of the brown color. Fish shouldn't swim in murky water either since their gills may obstruct the clay particles, killing the fish.

Greenish water is a sign of excessive plankton production . Turbidity in water is caused by these suspended particles, which are present in different proportions.

C. Water Level

Water level is the third. The water levels in fish ponds vary, and this has an impact on fish behavior. Fish frequently relocate to particular regions of the pond where they are able to rest and graze. Fish in the vicinity are likely to compete with one another for survival as the water level drops.

Aquaculture's Chemical Water Quality Components:

The following criteria are referred to as chemical aspects: pH, alkalinity, hardness, dissolved gases (oxygen, Carbon dioxide, nitrogen, and ammonia).

TABLE I. DESCRIBES THE DIFFERENT WATER PARAMETERS RANGES AND ITS SOLUTIONS

Parameters	**Range**	**Solution (if parameters cross the range)**
Temperature	5c-35c	Pumping fresh water into the
Turbidity	Less than Tank 25mg/l (TSS)	Change the water/Recycle the water

Fig. 1. Describes the different water parameters ranges and its solutions

III. MATERIAL

Sensors, Temperature sensor, Turbidity sensor, Water level sensor, PIR sensor, Water pump, Lithium-ion battery, Microcontroller, Sever.

IV. BLOCK DIAGRAM PROPOSED SYSTEM

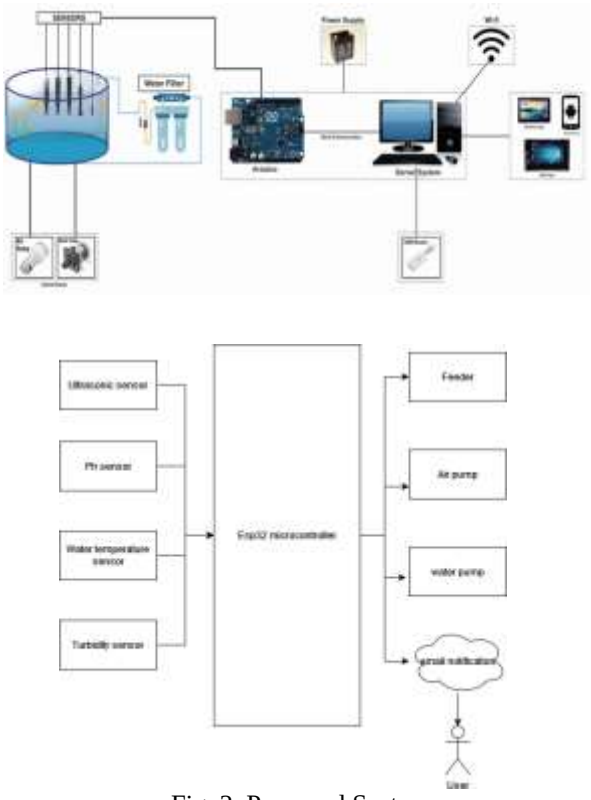

Fig. 2. Proposed System.

Fig. 3. Block Diagram for the proposed system.

V. RESULTS AND DISCUSSION

As was previously said, farmers measure the parameters of water quality using both forecasting models and conventional methods and procedures. Within our model, we minimize internet usage, develop a cost-effective model, and avoid using cloud databases due to internet consumption, but some research do use them . Certain versions are less expensive than others , but they are unable to meet water quality standards due to their systems' reduced sensor count. This system's primary goal is to provide real-time monitoring via desktop, Android, and GSM applications. When utilizing a serial port in this system, the Data is routinely sent over serial ports with low latency and error-free operation. The suggested model was used in an aqua pond, and tests were collected over the course of a day using several sensors. The plots that were gathered for different water quality parameters throughout time are listed below.

A. Temperature sensor graph

Fig.4 shows an example of a test sample of historical temperature data that has been charted. The user has the ability to track the temperature trend over a given period of time, which might be useful in examining potential temperature-related incidents. Water is pumped in until the temperature returns to normal when the temperature exceeds the threshold range of 35°C.

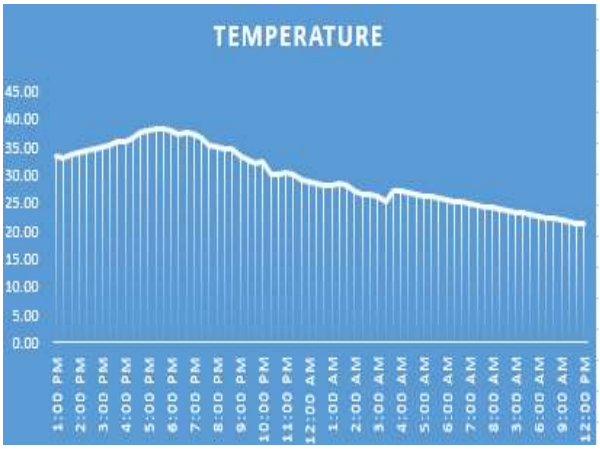

Fig. 4. Temperature graph.

B.Turbidity sensor graph

demonstrates the turbidity sensor tests, which measure how the frequency of feeding a fish affects the water's purity. As tilapia typically feeds four times a day, it grows quickly growing. Since the fish are feeding at these times, turbidity may be seen to rise rapidly at 17.00, 21.00, 12.00, and 16.00. This affects the water's quality and causes an increase in fish excrement. A particular level of turbidity in water has a favorable effect on fishery productivity because it lessens the amount of light that enters the water. When there is a water

drainage of more than 50 NTU, the pool must be emptied between 40 and 50 percent, then refilled.

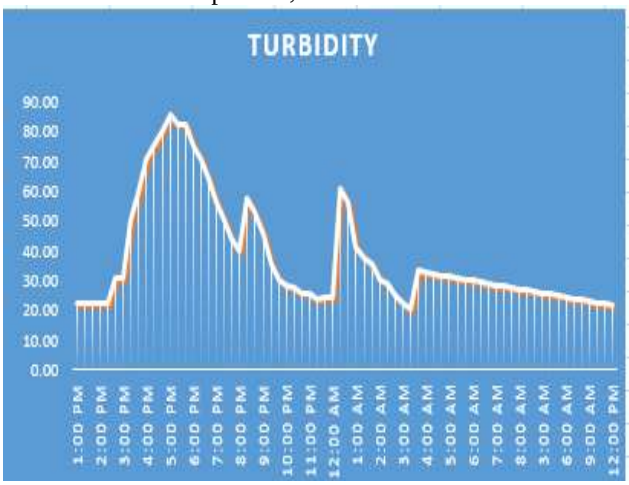

Fig.6. Turbidity graph.

Fig 7 and Fig 8 PC and an Android application When asked by the farmer, the application displays the parameters related to the water quality.

Fig. 7. Android application.

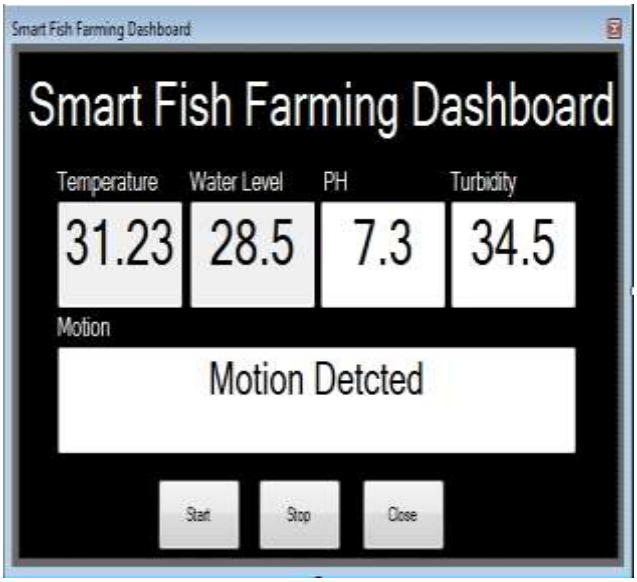

Fig. 8 . Desktop application.

Figure 8 displays the GSM's alarm message when the parameters go over the threshold range, and Figure 10 displays the prototype.

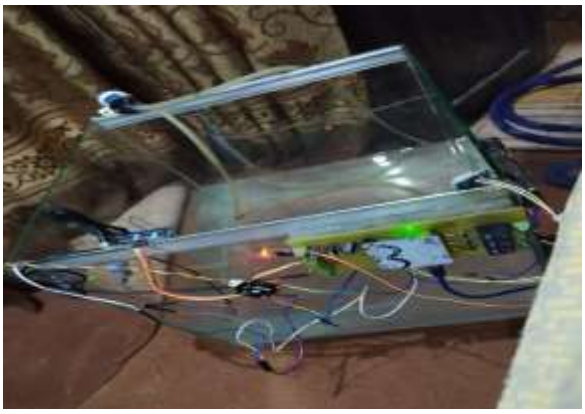

Fig. 9. Prototype.

VI.CONCLUSION

The design and execution of an aquaculture monitoring system are represented in this paper. IOT technology is being used in the system's development. It can be scaled, precise and adaptable. This will contribute to a notable boost in aquaculture productivity. Additionally, there is less need for manual testing and a decrease in losses. reduces labor costs and helps to avoid dangerous situations. Fish farms are challenging to operate using conventional, non-technical approaches. The technology solution that would monitor the water quality in real time is provided by the designed model.

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***Abstract*-Our daily lives are significantly impacted by automation. The primary automation field implementation is hand gesture recognition. According to this research, there is an issue with moving the bed around with hand gestures. For hand gesture recognition to be implemented in a real-time system, we require mutual application. Webcams are utilized in this real-time system to facilitate hand gestures for human-computer interaction. The idea is to use webcams and basic hardware components to demonstrate a real-time system that can move a bed using hand gestures. There is no one to care for the growing number of impaired patients in our society.A patient needed constant supervision from a caregiver, which isn't always feasible because of social or economical constraints. In order to reduce the need for caregivers and improve patient comfort, we have suggested an automated bed position control system for patients with disabilities. Other hand movements can also be used to adjust the bed's position. Additionally, the system has a continuous patient monitoring system that keeps an eye on a number of variables, including heart rate and temperature. This device alerts the doctor by sending an SMS if any of these parameters exceed the safe minimum threshold.**

Keywords*-*Raspberry Pi, Python, Open Cv, Camera.

I. INTRODUCTION

Due of the numerous social and financial difficulties that society has faced recently, there is less time for the elderly and the paralyzed. The number of disabled individuals who are unable to care for themselves in society is rising. A full-time caretaker may be necessary for the continuous monitoring of these patients, although social and economical limitations may make this unfeasible in certain situations. The current electronic bed systems in hospitals only allow for two bed motions: up and down.

Therefore, we have suggested a gesture control bed movement in which we have created the motion of the bed based on the various hand gestures to the current electronic bed systems in order to reduce the requirements of the caregivers and raise the comfort level of the patients. A bed system is also designed that may be utilized for a variety of situations, including elderly and impaired patients, paralyzed patients, and disabled people. By offering two movements, such as up and down, this bed seeks to reduce the amount of caretakers needed while also improving patient comfort.

The bed's design allows it to be automatically adjusted to the patient's desired position through the use of hand gesture detection. The bed is controlled by a DC motor that works with a DC motordriver

Additionally included is a continuous patient monitoring system with sensor nodes that can sense analogy biomedical signals, such as temperature and heart rate sensors. The Raspberry Pi board is then used to process these signals.

Due of the numerous social and financial difficulties that society has faced recently, there is less time for the elderly and the paralyzed. The number of disabled individuals who are unable to care for themselves in society is rising. A full-time caretaker may be necessary for the continuous monitoring of these patients, although social and economical limitations may make this unfeasible in certain situations. Hospital electronic bed systems now in use only offer two bed motions: up and down. Therefore, we have suggested a gesture control bed movement in which we have created the motion of the bed based on the various hand gestures to the current electronic bed systems in order to reduce the requirements of the caregivers and raise the comfort level of the patients here.

II. LITERATURE SURVEY

A. *Active Noise Control Scheme for Smart Beds Based on a Wide and Narrow Band Hybrid Control Algorithm*

Because intelligent technology is now ingrained in practically every area of people's lives, demand for data gathering technology is increasing, and information intelligence is becoming increasingly important in today's society as a result of scientific and technological advancements. One major challenge

with smart beds has been their active noise management. Smart beds are a subset of intelligent function beds that use sophisticated sensor technology to track a person's health and sleep in real time.

B. Design and development Intelligent Medical Care Bed Using Voice Recognition

The advent of smart homes and life-saving hospitals has been made possible by recent technological advancements in the medical and industrial domains. These advancements have allowed people to remain in their comfortable and normal living environments while still preserving their security and well-being. For patients in residences, nursing homes, hospitals, or any other setting where specialized care is required, Message Sheet provides a voice-activated medical care bed.

C. Smart Beds and Bedding Surfaces for Personalized Patient Care a Review

In order to discover patterns of suggestive hazards or pathogens, which early diagnosis and treatment is likely to lead to a reduction in morbidity and mortality and, subsequently, a reduction in both the time and expense of hospitalization, continuous patient monitoring is required during hospitalization. However, a patient's health can be seriously harmed by falling out of bed, and pressure ulcers can be prevented by promptly and accurately mapping the pressure sites that obstruct tissue perfusion and ultimately result in death.

D. Next Generation of Medical Care Bed with Internet of Things Solutions

The global advancement of technology is vital to many businesses. Smart homes and life-saving hospitals have made it possible for people to stay indoors in a secure, comfortable, and autonomous manner where they choose thanks to technological advancements. In this paper, a Medical Care Bed with Internet of Things Solutions—a bed that can be utilized using buttons, voice commands, and phone applications—is presented. It was created especially for hospital patients and other individuals in need of medical attention.

E. IoT based Smart Care Bed with Recommender System for Elderly People

The issue of caring for the elderly in their old age is as significant and laborious as caring for a child in today's environment, yet not everyone has the necessary time or resources. The suggested project is designed such that all necessary monitoring is completed automatically, and data reports and recommendations are forwarded to the caregivers. The suggested smart bed system, which is based on the Internet of Things, aims to benefit elders who have trouble taking care of themselves by assisting caregivers.

III. SYSTEM DESIGN

A. Hardware Setup

Assemble the physical components including Raspberry Pi, LCD, heartbeat sensor, temperature sensor, DC motor, emergency switch. Connect the components according to the specifications provided by the manufacturers.

B. Raspberry Programming

Write code for Raspberry Pi to initialize and read data from sensors (heartbeat and temperature). Implement logic for controlling the DC motor based on user input or sensor data. Code emergency switch functionality to disable motorized functions in case of an emergency.

C. LCD Display Integration

Write code to display relevant information on the LCD screen. Display real-time data such as heartbeat, temperature, and bed position. Ensure the LCD interface is user-friendly and informative.

D. Machine Learning Integration (Gesture Recognition)

Choose and set up a machine learning library, such as Mediapipe, for gesture recognition. Collect a dataset for training the machine learning model. This dataset should include examples of different hand gestures for bed control. Train the machine learning model using the collected dataset. Integrate the trained model into the Python code for gesture recognition.

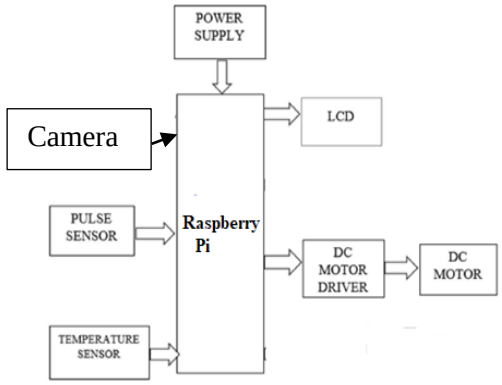
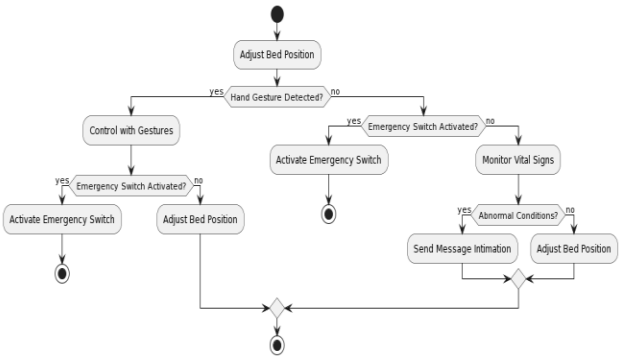


Fig 1: Block Diagram

III.IMPLEMENTATION



- Users can adjust the position of their bed (e.g., raising or lowering the head or foot of the bed) with simple hand gestures, eliminating the need for physical buttons or remote controls.
- This adds convenience for individuals with limited mobility or those who want to make adjustments without leaving the bed.
- The system can make beds more accessible to individuals with disabilities or mobility challenges, allowing them to independently control their bed's position, enhancing their quality of life, and reducing reliance on caregivers.
- Home automation systems provide a high level of convenience by allowing users to control various devices and systems in their homes with ease.
- Users can optimize their energy consumption by scheduling and automating device usage based on occupancy and environmental conditions.
- Lower energy consumption and reduced utility bills are common outcomes of home automation.

IV. HARDWARE AND SOFTWARE REQUIREMENTS

A. Hardware

1. Raspberry Pi

The Raspberry Pi foundation created the Raspberry Pi, a tiny single-board computer, in the UK with the goal of advancing computer science education in both developed and poor nations.CPU: 4x ARM Cortex- A53, 1.2 GHz**,**GPU: Broadcom VideoCoreIV**,**RAM: 1GB LPDDR2(900MHZ), Networking: 10/100 Ethernet,2.4 GHz 802.11n wireless,
Bluetooth: Bluetooth 4.1 Classic, Bluetooth Low Energy
Storage:micro SD,GPIO: 40-pin header, populated**,**Ports: HDMI, 3.4mm analogue audio-video jack, 4x USB 2.0 Ethernet, Camera Serial Interface (CSI), Display Serial Interface (DSI).

2.LCD display

A liquid-crystal display (LCD) is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals. Liquid crystals do not emit light directly, instead using a backlight or reflector to produce images in color or monochrome.

3.DC Motor

DC motors convert electrical into mechanical energy and they consist of permanent magnets and loops of wire inside, when current is applied, the wire loops generate a magnetic field, which reacts against the outside field of the static magnets. The interaction of the fields produces the movement of the shaft/armature.

4.H-bridge

An electronic circuit known as an H-bridge permits a voltage to be applied across a load in either direction. It is made up of four switches, which can be MOSFETs or transistors, organized in a H configuration to operate a motor or other high-power devices in both directions.

5.Regulated power supply

a.Transformer

A transformer is a device that transfers electrical energy from one circuit to another through inductively coupled conductors without changing its frequency. A varying current in the first or primary winding creates a varying magnetic flux in the transformer's core, and thus a varying magnetic field through the secondary winding.

b.Rectifier

rectifier is an electrical device that converts alternating current (AC) to direct current (DC), a process known as rectification. Rectifiers have many uses including as components of power supplies and as detectors of radio signals. Rectifiers may be made of solid-state diodes, vacuum tube diodes, mercury arc valves, and other components.

B.Software

1.PYTHON

It is an object-oriented programming language. The processing happens during the runtime, and this is performed by the interpreter. Python's simple to learn and easy to use is an advantage and thus makes it developer friendly. It is easier to read and understand as the syntax is conventional. The code can be executed line by line using the interpreter. Python can support multiple platforms like Linux, UNIX, windows, Macintosh, and so on.

2. OPEN CV

OpenCV (Open Source Computer Vision) is a library of programming functions mainly aimed at real-time computer vision. Originally developed by Intel, it was later supported by Willow Garage then Itseez (which was later acquired by Intel). The library is cross platform and free for use under the open-source BSD license. OpenCV supports deep learning frameworks TensorFlow, Torch/PyTorch and Cafe.

V.RESULT AND DISCUSSIONS

The implementation of a smart bed using Raspberry Pi technology yielded promising results across several key aspects. Through the integration of sensors like accelerometers and temperature sensors, the Raspberry Pi effectively monitored sleep patterns and regulated bed temperature to enhance user comfort. The development of a user-friendly interface, whether through a mobile app or voice commands, facilitated seamless interaction with the smart bed system. Data analysis revealed valuable insights into sleep quality, aiding in identifying patterns and potential areas for improvement in sleeping conditions. Moreover, the integration of the smart bed with other devices within the smart home ecosystem allowed for enhanced automation and personalization of the sleep environment. User feedback highlighted positive experiences and provided valuable suggestions for further refinement of the system. Looking ahead, future directions for the smart bed system could involve the incorporation of additional sensors for more comprehensive sleep monitoring and the refinement of data analytics algorithms to provide deeper insights into sleep health. Overall, the smart bed utilizing Raspberry Pi technology demonstrates considerable potential for improving sleep quality and enhancing the overall sleep experience.

V. CONCLUSION

The suggested Motion-Controlled Bed movement is an affordable and easy-to-use device. A system for man-machine interaction that recognizes hand gestures and uses that information to control bed position motions is feasible. The convex envelop and filthy points are examined using the three-coin procedure. The Gram method is utilized to locate fingertips, while the Skyum algorithm is used to estimate the palm center position. The position is set by a machine algorithm using various hand movements. This effort has successfully made it possible for those with speech impairments to express themselves verbally. Additionally, this idea assists patients in adjusting the bed to their own comfort level.

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Coal Mine Safety Monitoring System And Alerting Using IoT

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ABSTRACT: In this paper, a coal mine safety system is implemented using a Thinger Io platform as a medium to transmit the data. The system is implemented to monitor and control various parameters in the coal mines such as light detection, leakage of gas, temperature and humidity conditions, Fire detection in the coal mine. These all sensors are together considered as one unit and are placed in the coal mines. All the esteems of the sensors are continuously uploaded to the thinger for analysis. Here the gas is continuously monitored if any uncertainties in the level of gas arise, then buzzer is used to alert the workers. In this system LDR sensor is utilized to detect the presence of light. Automatically light gets one and can be controlled using the LED button. In case if any fire occurs in the coal mine, then an alert notification is sent to the mail of the authorized person. Temperature and humidity values are also continuously monitored and displayed on the serial monitor and also in the thinger platform. The developed system is mainly implemented to improve the working condition inside the coal mines and also to ensure workers safety.

Keywords –Cloud Server, Safety system, Sensors, Thinger.io

I. INTRODUCTION

Internet of Things (IoT) is nothing but the devices(things) communicating with each other by using the internet [1,2,3]. IoT applications vary on a large scale. European Research Cluster on the Internet of Things classifies major IoT applications as smart buildings, smart transportation, Smart energy, smart industry, smart health and the smart city as major areas.

IoT is a trend-setting innovation in which all the data from sensors is stored in the cloud where it can be easily accessed from the cloud. Sensors and actuators for gathering the data and sending across the internet are also included in this advancement. We use cloud not only to store data but also for data analysis, gathering, visualization. Such an emerging technology can be used in various IoT applications like agriculture, health, smart home etc, to make the already existing systems more efficient. The key characteristics of the cloud include on-demand service provision, ubiquitous access, resource pooling and, elasticity.

In India, we have 493 coalmines present. Coal is the most vital asset in the world. These petroleum products are natural assets of the earth which help create power and for some, purposes. Coal is a non-sustainable source which can't be supplanted commonly by humans, there are numerous coalmine mischance's happening in the mines, and the diggers are putting their lives in hazard by working in the coal mines, even once in a while they wind up losing their lives in the coal mines which is an unfortunate part. Mainly these mishaps are happening as a direct result of the old hardware and the wired systems, resulting in the terminate mischance's, spillage of the noxious gases in the coal mines are presenting immense dangers to the excavators inside the coalmines. In the underground coalmines light is an essential thing to convey their work, They can't leave the mine if there is no legitimate lighting which coming about them to harm the mineworker's vision because of working under low lighting area. So to stay away from this issue we have structured the coalmine security framework. In our work, we have tackled the issues by checking every one of the information gathered by the sensors which we have utilized and the observing is finished utilizing the Thinger

platform. controlling is possible by both automatically and manually.The microcontroller here in the work we have utilized is Node MCU

LITERATURE REVIEW

Kumar et al[1] proposed design which is built on MSP430, In the coal mine various parameters like Temperature, humidity, gas and smoke are monitored. A Zigbee transceiver is placed at the center location and by using the motor climate state is controlled.

Lihui et al[2] implemented a system, where temperature, humidity, methane values of the coal mine are collected by the sensor nodes and the information is collected by ARM controller for processing, for communication purpose Zigbee is utilized. If any esteems goes high, then an SMS is sent to maintain the safety of the workers.

Madhu et al[4] developed a coal mine safety monitoring system by utilizing Temperature, humidity and the amount of carbon-dioxide present are checked. If any uncertain condition occur then message is sent with the help of GSM to the forest and fire departments

Ashish et al [5] described a system that is based on ARM controller and different sensors like temperature sensor, humidity sensor and the gas sensor. An IR sensor is placed in the mine to check the conditions.

Wakode et al[6] suggested a system that mainly used to monitor the concentration of dangerous gases in the coal mine to provide safety the systems gives the alerts that will be helpful to the workers in the mine to save their lives. An alert switch is placed at the transceivers and receivers side for emergency purpose.

The DCS Coal Mine Monitoring System was developed by Zhenzhen Sun. A computerized bus that runs on the same lines as RS485 uses a bus structure that supports multipoint and two-way communication. So, the design of such a watching device will be done using commonly available 8-bit microcontrollers. With a circuit structure that is both simple and inexpensive, you enjoy the advantages of inexpensive circuit design. Thus, on the contrary, due to the use of a master-slave network arrangement, it is almost impossible to ensure the liability of the network structure.

The JINGLING SONG and YINGLI ZHU's design of an automated mine safety monitoring device assisted by a wireless sensing element network. MSP430F and nRF2401 have been implemented in the process design to watch for underground mine protection. Sensor teams in the device intensively track temperature, humidity, and various parameters in the underground mine. Temperature, humidity, and various parameters are monitored by sensors and sent to a wireless communication module by the microcontroller. That information is sent via cable to the far-off location where it is watched by the observers. The problem with this implementation is that hardware is installed in the coal mines when disasters or roof collapses occur, and once the damage has occurred, it's impossible to repair the device. The other drawback is that the working state of the coal pit is extremely shaky, and if the gap between the manual laborer and the system is long, the miner will not receive the correct instructions.

Aarti et al[7] developed a system that monitors temperature, humidity, methane values in the coal mine and all the values are sent to the ARM9 processor and a using a Wi-Fi module the values are continuously updated in the webpage.

Dheerajet al[8] suggested a framework that values of all the parameters that are monitored are stored and visualized in the cloud and those can be controlled using smart phone so that safety of the coal mine workers are maintained.

Dong et al[9]proposed a coal Mine safety Monitoring framework dependent on Zigbee and GPRS remote transmission was established. With GPRS innovation, remote information transmission was accomplished and informed through the short message sent to his cell phone, which adds to the early ID of genuine mishaps and continuous treatment, subsequently expanding the security of coal mining.

Yongping Wu and Guo Feng make use of A Bluetooth wireless transmission device that has been implemented in coal mine monitoring to greatly expand the scope of the technology. Currently, the industry believes that to control costs and provide a standard in the short range wireless networking market, Bluetooth is supposed to implement a powerful kit gap scheme, and it is also expected to provide a minimum power demand for low-cost, low-power air interfaces. This paper describes the context of the situation, as well as different technical choices, as well as the architecture of the protocol stack of Bluetooth technology. Also, the paper goes into possible solutions for the Bluetooth HCI wireless networking, which is a necessary component in the development of this technology. Also at the same moment, the system has completed the integration of wired and wireless information transfer. This use of the new technologies, known as the "Wired Bus," is being employed. The problems that come along with this strategy include the main ones. For one, Bluetooth is a short-range wireless system. Even though it's difficult to work in the mine due to the abrasive environment, it is even more difficult to install and maintain the wired communication system.

COAL MINE SAFETY SYTEM

In this proposed system the coal mine safety systems are fixed with gas sensor modules, the light dependent resistor(LDR sensor), temperature/humidity sensor, fire sensor, buzzer and led. We integrate all the sensors to the Node MCU. First we need to create an account in the Thinger platform.

In this system we mainly have monitoring and controlling systems monitoring system we monitor all the data from different sensors. gas sensor detects the gas in the coal mine environment, if the gas level exceeds the normal level then the buzzer gets high so that the mine workers gets notified. These sensor values are continuously uploaded to the cloud (Thinger.io) for analysis and also for further use. The temperature and humidity values are also he monitored inside the coalmine. LDR sensor is used to measure the intensity of the light by varying its resistance value. If there is an obstacle to the LDR sensor then led gets on automatically. If in case any fire accidents occur, then immediately fire alert messages are sent to the authorized persons mail and also the link of the location is shared. Controlling system is completely done using thinger platform. In the thinger platform, we create widgets .by using the widgets we control buzzer and led manually.

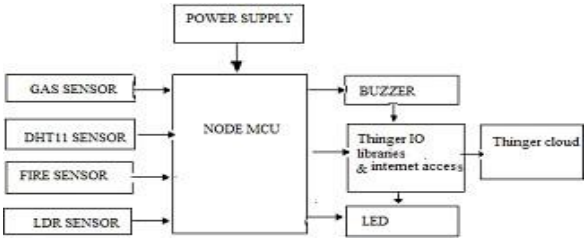

Fig. 1 represents an overview of the proposed system
Sensor:

Choosing a sensor is a difficult task, according to the application requirements we have to choose sensors, if the system has to sustain for long time sensors should work accurately, they should be reliable

Gas sensor:
Here mq2 gas sensor is used, in particular in using the mq2 sensor. It has a high sensitivity and a fast response rate. Gas sensor mainly comprises of four pins, where three pins are used A0, GND, VCC,A0 is an analog pin that is connected to the analog pin of Node MCU,GND is connected to GND, VCC supply is 3.3v.This sensor effectively detects gas leakage in industries and detect combustible smoke and gases.

Fig. 2. Picture of Gas sensor

Fire Sensor:
Here Fire sensor is used to detect the fire in the coal mines. Fire sensor mainly comprises of four pins, where three pins are used A0,GND, VCC,A0 is analog pin that is connected to analog pin of Node MCU, GND is connected to GND, VCC supply is 3.3v

Fig 3: Picture of Fire sensor

LDR Sensor:
LDR sensor mainly consists of four pins A_0, GND, Digital pin,The power supply for the sensor is 3.3v and the GND pin of a sensor is connected to GND pin of Node MCU, the digital pin of LDR sensor to digital pin of Node MCU

Fig4: Picture of LDR Sensor

DHT11 Sensor:
DHT11 Sensor is used to check the temperature and humidity values inside the coalmines.DHT11 sensor consists of three pins, power supply of dht11 is 3.3v,Gnd pin is connected to GND pin of NodeMCU, Digital pin of a dht11 sensor is connected to Digital pin of NodeMCU.

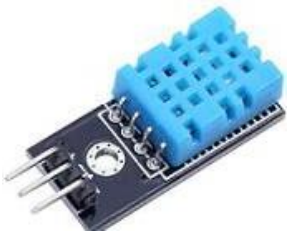

Fig5: Picture of DHT11 sensor

NodeMCU:
The Node Micro Controller Unit (NodeMCU) is used as a gateway. It has inbuilt Wi-Fi module which is used to send the sensor data to cloud for storage and analysis. The main reason behind selecting NodeMCU is that the sensors used in our project uses only digital pins and one analog pins are required. Also, it consumes less power (3.3v) and is of low cost when compared to other microcontrollers /processors like Arduino and Raspberry pi. Node MCU is connected to ultrasonic sensors, gas sensor, temperature sensor, IR sensor. All the values are connected and send to Cloud server.

Fig. 6. Photo representing Node MCU

The ESP8266 is designed and manufactured by Espressif Systems. NodeMCU contains all crucial elements of the modern computer: CPU, RAM, networking (Wi-Fi), and even a modern operating system and SDK. When purchased at bulk, the ESP8266 chip costs just $2 USD a piece. The features like establishing a Wi-Fi connection with just a few lines of code, Plug and play mode, Programmable Wi-Fi module and Arduino like software and hardware I/O made

NodeMCU an IoT Tool that is best suitable for various applications based on IoT. It has a deep sleep mode which consumes 60mA is useful for the low power consumption of an application. Some more features of NodeMCU are:

- Voltage:3.3V.
- Wi-Fi Direct (P2P), soft-AP.
- Operating current Average: 80mA
- Flash memory attachable: 16MB max (512K normal).
- Integrated TCP/IP protocol stack.
- Processor: Tensilica L106 32-bit.
- Processor speed: 80~160MHz.
- RAM: 32K + 80K.
- GPIOs: 17 (multiplexed with other functions).
- +19.5dBm output power in 802.11b mode

THINGER.IO Platform:

It is an open source platform for IoT. Thinger io, devices can be controlled from internet within minutes.

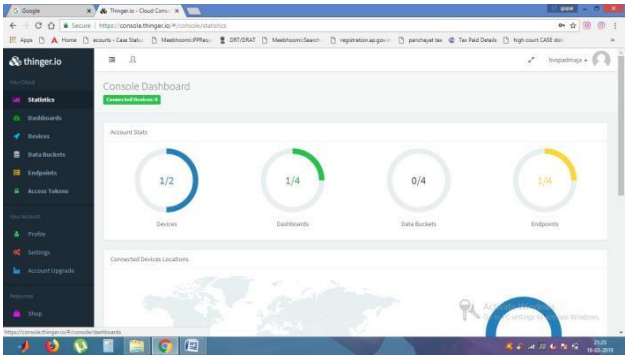

Fig 7:image of Thinger io platform.

To use the thinger platform first create an account in the thinger platform. In the console a dashboard, it will show the number of devices connected. It can connect up to 4 devices at a time in the platform. In Devices, you can manage and access the item .it displays how many devices are connected in the project. A dashboard is created using an dashboard id ,Each dashboard can be connected to different sensors and actuators .Widgets is created in the dashboard for monitoring the values .In Data buckets, here we can access and manage your buckets .Data buckets are used to store the historic information about the project .End points are used to communicate with third party devices, here in endpoints can be called by devices to make the HTTP request ,sending emails etc.

RESULT AND DISCUSSION

Experimental Setup:

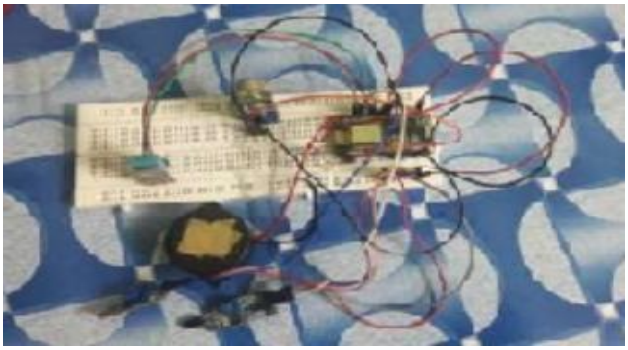

Fig8: Set up of coalmine safety system

All the values of the sensors are collected by NodeMCU and are sent to Thinger io

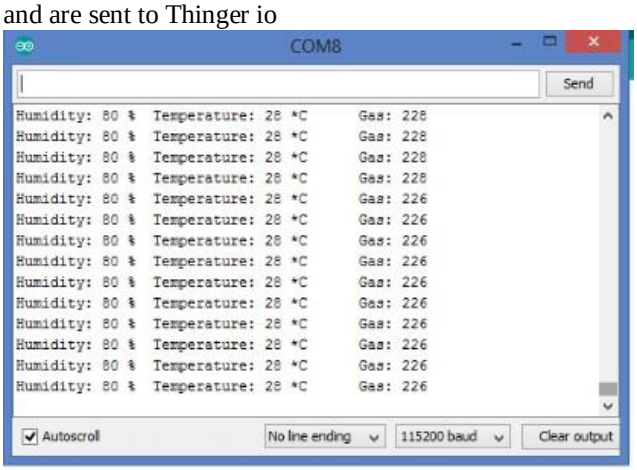

Fig9: screenshots representing the values and the message displayed on the serial monitor

The Temperature, Humidity and gas values are displayed on the serial monitor.

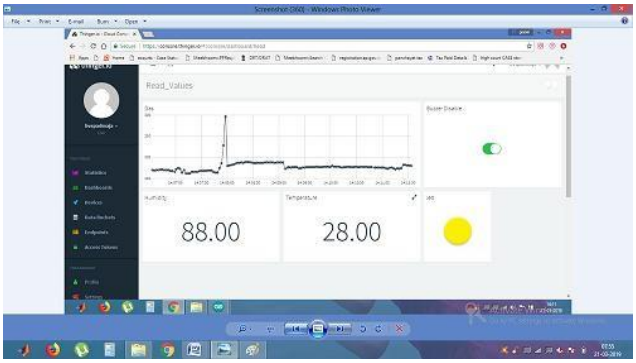

Fig 10:screenshots values of all the sensors displayed on the Cloud using widgets.

We are controlling the buzzer with switch widgets created in the cloud platform. When the light is not detected in the coal mines then the yellow button represents the absence of light in the coal mine. If any uncertain conditions occur then notification is sent to the mail of the authorized person

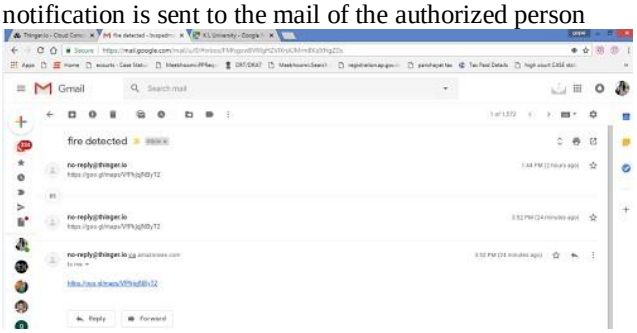

Fig 11: Screenshots showing the alert messages to the email is there is a chance of catching the fire

CONCLUSION

Implementation of Coal mine safety system is implemented using Fire sensor, Gas sensor, LDR sensor, DHT11 sensor to increase the safety of the workers in the coal mine and to prevent them from danger, By using this system constant checking of the coalmine and alerting the worker is done by using Thinger io. The system is cost-effective and efficient

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Intelligent Solar Based Climate Adjustable E-uniform for Soldiers

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Abstract*—Soldiers operate in a variety of extreme environments, from hot deserts to frigid mountains. This can put a strain on their bodies, making it difficult to maintain a comfortable temperature. An intelligent solar-based climate-adjustable e-uniform can help to address this problem. This uniform would use solar energy to power a system that can heat or cool the soldier's body depending on the environmental conditions. The e-uniform would use a variety of sensors to monitor the soldier's body temperature and the ambient temperature. This data would be used to control a series of thermoelectric devices that are embedded in the uniform. The thermoelectric devices can be used to heat or cool the soldier's body depending on the desired temperature. The increasing challenges posed by climate variability on military operations necessitate innovative solutions to enhance the adaptability of soldiers in diverse environmental conditions.

This introduces an intelligent solar-based climate-adjustable e-uniform designed for military personnel, employing Arduino technology. The proposed system integrates advanced sensors and actuators into the uniform fabric, enabling real-time monitoring of environmental parameters such as temperature, humidity, and solar radiation. The Arduino microcontroller processes this data and automatically adjusts the uniform's climate control features to optimize the soldier's comfort and performance. Key components include a solar power harvesting system that provides sustainable energy to the uniform's electronic components, reducing reliance on traditional power sources. The e-uniform incorporates a responsive climate control algorithm that dynamically regulates ventilation, heating, and cooling elements based on the soldier's physiological and environmental needs. This intelligent uniform aims to enhance operational efficiency, mitigate heat related stress, and improve the overall well-being of military personnel by offering a personalized and adaptive climate control solution. The integration of Arduino technology not only ensures reliability and precision in environmental sensing and control but also facilitates future upgrades and customization for evolving mission requirements. In summary, the proposed intelligent solar-based climate-adjustable e-uniform represents a cutting-edge approach to address the challenges of climate variability in military contexts, offering a versatile and sustainable solution for enhancing the performance and resilience of soldiers in environments.

Keywords— Solar Panel, Rechargeable Battery, Temperature sensor, Heart Rate sensor, Peltier Plate.

INTRODUCTION

In an era characterized by rapid technological advancements and an increasing focus on sustainability, innovation has become a driving force in addressing the unique challenges faced by various sectors, including defense. One such groundbreaking development is the Intelligent Solar-Based Climate Adjustable E-Uniform for soldiers, a cutting-edge solution that seamlessly integrates advanced technologies, particularly Arduino-based systems, to enhance the comfort, performance, and adaptability of military personnel in diverse environmental conditions. The conventional challenges associated with military uniforms, such as discomfort, inadequate climate adaptability, and energy consumption, have prompted a paradigm shift towards more intelligent and eco-friendly solutions. The proposed intelligent e-uniform leverages solar power as a renewable energy source, tapping into the inexhaustible potential of the sun to power a range of features designed to optimize the soldier's experience in the field. The incorporation of Arduino, an open-source electronics platform, adds a layer of programmability and customization, allowing for real-time adjustments based on environmental parameters and individual preferences. At the heart of this innovation is the integration of intelligent sensors that monitor and analyze ambient conditions, including temperature, humidity, and solar radiation. These sensors provide crucial data inputs to the Arduino microcontroller, which acts as the brain of the system, orchestrating a dynamic response to ensure optimal thermal comfort for the soldier. The e-uniform's climate-adjustable functionality goes beyond the traditional one-size-fits-all approach, offering a personalized and responsive solution that adapts to the specific needs of each wearer. The solar panels integrated into the fabric of the uniform serve a dual purpose – harnessing solar energy to power the system and acting as a smart layer that regulates temperature. This innovative use of solar technology not only reduces the reliance on conventional power sources but also contributes to a more sustainable and energy-efficient solution for military applications. The Arduino platform enables efficient energy management, ensuring that power is distributed intelligently among the various components of the e-uniform, thereby maximizing operational longevity in the field. Furthermore, the Intelligent Solar-Based Climate Adjustable E-Uniform incorporates state-of-the-art communication modules that facilitate seamless connectivity with central command systems.

I. OBJECTIVE

The objective of the project "Intelligent Solar-Based Climate Adjustable E-Uniform for Soldiers using Arduino" is to design and develop a cutting-edge, sustainable solution that addresses the challenges faced by military personnel in varying environmental conditions. The primary goal is to enhance the comfort, performance, and well-being of soldiers by integrating intelligent technologies into their uniforms. The project aims to create a climate-adjustable electronic uniform that utilizes solar power through embedded photovoltaic cells. These cells will harness solar energy to power an Arduino-based control system, enabling real-time monitoring and adjustment of the uniform's climate control features. The key objectives of the project include the development of a sensor array to gather data on environmental factors such as temperature, humidity, and solar radiation. The collected data will be processed by the Arduino microcontroller, which will implement intelligent algorithms to assess the soldier's thermal comfort level. The system will then automatically adjust the uniform's features, such as built-in fans, heating elements, and ventilation, to maintain an optimal microclimate within the uniform. Furthermore, the project will focus on designing a user-friendly interface for soldiers to manually override the automatic adjustments if needed. This interface will be integrated into the uniform, allowing soldiers to customize their comfort settings based on personal preferences and specific mission requirements. Additionally, the project will explore energy-efficient mechanisms to ensure the sustainable operation of the electronic components, maximizing the utilization of solar power and minimizing the reliance on external energy sources.

II. METHODOLOGY

The following figure shows the block diagram for the Intelligent Solar-Based Climate Adjustable E-Uniform for Soldiers using Arduino comprises several interconnected components that work cohesively to create a sophisticated and adaptive system. The diagram reflects the key functionalities and interactions within the electronic framework. At the core of the system is the Arduino microcontroller, which serves as the central processing unit. The Arduino is responsible for receiving inputs from various sensors strategically placed on the uniform. These sensors include temperature and humidity sensors to measure environmental conditions, a solar radiation sensor to assess available sunlight, and potentially physiological sensors to monitor the wearer's vital signs. The information gathered by these sensors forms the basis for the intelligent decision-making process. The Arduino communicates with a control algorithm designed to assess the thermal comfort level of the soldier. This algorithm takes into account the environmental data collected by the sensors and determines whether adjustments are required to the uniform's climate control features. These features include built-in fans, heating elements, and ventilation systems.The solar power subsystem is a critical component, consisting of photovoltaic cells integrated into the fabric of the uniform. These cells capture solar energy and convert it into electrical power to sustain the operation of the electronic components, reducing dependence on external power sources.

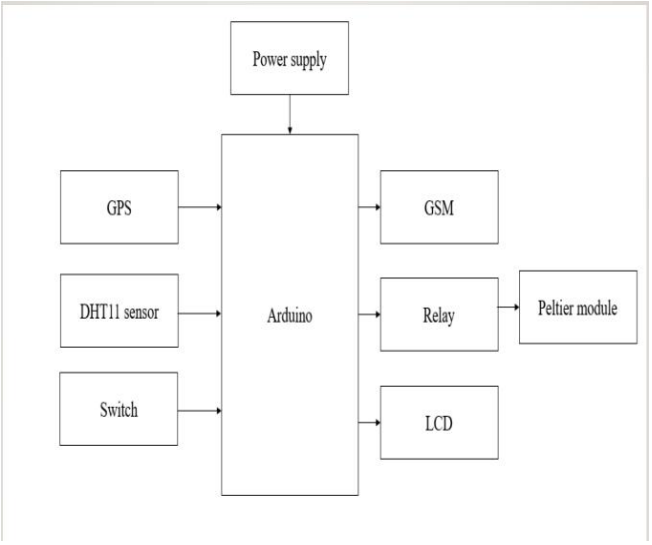

Figure 1: Block Diagram of Proposed System

The energy management module ensures efficient utilization of the harvested solar power and may include a battery storage system to store excess energy for periods of limited sunlight. The user interface module allows soldiers to interact with the system, providing manual control options. This interface could be in the form of a control panel integrated into the uniform, allowing users to override the automated adjustments based on their personal preferences or specific mission requirements. The actuation and control elements represent the mechanisms responsible for physically adjusting the uniform based on the decisions made by the control algorithm. These may include actuators for fans, heating elements, and other climate control features, as well as valves or vents for regulating airflow. In summary, the block diagram illustrates a comprehensive and integrated system that combines environmental sensing, intelligent decision-making, solar power harvesting, and user interaction to create an innovative Intelligent Solar-Based Climate Adjustable E-Uniform for Soldiers. This design aims to enhance soldier comfort, adaptability, and operational effectiveness in diverse environmental conditions.

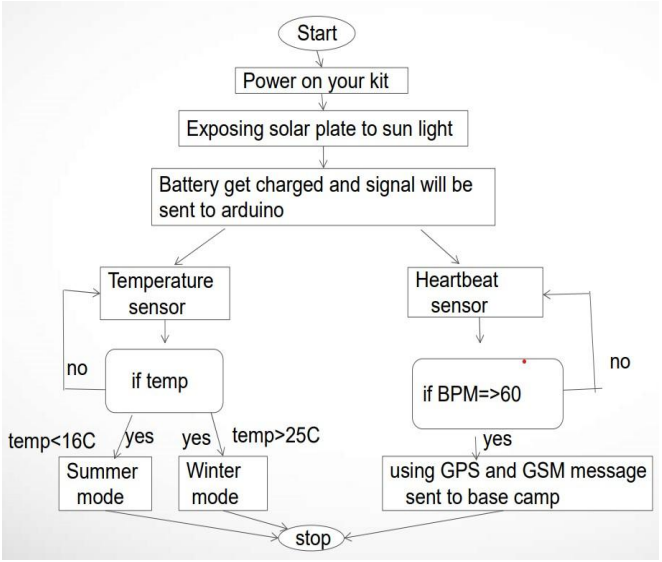

Figure 2: Proposed Methodology Flow Chart

III. RESULTS

The "Intelligent Solar-Based Climate Adjustable E-Uniform for Soldiers using Arduino" project aims to revolutionize military apparel by integrating advanced technologies to enhance the comfort and performance of soldiers in diverse environmental conditions. The expected outcome is a cutting-edge electronic uniform that utilizes Arduino microcontrollers, solar panels, and sophisticated climate sensors. The uniform will dynamically adjust its features, such as ventilation, heating, and cooling, based on real-time climatic data. The integration of solar panels will enable the uniform to harness solar energy, reducing dependence on external power sources and ensuring prolonged operational capabilities. The Arduino platform will serve as the brain of the system, orchestrating the seamless interaction between sensors, actuators, and power sources. This intelligent e-uniform not only optimizes the soldiers' thermal comfort but also enhances their overall operational efficiency by adapting to the ever-changing environmental conditions on the battlefield. Ultimately, the project aims to provide a scalable and modular solution that can be easily integrated into existing military gear, showcasing the potential for technological innovation to improve the well-being and performance of military personnel

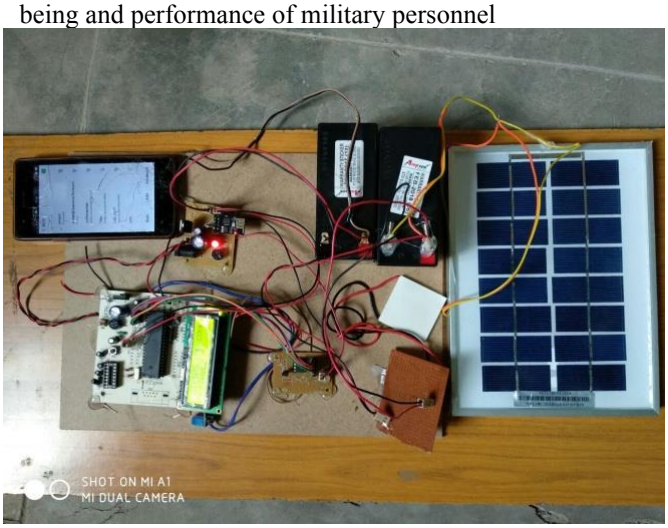

Figure 3: Final result

IV. ADVANTAGES AND DISADVANTAGES

Advantages:

Climate Adaptability: These uniforms can adjust to various climate conditions, providing soldiers with optimal comfort regardless of whether they are operating in hot, cold, or humid environments. The ability to regulate temperature can prevent heat exhaustion, hypothermia, and other weather-related health issues.

Energy Efficiency: By harnessing solar power, these uniforms reduce the reliance on conventional power sources, thus lowering the logistical burden of supplying batteries or fuel for soldiers in the field. This energy efficiency also aligns with sustainability goals, reducing the environmental impact of military operations.

Customizable Comfort: Intelligent e-uniforms can be personalized to individual preferences and physiological needs. Soldiers can adjust settings such as temperature, humidity, and ventilation to suit their comfort levels, enhancing overall morale and performance during missions.

Enhanced Performance: Maintaining optimal body temperature is crucial for peak physical and cognitive performance. By regulating temperature and moisturelevels, these uniforms can help soldiers stay focused, alert, and effective in challenging operational environments.

Health Monitoring: Some intelligent e-uniforms may incorporate biometric sensors to monitor vital signs such as heart rate, body temperature, and hydration levels. This data can be transmitted to commanders or medical personnel in real-time, enabling early intervention in case of health emergencies.

Disadvantages:

Complexity and Reliability: Integrating advanced technology into uniforms increases their complexity, which can lead to higher chances of malfunctions or technical issues. Soldiers rely heavily on their equipment, and any failure could compromise their safety or effectiveness.

Maintenance Requirements: Intelligent e-uniforms require regular maintenance and upkeep to ensure proper functioning. This adds to the logistical burden of military units, requiring specialized personnel and resources for repair and maintenance.

Cost: Developing and manufacturing intelligent e-uniforms with solar-based climate adjustment technology can be expensive. The initial investment in research, development, and production may pose budgetary challenges for military organizations, especially those with limited resources.

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DESIGNING IOT FACE RECOGNITION AI ROBOT

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ABSTRACT :- ***This project aims to design an IOT-enabled face recognition AI robot for diverse applications ranging from security to personal assistance. The proposed system integrates advanced machine learning algorithms with IOT technologies to achieve real-time face detection and recognition capabilities. The robot utilizes a camera module to capture facial images, which are then processed using deep learning models trained on large datasets. The IOT aspect enables seamless connectivity, allowing remote access and control via smartphones or other devices. Additionally, the robot incorporates features like facial emotion recognition and personalized interaction to enhance user experience. The project addresses challenges related to accuracy, speed, and privacy concerns through algorithm optimization and data encryption techniques. Ultimately, the IOT face recognition AI robot offers a versatile solution with potential applications in smart homes, offices, and public spaces.***

INDEX TERMS :- ***AI (Artificial Intelligence) ,IOT (Internet Of Things) , Face Recognition , Deep Learning, Real-Time Processing .***

I. INTODUCTION

The project endeavors to conceive an innovative IOT-based facial recognition AI robot, designed to serve a myriad of purposes ranging from security enhancement to personalized assistance. Integrating cutting-edge machine learning algorithms with IOT technologies, this initiative seeks to pioneer real-time facial detection and recognition capabilities. By harnessing a camera module to capture facial images, the system employs sophisticated deep learning models trained on extensive data sets [1]. Through seamless connectivity facilitated by IOT infrastructure, the robot enables remote access and control via various devices, ensuring user convenience and flexibility. Furthermore, the robot's functionalities extend beyond mere recognition, encompassing features such as emotional analysis and tailored interactions, thereby enriching user engagement. By addressing challenges pertaining to accuracy, speed, and privacy, this project aims to deliver a versatile and indispensable solution applicable across diverse domains, including smart homes, workplaces, and public awareness [2].

Moreover, this project seeks to push the boundaries of technological innovation by implementing novel approaches to address existing limitations. By embracing cutting-edge methodologies and techniques, such as federated learning and edge computing, the system aims to enhance both the efficiency and privacy of facial recognition processes. Additionally, the incorporation of multimodal biometric authentication further strengthens security measures, ensuring robust protection against unauthorized access. Furthermore, the IOT-enabled architecture enables seamless integration with existing smart infrastructure, fostering interoperability and expanding the potential applications of the robot

across interconnected ecosystems. Through continuous refinement and optimization, the project strives to stay at the forefront of advancements in AI and IOT, driving forward the evolution of intelligent robotics in the digital era [3].

II. OBJECTIVE

The primary objective of this project is to design, develop, and deploy an innovative IOT-based facial recognition AI robot that offers real-time detection and recognition capabilities. Key goals include achieving high accuracy and speed in facial recognition tasks while addressing privacy concerns through advanced encryption techniques. The project aims to integrate seamlessly with IOT infrastructure for remote access and control, enhancing user convenience and accessibility. Additionally, the robot will incorporate features such as emotional analysis and personalized interactions to enrich user experience. By leveraging cutting-edge machine learning algorithms and IOT technologies, the project seeks to pioneer advancements in intelligent robotics with broad applications in security, personal assistance, and beyond. Furthermore, the project aims to explore novel methodologies, such as federated learning and multimodal biometric authentication, to enhance efficiency, security, and interoperability. Overall, the objective is to deliver a versatile and indispensable solution that sets new standards in facial recognition AI robotics.

Enhanced Security: Develop a robust security system by implementing accurate and reliable facial recognition to control access and identify authorized individuals

Automation and Efficiency: Enable automation in various scenarios by integrating facial recognition capabilities, improving operational efficiency and reducing manual interventions.

Personalized user experience: Create a personalized and user-friendly interaction with the robot, allowing it to recognize individuals and tailor responses or actions based on their identity.

IOT Connectivity: Establish seamless IOT connectivity to facilitate communication with other devices and systems, enabling the robot to be part of a larger inter connected network.

Real-time Decision Making: Implement edge computing capabilities to enable real-time processing of facial recognition tasks, minimizing latency and dependence on external servers.

Privacy Protection: Incorporate measures to address privacy concerns, ensuring that facial recognition data is handled securely and with respect to privacy regulations.

User Education and Acceptance: Develop strategies to educate users about the capabilities and limitations of the face recognition AI robot, fostering acceptance and understanding of the technology.

Energy Efficiency: Optimize the robot's energy consumption through efficient hardware and software design, promoting sustainability and prolonged operation on battery power. Incorporate measures to protect privacy concerns , ensuring that facial recognition data is handled securely with respect to privacy regulations.

III. DESIGN AND DEVELOPMENT

Block Diagram :

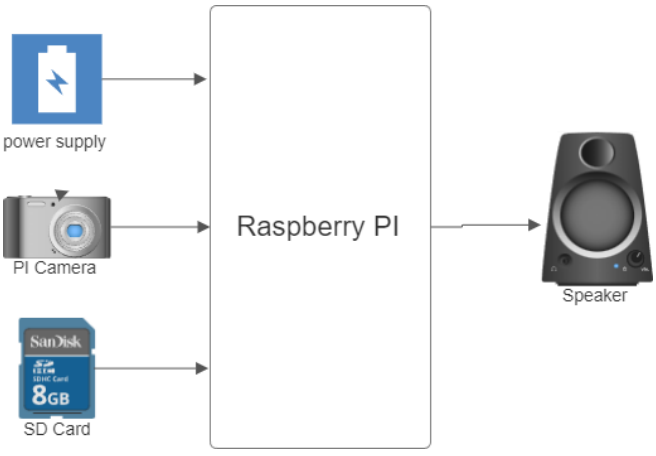

Fig .1

Raspberry pi:

Raspberry Pi: is a series of small single-board computers (SBCs) developed in the United Kingdom by the Raspberry Pi Foundation in association with Broadcom. The Raspberry Pi project originally leaned towards the promotion of teaching basic computer science in schools and in

developing countries. The original model became more popular than anticipated, selling outside its target market for uses such as robotics. It is widely used in many areas, such as for weather monitoring, because of its low cost, modularity, and open design. It is typically used by computer and electronic hobbyists, due to its adoption of the HDMI and USB standards.

Power Supply: Raspberry Pi boards typically use a micro-USB or USB-C connector for power. The power requirements vary depending on the model. The latest RPi 5 requires 5V and 5A while the oldest ones only required 5V and 500 mA.

Pi Camera: It is used to capture image of the crops. It is directly connected to raspberry pi model. There are two ways to Raspberry pi is a small size module like a small computer. The image captured by camera is sent to the raspberry pi. Using tensor flow, the image is processed and detected by the raspberry pi

Speaker : Speaker uses encompass a variety of linguistic tools such as rhetorical devices and figurative language, aimed at engaging the audience and effectively conveying the message with clarity and impact, while also leveraging nonverbal cues like tone.

SD Card : used to store the real time image data for face recognition.

Block Diagram :

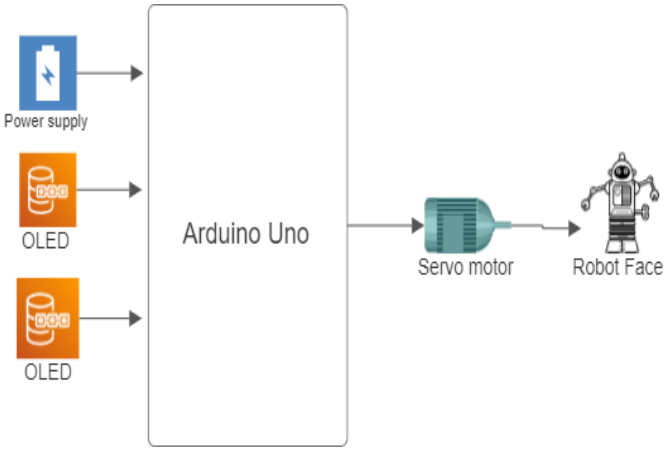

Fig 2 Face mask design

ARDUINO UNO:

Arduino UNO: is a standard board of Arduino. Here UNO means 'one' in Italian. It was named as UNO to label the first release of Arduino Software. It was also the first USB board released by Arduino. It is considered as the powerful board used in various projects. Arduino.cc developed the Arduino UNO board.

OLED: OLED displays are available in a range of sizes (such as 128×64, 128×32) and colors (such as white, blue, and dual-color OLEDs). Some OLED displays have an I2C interface, while others have an SPI interface. One thing they all have in common, however, is that at their core is a powerful single-chip CMOS OLED driver controller – SSD1306, which handles all RAM buffering, requiring very little work from your Arduino.

Servo motor: The input to its control is a signal (either analog or digital) representing the position commanded for the output shaft.

IV. METHODOLOGY

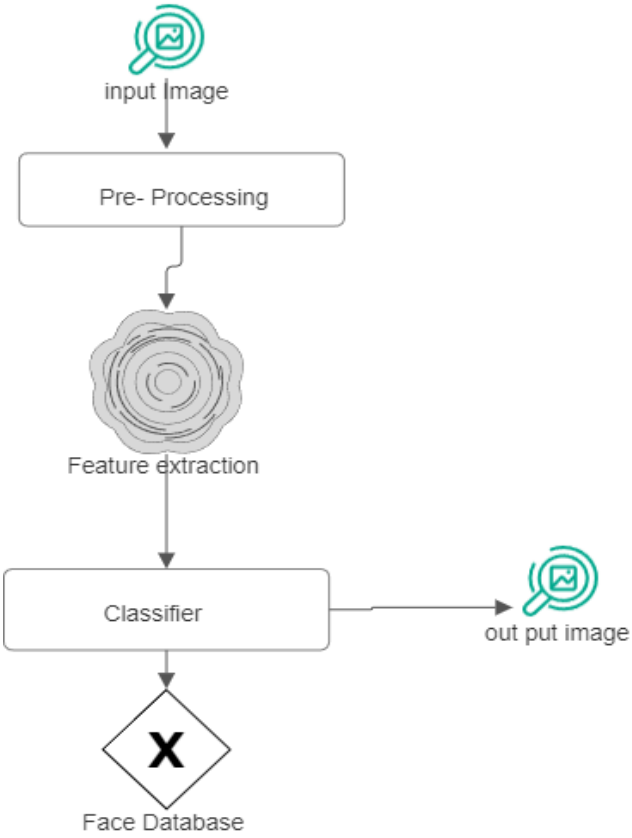

Fig 3 Face recognition

1.Image input: to acquire a digital image.

2. Image pre-processing: Partitions an input image into its constituent parts of objects. Converts

the input data to a from suitable for computer processing.

3. Template (feature database) : The features of the trained images are stored and the classifier checks the input images with the feature database.

4. Image Feature extraction: In this step, the system extracts the features of the input image and checks some quantitative information and checks some basic similarities from the trained images.

5. Image Classification: In this step, the system checks if the features of the input image matches with the features of featured database images.

6. Image recognition/Output: to assign a label to an object based on the information provided by its description.

V. RESULTS

The performance evaluation of Convolutional Neural Networks (CNNs) involves several key metrics. Firstly, accuracy measures the percentage of correct predictions made by the model on a given dataset, providing a fundamental assessment of its classification capabilities. Additionally, the loss function quantifies the error between predicted and true labels, with lower values indicating better model performance. Precision, recall, and F1 score offer insights into the model's ability to correctly identify positive instances, capture all positive instances, and balance precision and recall. The confusion matrix provides a comprehensive summary of the model's classification performance across different classes, facilitating a detailed analysis of prediction outcomes. Moreover, metrics such as ROC curve and AUC evaluate the model's ability to distinguish between classes, with higher AUC values indicating better discrimination ability. Finally, computational efficiency metrics, including training time and inference speed, assess the model's practicality for real-world applications, guiding further optimization efforts. Together, these metrics offer a comprehensive assessment of CNN performance, aiding in model refinement and optimization for specific tasks and applications.

The face detector we use is made using the classic Histogram of Oriented Gradients (HOG) feature combined with a linear classifier, an image pyramid, and sliding window detection scheme. The pose estimator was created by using dlib‟s implementation of the paper. When using a distance threshold of 0.6, the dlib model obtains an accuracy of 99.38% on the standard LFW face recognition benchmark, which is comparable to other state-of-the-art methods for face recognition as of February 2017. This accuracy means that, when presented with a pair of face images, the tool will correctly identify if the pair belongs to the same person or is from different people 99.38% of the time.

Fig 4 : Face detection

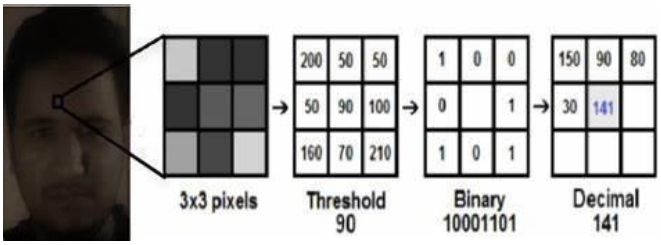

Fig 5 : Feature Extraction

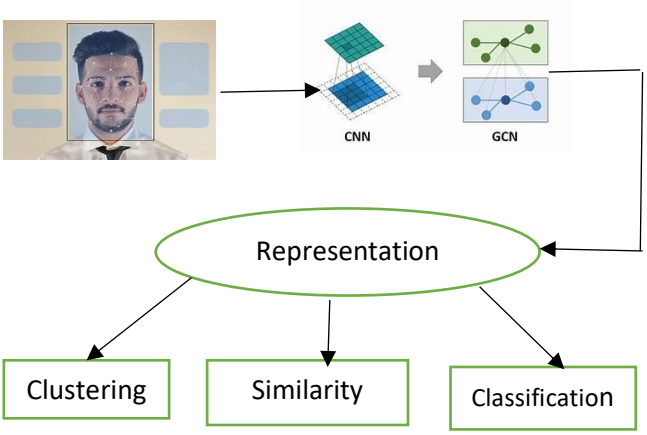

Fig 6 : working of Algorithm

Fig 7 : Proposed project Model

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Driverless Automatic Metro Train With Alert System

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***Abstract*—This paper proposes an innovative driverless automatic metro train system integrated with an advanced alert system. The driverless metro train employs cutting-edge technologies such as artificial intelligence, sensors, and communication systems to ensure safe and efficient operations. The alert system utilizes real-time data analysis to detect potential hazards such as obstacles on the track, mechanical failures, or unexpected changes in the environment. Upon detection, the system triggers immediate alerts to both onboard personnel and control centers, allowing for swift response and mitigation of risks. This integrated approach not only enhances passenger safety but also improves the overall reliability and performance of metro transportation networks. The paper discusses the design, implementation, and performance evaluation of this system, showcasing its potential for revolutionizing urban transit systems.**

Keywords—Driverless metro train, Alert system

I. INTRODUCTION

This project focuses of driverless automatic metro train systems represents a significant milestone in the realm of urban transportation, promising enhanced safety, efficiency, and reliability. In recent years, advancements in artificial intelligence, sensor technology, and communication systems have enabled the development of sophisticated autonomous train control systems capable of navigating complex urban environments without human intervention. However, ensuring the safety of passengers and the integrity of operations remains a paramount concern. In response, this paper introduces a novel approach integrating a robust alert system into driverless metro train networks. By leveraging real-time data analysis and advanced sensor technologies, this system detects and responds to potential hazards promptly, mitigating risks and ensuring the seamless operation of the metro network. This introduction sets the stage for exploring the design, implementation, and performance evaluation of this innovative driverless automatic metro train with an alert system, aiming to contribute to the advancement of safe and efficient urban transportation solutions.

II OBJECTIVE

The primary objective of this IEEE paper is to propose and investigate an integrated driverless automatic metro train system equipped with a sophisticated alert system, aiming to enhance safety, efficiency, and reliability in urban transportation networks. The specific objectives are multifaceted:

Design and Development: To design a comprehensive driverless automatic metro train system that incorporates state-of-the-art technologies such as artificial intelligence, sensors, and communication systems. This entails developing algorithms for autonomous train operation, integrating sensor arrays for environment perception, and designing communication protocols for real-time data exchange.

Alert System Implementation: To implement an advanced alert system capable of detecting and responding to potential hazards in the metro train environment. This involves deploying a network of sensors along the train track and onboard the train itself, enabling the system to identify obstacles, track anomalies, and mechanical failures promptly.

Real-time Data Analysis: To develop algorithms for real-time data analysis to interpret sensor data and identify potential hazards accurately. This includes employing machine learning techniques for pattern recognition, anomaly detection, and predictive maintenance, enabling the system to preemptively address issues before they escalate.

Alert Generation and Dissemination: To design a mechanism for generating timely alerts in response to detected hazards and disseminating them to relevant stakeholders. This encompasses developing notification protocols for onboard personnel, control center operators, and emergency responders, ensuring swift and coordinated responses to emerging situations.

Performance Evaluation: To conduct rigorous performance evaluation of the proposed system under various operating conditions, including normal operation, simulated emergency scenarios, and unexpected disruptions. This involves assessing the system's responsiveness, accuracy, reliability, and effectiveness in mitigating risks and maintaining operational continuity.

Safety and Reliability Assessment: To assess the safety and reliability implications of the integrated driverless automatic metro train system with the alert system. This includes analyzing potential failure modes, conducting risk assessments, and comparing the safety performance of the proposed system with traditional manned operation and existing driverless metro systems.

By addressing these objectives, this paper aims to contribute to the body of knowledge on autonomous transportation systems, providing insights into the design, implementation, and performance of integrated driverless metro train systems with advanced alert capabilities. Furthermore, the findings of this research are expected to inform decision-making processes for urban transportation planners, operators, and policymakers, ultimately facilitating the adoption and deployment of safer and more efficient metro train networks.

II LITERATURE REVIEW

1. A Driverless Metro Train using ARM7" by Parkash Ratan Tambare, and Chandra Jogi, tell us how a metro train can be made to travel from one platform to another without the aid of driver by using ARM 7 processor with the LPC2148 Microcontroller. The functions are not only limited to travelling but it also automatically opens the door, waits for the passengers to board and deboard and closes the door automatically. The system will know if the train has arrived at the station or not, through the IR reflectance sensors. The walls adjacent to the train runs out when the station arrives because of which the IR rays are not reflected back, indicating to the train that the station has arrived.

2. In the paper titled "Advance Mechanized Metro Train" by Bomdar Bagra1, Vinay Kesharwani, Neeraj Singh, Roheet Khambe, Niranjan Samudre tell us about how we can enhance the safety of passengers in metro trains by incorporating certain feature to it using AT-MEGA 328p as central processing unit. It provides features such as collusion avoidance using ultrasonic sensors and monitoring the temperature of wheels of the train using IR sensors. Based on the data provided by these sensor systems the train will stop and avoid any casualties.

III METHODOLOGY

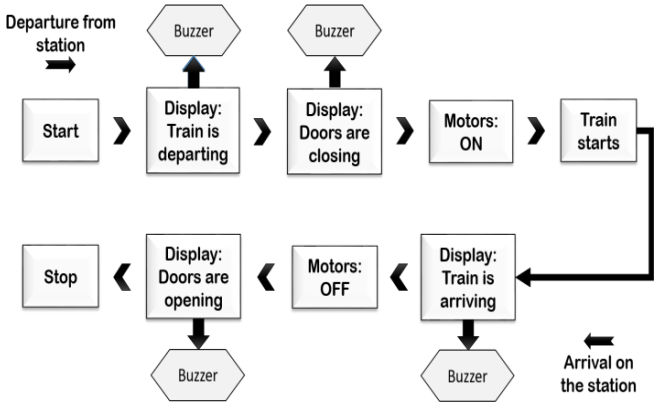

Fig 1**:** State diagram of train during departure and arrival on the station.

The methodology employed in this paper involves a systematic approach to design, implement, and evaluate an integrated driverless automatic metro train system with an advanced alert system. We have used Arduino Mega as the main controller. The supply of 5V to the Arduino is given by a source like power bank. All the components which are used for the different operation of the train are connected to the Arduino. At first, the train will get supply from a source and gets ready to move. Here we have used the 12V battery for giving supply to the motor driver IC and door motor. But before that, the LCD will display the message that "The train will depart from the station in few minutes". The buzzer operates for every LCD message and for door operation. The passenger counting section came into action and count the passenger by use of IR modules and display on the LCD. Then the LCD will display the message that "Doors are closing" with buzzer operation. The state of the motor is changed from off state to on state and the train starts moving and departs from the station. When the train is arriving on the station, the LCD will display the message that "Train is arriving on the station in few minutes" with buzzer operation. The state of the motor changes from on state to off state by use of RFID sensor and RFID tags. RFID sensor is fixed on the train and RFID tags are fixed near the station. By detection of RFID tags by RFID sensor, the train changes its state of motors from on state to off state.

Then the LCD will display the message that "The doors are opening" and the door control will open the door. The whole operation of departure and arrival is repeated on every station during the train operation. This project also contains some additional features like GSM based SMS service. We can track the position of the train by using this system and send the information to the control center by using this service. This train is having a solar panel on the top for running the auxiliaries of the train like LCD displays, mobile charging sockets, lighting, fans etc. The produced solar power can be converted into AC power according to the requirement by the inverters. The use of solar panels reduces the power consumption of the train. This project also includes smoke detection via the MQ2 smoke sensor for the protection purpose. When there is some problem in the train due to system failure or electric shocks, smoke is produced which is detected by the smoke sensor and give the signal to the Arduino for protection of the train. It protects the train against fire as well as short circuits in the train.

IV ALGORITHM

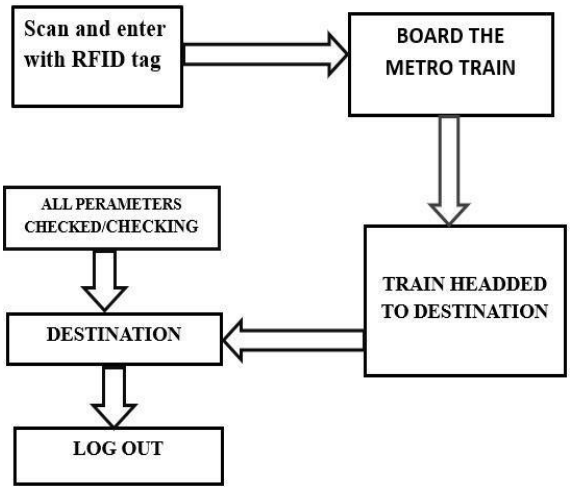

Fig: Implementations And Algorithm

This project implementation of a driverless metro train system with an alert system utilizing RFID tags represents a significant advancement in transportation technology. In this innovative setup, each passenger is issued an RFID tag upon entry into the train station. These tags are uniquely encoded to correspond to individual passengers or groups, allowing for precise tracking and identification throughout the journey.

As passengers board the train, their RFID tags are scanned, registering their presence onboard. The train's onboard computer system continuously monitors the RFID signals, ensuring that all passengers are safely accounted for during

transit. In the event of an emergency or abnormal situation, such as a passenger falling ill or attempting to access restricted areas, the alert system is triggered.

Upon detection of such an event, the onboard computer immediately notifies the central control system, which can take appropriate action. This may include alerting security personnel, rerouting the train to the nearest station, or initiating emergency protocols to ensure the safety of passengers and staff. The RFID-based alert system enhances security measures by providing real-time tracking of passenger movement and behavior. This capability enables operators to quickly identify and respond to any potential threats or incidents that may arise during the journey.

V RESULT

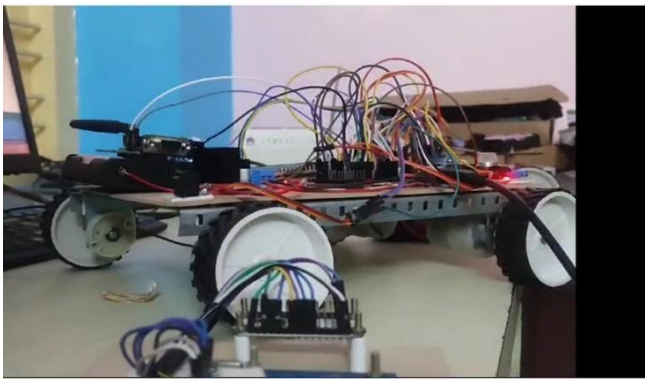

Fig: Result

Demonstrated this project by built a prototype model of driverless metro train. Have used DC gear motors and connected it to the wheels. A simple CD drive is used for automatic door operation. A DC motor is used for door operation. It is to be noted that a buzzer will operate at every door operation function. By running this prototype model we got results as getting messages like the name of the station, he number of passengers and door position on LCD display. The passenger counting is completed by using IR module and displayed on LCD. The speed of the motor is controlled by the motor driver IC and the supply to the motor driver IC and door motor is given by battery of 12 volts. The door is automatically open and close with detection of the station by RFID sensors. There is some delay is provided between opening and closing of the doors by means of programming. Detection of the station is done by sensing RFID tags by RFID sensor and it gives a signal to change the motor state from on state to off state. The solar panel on the top of the train is used to supply the train auxiliaries. We are using an LED as load or auxiliary of the train. It reduces the overall power consumption of the train. The train on which station is detected by the RFID sensor by sensing the RFID tag on that station. So we can get the location of the train on the particular station by GSM system. The vibration sensor has come into action when the vibrations in the train due to some fault is exceeded from the predefined limit. It sends the signal to Arduino and that signal can be sent to control center by using GSM module.

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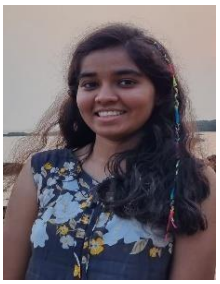

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Exploring the Foundations: An Overview of Communication Protocols

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***Abstract*—This paper is designed to build the landscape of modern communication networks encompassing a diverse array of wired and wireless technologies, each with unique characteristics and challenges. This paper provides an overview of communication protocols, exploring their roles in wired domains. It discusses the fundamental principles underlying these protocols, addressing type's distinct requirements, advantages, and limitations. Additionally, the paper delves into the convergence of wired and wireless protocols, highlighting efforts to establish seamless interoperability between heterogeneous networks. It analyzes the implications of this convergence on data transmission, network efficiency, and user experience. This paper aims to contribute to a holistic understanding of modern communication infrastructures by examining the commonalities and differences between wired and wireless protocols.**

I. INTRODUCTION

Communication protocols serve as essential frameworks that dictate the rules and conventions governing the exchange of information between devices or systems[1]. Their primary objective is to ensure a standardized and efficient communication process, defining how data is transmitted, received, and interpreted. These protocols play a vital role in enabling seamless interaction and data exchange across various applications, including computer networks, the internet, industrial automation, and telecommunications[2]. Two main categories of communication protocols exist: wired and wireless. Wired communication involves physical connections like cables, where protocols such as Ethernet and USB dictate data transfer. Conversely, wireless communication utilizes radio waves or infrared signals, with protocols like Wi-Fi and Bluetooth facilitating wireless data exchange. Wired communication protocols offer several advantages, including greater reliability, higher data transfer rates, and enhanced security due to the physical medium, making them less susceptible to interference[3]. These protocols find applications in critical systems such as industrial control networks, where reliability is crucial, and in data centers for efficient and secure communication between servers and devices[4].

In summary, communication protocols are indispensable for modern connectivity, providing the necessary rules and standards for effective data exchange. Wired communication protocols, in particular, stand out for their reliability and security, making them essential in critical applications[5]. As technology evolves, developing and adhering to communication protocols will continue to be fundamental for ensuring standardized and efficient communication across diverse systems and devices.

II. PROPOSED METHODOLOGY

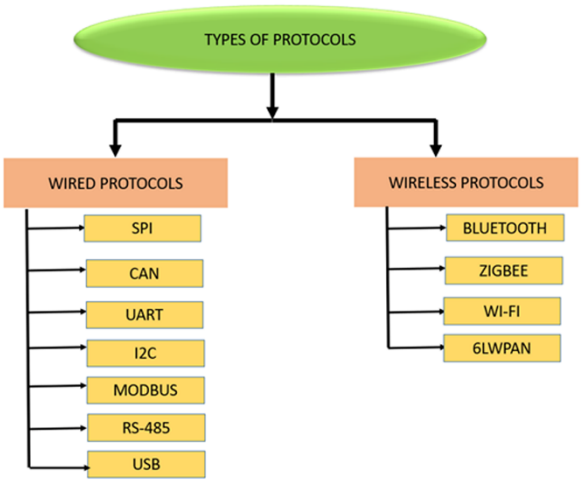

Fig. 1: Flow diagram of types of protocol

In this paper, we mainly concentrate on wired communication protocols. As shown in fig 1, we consider SPI, CAN, UART, USB, MODBUS, RS-485, and LIN protocols. Let us understand each of them briefly. First, we will go with the SPI protocol, SPI (Serial Peripheral Interface), which is a synchronous serial communication interface used for short-distance communication between microcontrollers, sensors, and other peripheral devices[6]. It employs a master-slave

architecture and supports high-speed data transfer. Now we will consider CAN (Controller Area Network) is a robust and widely used communication protocol primarily utilized in the automotive industry and other embedded systems[7]. Now we will go with UART (Universal Asynchronous Receiver-Transmitter): A simple asynchronous serial communication protocol used for transmitting data between devices. It's commonly found in microcontrollers, allowing data transfer between devices at lower speeds compared to other protocols[8].

Now we will consider another protocol, I2C (Inter-Integrated Circuit), which is a two-wire serial communication protocol facilitating connectivity between electronic devices[9]. Widely adopted for its versatility, it supports multi-master configurations and is commonly used in interfacing sensors, memory, and peripherals. Now we will see USB (Universal Serial Bus): A popular wired communication protocol for connecting devices like computers, peripherals (printers, keyboards, etc.), and storage devices. USB supports data transfer, power supply, and various device connections[10]. Now, we will go with Modbus: A communication protocol commonly used in industrial automation. It defines a standard for communication between devices connected via serial lines (RS-232, RS-485, etc.), typically used for transmitting data between electronic devices[11]. Consider RS-485 (Recommended Standard 485): A serial communication standard that supports multiple devices on a single bus, commonly used for industrial and long-distance communication due to its noise immunity and robustness[12]. Lastly consider LIN (Local Interconnect Network): A serial communication protocol used in the automotive industry for communication between vehicle components like sensors, actuators, and other control devices[13].

Now we will consider a few examples from wireless protocols like Bluetooth, Zigbee, Wi-Fi, and 6LoWPAN. Bluetooth: A short-range wireless communication protocol used for connecting devices like smartphones, speakers, headphones, and IoT devices[14]. It operates in the 2.4 GHz frequency band and facilitates data and audio transfer. Zigbee: A wireless communication protocol designed for low-power, low-data-rate applications like home automation, IoT devices, and sensor networks. It operates on the IEEE 802.15.4 standard , allowing devices to form mesh networks. Wi-Fi 6 (802.11ax): The latest standard of the Wi-Fi protocol, offering faster speeds, improved efficiency in high-density environments, and reduced latency compared to its predecessors. 6LoWPAN (IPv6 over Low-Power Wireless Personal Area Networks): A communication protocol that allows transmitting IPv6 packets over low-power wireless networks, often used in IoT applications for connecting devices[15].

Wired protocols offer greater reliability and stability compared to wireless counterparts, ensuring consistent and secure data transmission. They often provide higher data transfer rates, reducing latency and enhancing real-time communication[16]. Wired protocols are less susceptible to interference, making them suitable for critical applications where signal integrity is crucial. Additionally, they typically have lower power consumption, contributing to energy efficiency in connected systems.

III. COMPARISON TABLE 1

Protocol	Data Rate (bps)	Distance (meters)	Topology	Half/Full Duplex	Error Checking	Complexity	Application
UART	300 bps - 25 Mbps	15 - 1,000	Point-to-Point	Half/Full Duplex	No	Low	General-purpose serial communication
I2C	100 kbps - 3.4 Mbps	1 - 100	Multi-master, Multi-slave	Half Duplex	Yes (CRC)	Low	Short-distance communication in embedded systems
SPI	1 Mbps - 10 Gbps	0.3 - 50	Point-to-Point, Daisy Chain, Bus	Full Duplex	No	Moderate	Short-distance communication in embedded systems
USB	1.5 Mbps - 20 Gbps	3 - 5	Point-to-Point, Bus	Half/Full Duplex	Yes (CRC)	High	Computer peripherals, data transfer
LIN	Up to 20 kbps	40 - 300	Bus	Half Duplex	Yes (Checksum)	Low	Automotive networks for body electronics
Modbus	9600 bps - 115 kbps	1,200 - 1,500	Master-Slave, Multi-master	Half Duplex	Yes (LRC)	Low	Industrial control systems
RS485	100 bps - 10 Mbps	1,200 - 1,500	Multi-point, Multi-drop	Half Duplex	Yes (CRC)	Moderate	Industrial automation, building automation
RS422	Up to 10 Mbps	1,200 - 1,500	Point-to-Point, Multi-point	Full Duplex	No	Moderate	Industrial data transmission
CAN	Up to 1 Mbps	40 - 1,000	Bus	Half Duplex	Yes (CRC)	Moderate	Automotive networks, industrial automation

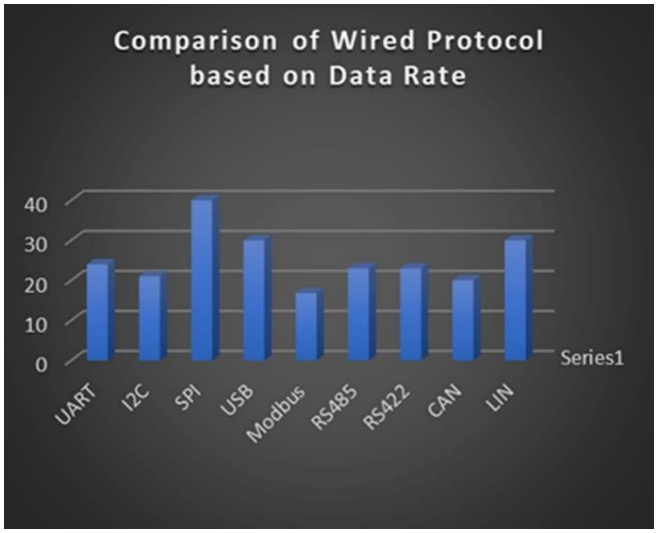

Fig. 2: Comparison of wired protocols based on Data rate

The provided table comprehensively compares several communication protocols- UART, I2C, SPI, USB, LIN, Modbus, RS485, RS422, and CAN—across various key parameters. The first column lists the protocols, while subsequent columns delve into critical aspects of their

performance. Data rate, expressed in bits per second (bps), indicates the speed at which data can be transferred. For instance, USB boasts high data rates ranging from 1.5 Mbps to 20 Gbps, suitable for rapid data exchange in computer peripherals[17]. In contrast, LIN operates at a maximum of 20 kbps, making it suitable for less data- intensive applications in automotive networks. Distance, measured in meters, outlines the effective range over which each protocol can reliably transmit data. RS485, commonly used in industrial automation, can cover distances of up to 1,500 meters, whereas USB is optimized for shorter ranges of 3 to 5 meters. Topology defines the network structure each protocol supports. SPI offers versatility with options like point-to-point, daisy chain, and bus configurations, while LIN operates on a bus topology ideal for automotive networks[18]. Half/Full Duplex signifies whether the communication is simultaneous (full duplex) or one-way at a time (half duplex). RS422 supports full-duplex communication, enabling simultaneous data transmission and reception. Error-checking mechanisms, such as cyclic redundancy check (CRC) and checksum, contribute to data integrity. USB and I2C implement CRC, enhancing reliability, while LIN employs a checksum for error detection. USB, a high-speed, sophisicated protocol, entails greater complexity, and is suitable for demanding applications like data transfer between computers and Peripherals.

Applications describe the primary use cases for each protocol. Modbus, with its reliability and simplicity, finds application in industrial control systems, while CAN is widely employed in automotive networks.

In summary, the table provides a comprehensive overview of the strengths and limitations of each communication protocol, aiding in the selection of the most suitable one based on specific requirements and application scenarios.

IV. RESULT

Wired and wireless communication protocols serve the same fundamental purpose of facilitating data transfer but do so through different mediums. Wired communication protocols commonly include SPI (Serial Peripheral Interface), USB (Universal Serial Bus), I2C (Inter-Integrated Circuit), and others. These protocols rely on physical cables to transmit data, offering reliability and often faster speeds due to the stable connection. On the other hand, wireless communication protocols utilize electromagnetic waves for data transmission. They offer mobility and flexibility but might be prone to interference and have variable speeds based on environmental factors. Both types of protocols have their strengths and weaknesses, and their suitability depends on factors like range, data transfer speed, security, and specific use cases. Data rate is a crucial parameter for assessing the efficacy of various wired protocols, with Comparison Table 1 as our point of reference. Our analysis involves the creation of a bar graph, depicted in Fig. 2, to discern the performance trends concerning data rates among different communication protocols. Notably, our findings indicate that the SPI protocol outperforms others, emerging as the communication protocol with the highest data rate.

V. CONCLUSION

wired communication protocols offer reliability, stable connections, and often faster speeds due to physical cable connections. They are generally less susceptible to interference but lack mobility. On the other hand, wireless communication protocols provide mobility, flexibility, and convenience but might suffer from interference, security concerns, and potentially slower speeds depending on environmental factors. Each type has its advantages and drawbacks, and their suitability depends on specific needs, such as range, speed, mobility, and the intended application or environment. Combining wired and wireless protocols is common to leverage the strengths of each for diverse connectivity requirements.

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"IoT Innovations in Health Management: A Monitoring System Approach"

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Abstract— This project's primary goal is to create a unified approach for heart rate monitoring and a heart attack alert system for all cardiac patients, particularly the elderly and those who are at risk. A pulse sensor is utilized in this proposed system to measure an individual's heart rate, which is then posted on hardware and uploaded to cloud servers via the Internet of Things. This system was developed with mobility and compactness in mind. The majority of the components were also designed to fit into a strap-on container. The system uses the heart rate data to send emails and notifications to any address regarding an emergency based on a very high or low heart rate. When tested against at least one other commercial device that has the ability to measure heart rate, the notification system's overall accuracy and performance were found to be at least 96%. In this report, the system's recommendations and limits have also been completed.

Keywords: Blynk, smartphone application, ThingSpeak, heart attack, heart rate data, and the Internet of Things

INTRODUCTION

As the most intelligent species to roam the globe, we unquestionably have a highly important organ in our bodies: the heart. For this reason, we have been able to advance technology and can still do so—sometimes even on a daily basis. Ensuring the improvement of our healthcare system is one of the primary goals of technology, which has many applications. One of the most significant technical developments in recent years is the Internet of Things, or IoT. (Abdulla et al., 2020; Al-Gumaei et al., 2018; Eldemerdash et al., 2020; Haziq et al., 2022; Hon et al., 2020; Kalilani et al., 2021; Katemboh et al., 2020; Lakshmanan et al., 2020; Murugiah et al., 2021; Nazrin et al., 2021; Rasheed et al., 2021; Samson et al., 2020; Singh et al., 2021; Yong et al., 2020). Among other things, having a network or system of various sensors and devices that can gather data and information and transmit it over the internet to more sophisticated systems that can process and/or store it for convenient viewing is very profitable. All of this happens automatically, eliminating the need for human oversight or human-to-human interaction. (GOPI & VAM, 2019) Regarding the heart, the heart's pulse rate in a given amount of time can provide significant information about an individual's health and is, thus, an extremely valuable metric to keep an eye on, particularly for individuals who have cardiac issues and are at higher risk. Despite the fact that most hospitals and clinics can assist individuals with such if the situation is not too bad, monitoring, the cost, and time wasted should all be taken into account (Abbasi- Kesbi et al., 2018).

Here's where an IoT gadget that's reasonably easy to make could help these folks. Patients almost always depend on these devices to improve their quality of life by reducing the number of times they visit the clinic for minor ailments and by enabling continuous data recording that can be reviewed by medical professionals. These devices are highly accessible and innovative, and anyone can wear them to monitor and, if possible, control vital health parameters like heart rate. Furthermore, as delayed diagnosis and treatment are two of the main causes of the high rate of cardiovascular patient deaths (Patel et al., 2018), it enables those professionals to act as soon as possible when the data may indicate worsening conditions and/or when the user is in a state of emergency (Majumder et al., 2019). Because of this, using and implementing connected health systems is crucial to giving users access to more information about their health status at any time and place for self-diagnosis and self-treatment, as well as the possibility of early detection of medical attention needs (Majumder et al., 2019).

Globally, cardiovascular disease is one of the most significant health problems. Continuous heartbeat monitoring is one approach to both identify potential issues and the need for medical attention, as well as to maintain daily awareness of one's health status (Lin et al., 2017). This isn't possible because gathering this data requires traveling to designated locations, which can be costly and time-consuming. According to Abbasi-Kesbi et al. (2018), the objective is to create a reasonably easy and intelligent system that everyone can wear for this kind of purpose in their daily life. This device must be able to accurately gauge a person's heart rate in beats per minute. Additionally, this information must be uploaded and kept so that any healthcare provider may easily access it; ideally, this will involve building a database on the individual. According to Sethuraman et al. (2019), the gadget must not only be able to identify irregularities in the patient's heartbeat but also include a notification system that can warn a loved one who may be able to assist the patient. This gadget is also intended for medical professionals, giving them access to continuous, round-the-clock cardiac data that they may utilize to build patient profiles or databases that they can consult for diagnosis. The project's goal is to build and create a wearable heart-monitoring gadget that can detect and notify users of impending heart attacks.

The project's beneficiaries are essentially all people on the planet, particularly those who suffer from cardiovascular disease, which should be more than enough motivation to work and invest in developing such systems given that it is the leading cause of death worldwide (Lin et al., 2017). It certainly helps the cause that researchers discovered that a person's heart rate alone is an independent cardiovascular risk factor and that one of the goals of treatment (Lin et al., 2017) is to monitor and control the heart rate to be in the normal range (for most people of average age) of 60-100 beats per minute (bpm) (Patel, Patel & Patel, 2018). Additionally, this technology makes it possible for more people who are not fortunate enough to regularly visit a hospital or clinic to spend time and money on monitoring to have access to a reliable, accurate, and purpose-built heartbeat measuring gadget. Having access to continuous cardiac data around-the-clock and creating patient databases and profiles that can be reviewed when issues emerge also helps healthcare personnel keep an eye on their patients.

(Patel et al., 2018) designed and developed a system that uses Internet of Things monitoring of an individual's heart rate to detect a possible heart attack. Theoretically, this method would speed up the diagnosis process for heart attack victims, potentially increasing their chances of survival. (GOPI & VAM, 2019) suggested creating a useful system that can monitor a patient's heart rate utilizing the Internet of Things and readily available sensors. This would make it possible to monitor heart rate anytime, anywhere, and without a nurse's supervision. The technology is also said to be affordable and simple to use. (Sethuraman et al., 2019) proposed an IoT-based system that could monitor heart rate. This would help users and doctors alike assess how well a person's heart is functioning over the long term and maintain a better heart shape. The system would also be able to detect any abnormalities in heart rate, in which case the doctor would receive an alert.(Abba & Garba, 2019) presented a system that purported to have developed a clever, user-friendly framework for pulse rate monitoring and regulation that sought to be accommodating, trustworthy, discreet, and equipped with an Internet of Things network of sensors to be used in the medical profession to make physicians' and nurses' jobs easier. Beach et al. (2018) presented a device that incorporates ECG sensors into a physically configurable wristwatch-style body that is designed to last for an extended period of time without requiring recharge. This system will be linked to SPHERE (a Sensor Platform for HEalthcare in a Residential Environment), a UK-recognized IoT framework that offers a platform for wearable data integration. In order to create a real-time health monitoring system, (Wan et al., 2018) proposed the WISE (Wearable IoT-cloud-baSed hEalth monitoring system) system. This system makes use of the body area sensor network (BASN), which is a component of the IoT infrastructure. The idea behind the data is that it will encourage users to be more aware of their own health status. Additionally, the system was designed to transmit all data directly to cloud servers, eschewing the need for smartphone usage. In order to create a device that can measure and monitor heartbeat rates in both healthy individuals and heart patients, (Goel et al., 2018) developed a system utilizing basic components. This is helpful for monitoring heart rate as well as the condition and functionality of the cardiovascular system in humans.

I. SYSTEM IMPLEMENTATION

As seen in Fig., a flowchart was made to help identify and visualize the various elements involved in the construction of the system for this research project.

1.

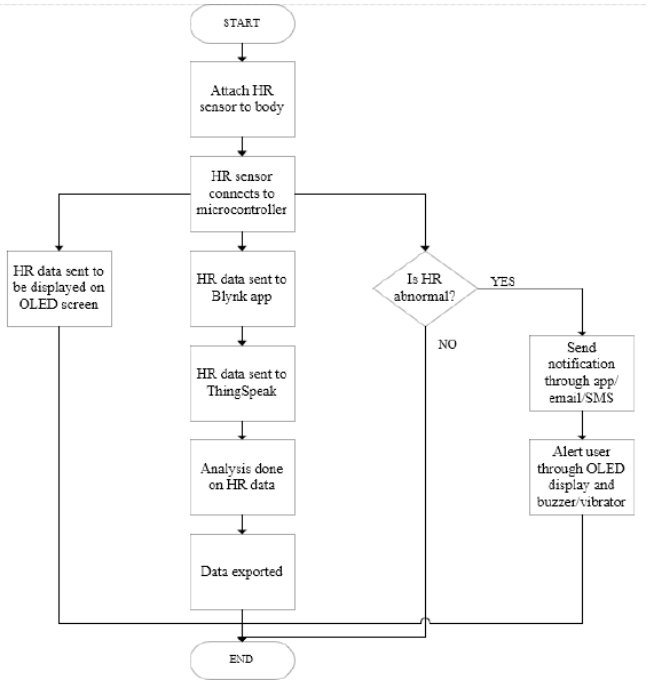

Fig. 1. Flowchart of the project system

The flowchart created to describe every facet of this project's technique is displayed in Fig. 1. First, an elastic strap that fits either way is used to attach the heart rate sensor to a part of the body, specifically the wrist or the index fingertip for improved accuracy. In order to make the system portable, the microcontrollers are also housed in a small box that can be strapped to the upper arm.

The selected NodeMCU microcontroller receives the measured HR data from the sensor in terms of BPM. The source code has been updated since coding for the many jobs the microcontroller must perform was completed. Through the on-board Wi-Fi module, the microcontroller establishes a connection to the internet and transmits data to the Blynk servers. This is done to enable Blynk to receive HR data, which is only received every 20 milliseconds, and display the data in real-time on the app. It is challenging to transmit data straight from the microcontroller to ThingSpeak since it can only update once every 15 seconds, and data from the sensor seems to get lost and the website would fail to update.

The HR data is therefore posted using Blynk, and ThingSpeak is updated with the most recent accurate reading from Blynk. MATLAB analytics is available for ThingSpeak and is helpful in analyzing the data that is supplied to the servers. In order to analyze additional data based on the HR data that is supplied and stored on ThingSpeak over time, MATLAB code is therefore done. Additional details that can be obtained include the highest and lowest HR values recorded by the sensor over a 24-hour period, the average HR during that same period, and so on. The HR data may also be exported using the ThingSpeak function, which enables the user or anybody else to download the data in an excel file with date and timestamps for each reading in a report-like format.

A) Overall Block Diagram

The block diagram of the completed system is displayed in Fig. 2. The block diagram was created using the same components and operating theory for the same system. The input device was a smart pulse rate sensor from the Gravity brand. The pulse or beat per minute is measured by this sensor, and the data is transmitted into a NodeMCU microcontroller to determine the user's heart rate. This is connected to two output devices: an OLED screen that shows the sensor's data directly on hardware, and a buzzer that sounds when the sensor reading deviates from predetermined levels.

The microcontroller is coupled to an external battery to provide power and enable mobility for the system. Because it has an on-board Wi-Fi chip, the microcontroller can be programmed with software to change hardware as needed for the project. It then connects to the internet via Wi-Fi and uploads data to cloud servers in an appropriate and timely manner.

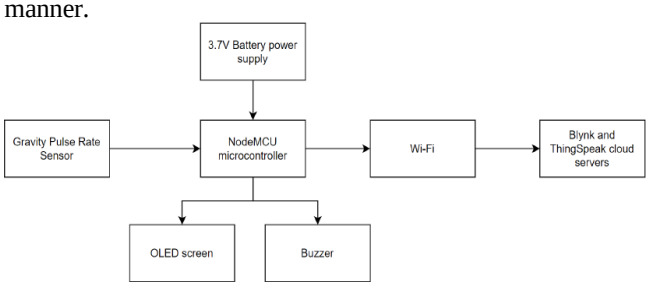

Fig. 2. Block diagram of the system

In order to enable users to view the HR reading in real-time straight from the physical system without having to constantly log in to a phone or web server, the microcontroller is further attached to an OLED screen. Additionally, the conditioning mechanism that compares each sensor data output to the predetermined maximum and lowest HR limits is coded into the microcontroller.

The Blynk app is configured to notify users through the app and, if desired, by email or SMS, in the event that a reading falls or rises above specific levels. This serves as a warning to others about any potential abnormalities. In order to inform the user from the hardware itself and not rely on a phone app that can be out of reach, an alert message is also presented on the OLED screen. The user can choose between a buzzer and a small vibration motor.

B) Concept Design

Even if the mechanism in this project is implemented as best it can, a few presumptions must be made. It is important to note that, even if the system functions well and produces high-quality results, it should not be regarded as a medical device of the same caliber as a professional one because errors may still occur due to inherent flaws in the sensor. Another supposition is that in order for the hardware to provide a reliable readout, the person must be motionless. According to Pietilä et al. (2018), the accuracy test between two commercial devices—one that used PPG and the other that used ECG—showed that while the PPG device's results for HR while moving and stationary were significantly better than those of the ECG device, the percentage of correctly measured HR decreased from 89% while stationary to 76% while moving. As a result, an accuracy of roughly ±10 BPM and comparable accuracy can also be anticipated from the project; however, this accuracy will still be evaluated using final hardware against other devices.

Using a program called Fritzing, the concept hardware circuit connections were constructed digitally. In Figure 3, the circuit design is displayed.

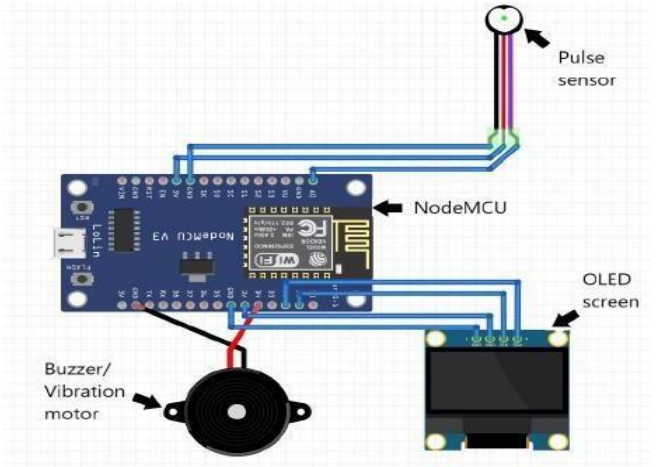

Fig. 3. Circuit design for the hardware

Figure 2 illustrates how the pulse sensor is linked to the NodeMCU in order to receive the "GND" and "5V" connections for the sensor's power supply. The sensor's signal pin is attached to the single analog pin "A0." Data is sent and fed into the microcontroller at this point. Similar to the sensor, the OLED screen is similarly wired for power. For data interchange, its data ports ―SCL‖ and ―SDA‖ are connected to digital pins ―D1‖ and ―D2,‖ respectively. In order for the buzzer in the figure to work as intended, it must be connected to ground and digital pin "D4", which is configured as an input. The buzzer might alternatively be a straightforward vibration motor.

The chosen sensor already delivers the heartrate data in digital form in terms of BPM, therefore coding was done for the NodeMCU to receive it, display it on the OLED panel, and send it to the mobile and online GUI. By comparing the received measured heart rate value with the predetermined threshold values, conditioning codes were utilized to transmit alerts when and if very high or very low heartrate is identified.

C) Constructional Details

The SolidWorks software's 3-D design for the box is displayed in Figures 4,5, 6. The general isometric view of the design is displayed in Fig. 4. Proper ventilation of the container is made possible by the slots on the sides; otherwise, parts such as the NodeMCU would overheat and experience throttle. The slits on the lid, which slide to open as seen in Fig. 5, are similarly functional and designed to let the jumper cables for the OLED panel pass through. This enables the NodeMCU and other components to be placed within the container, with the display mounted on its exterior, front face. The rear of the container as depicted in Figure 6. further displays two lengthwise slides on either side of the box. They are designed to allow a rubber strap with Velcro to be looped between them. This is done so that the user can attach the box to their upper arm or any other comfortable place. This would certainly eliminate the need for the user to carry all the components around by hand, which is obviously not ideal, in addition to making the user mobile. The container was designed to be made of plastic, which reduces weight, and was to be created using a 3-D printer. The box's bottom has a rubber texture cushion

attached to it so that customers won't find it too uncomfortable to wear over bare skin.

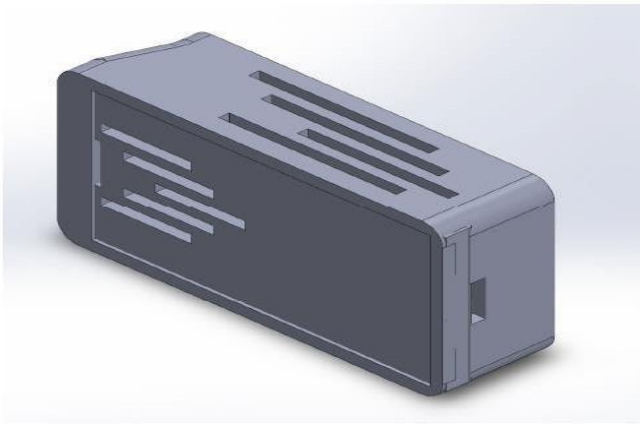

Fig. 4. Front (isometric) view of 3-D printable container

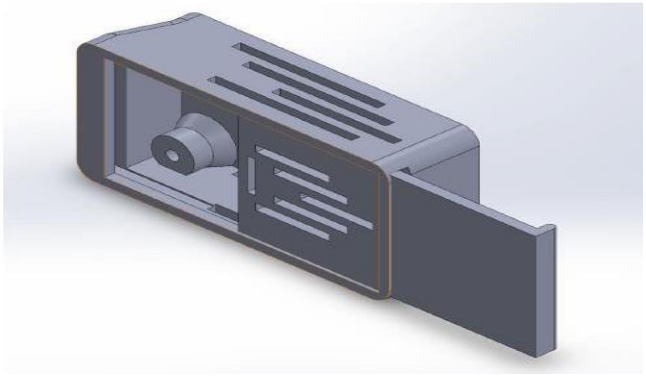

Fig. 5. Front (isometric) view of 3-D printable container with sliding door open

Fig. 6. View of backside of the container

A photograph of the entire hardware circuit, connected in accordance with the Fritzing diagram's construction specifications, may be found in Fig. 7. Like a laptop, the entire system is mobile and not dependent on any external power source because it is fueled by a battery that serves as a remote power supply. The system will automatically begin posting the user's heartrate on the display and sending the numbers to Blynk as soon as they wear the pulse sensor. This will happen after a brief wait during which the device connects to the Wi-Fi and self-calibrates for the reading. Two graphical user interfaces (GUIs) were created for the system: one for a Blynk-made mobile app and another for the ThingSpeak webserver.

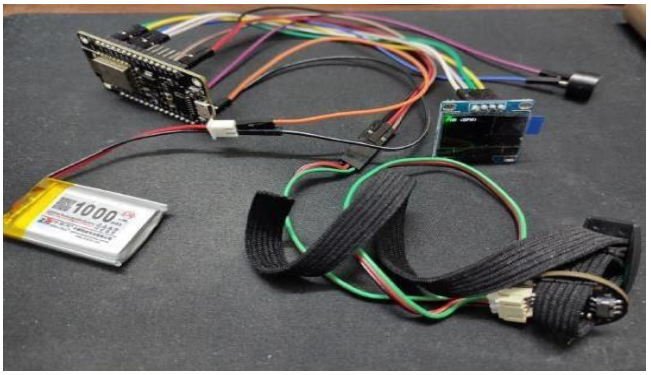

Fig. 7. Image taken of full hardware circuit

Figure 8 displays a few useful widgets along with the arrangement of the many parameters that will be presented. The first widget feeds data to the virtual pin "V0" and is used to communicate the heartrate values that are to be shown. It refreshes a few times per second based on the microcontroller's data transmission rate. Because these values are stored on Blynk servers, they may be utilized to display a real-time graphical depiction of the incoming data as well as plot a graph of the heartrate over a user-selectable period of time.

Fig. 8. Blynk GUI

The reports widget makes it possible to export the data that the servers are saving to a variety of file formats, such as Excel with time and date stamps for every item, which can be helpful. The app is able to send emails to the specified address and push notifications to the mobile device since the email and notification widgets are present in accordance with the coding done in the Arduino IDE for the microcontroller. The final widget utilized is referred to as "WebHook," and its primary function is to interface external applications with Blynk. This is how information is sent to ThingSpeak, which can only refresh once every fifteen seconds. As a result, the sensor's considerably faster output is frequently missed. As a result, ThingSpeak can take the most recent reading every fifteen seconds by transmitting the data through Blynk, which already records practically all readings into its server. Since the widget actually manages the entire process on its own, provided that the widget settings are input with the necessary correct information, such as the ThingSpeak API URL, the virtual pin to get the data from, and so forth, this also enables very effective and simpler coding for the microcontroller.

Figure 9 displays the GUI created on the ThingSpeak platform. This GUI, which is accessible from any web browser, offers a web server where the heartrate data can be saved, as previously mentioned. The first GUI feature displays a graphical depiction of the stored heartrate data over time. For a better or wider range of data to be displayed, the user can also alter the graph's timeline. The second widget, which updates every 15 seconds from the ThingSpeak side, displays the most recent heartrate data that has been collected from Blynk servers.

Fig. 9. ThingSpeak GUI

II. TESTING OF THE PROPOSED SYSTEM

A) Pulse Sensor test

The initial test performed on the project system was to verify and obtain the system's input data, which was the user's heartrate readings expressed in beats per minute (BPM) using hardware from a pulse sensor. The user can choose to have the pulse sensor affixed to their index finger or wrapped around the wrist of their hand—ideally the left one. Each of the five subjects is assigned a value after at least ten consecutive readings are averaged. This is done twice: the first set of data is collected while the subjects are at rest, and the second set is collected following a brief yet shared exercise session. The mean heart rate for each of the five subjects is displayed in Table I below, first at rest and then following a brief period of gentle exercise.

TABLE I. MEASURED MEAN HEARTRATE AT REST AND AFTER EXERCISE

Person	Mean Heartrate at rest	Mean Heartrate after exercise
1	75	126
2	78	131
3	68	109
4	69	114
5	71	119

For improved display, the heartrate data in Table I is collected and plotted into a graph. Heartrate is displayed on the y-axis, and person number is displayed on the x-axis. Orange dots indicate readings following exercise, and blue dots indicate readings when at rest. Looking at the graph demonstrates that the project hardware system can take readings and reflect variations in an individual's heart rate depending on their activity level in every case. This makes sense because exercising is the most natural and, more importantly, healthful way to raise heart rate, as this test here illustrates and from which the conclusion follows.

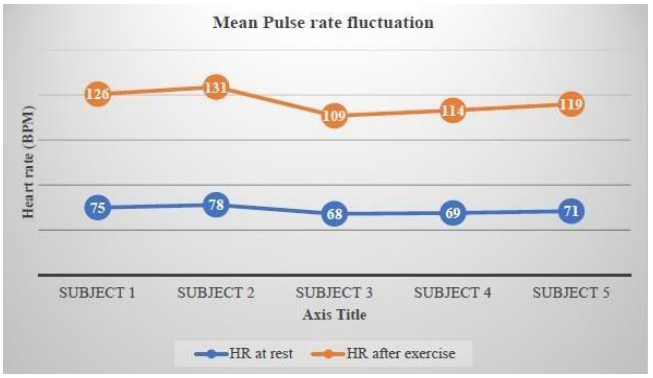

Fig. 10. Graph plot for mean pulse rate fluctuation test

B) ThingSpeak Analysis and Email Notification Test

The application of ThingSpeak and its collection of data analysis tools to the sensor data values was the subject of the third test. In this test, the hardware and the database of values kept on the ThingSpeak servers were used to obtain the findings from the MATLAB analysis and visualization coding that was completed for the hardware as part of the data analysis component of the project. Making sure the NodeMCU is linked to the Wi-Fi and placing the pulse sensor on the left wrist or index finger completes the standard configuration of the hardware. The user must light exercise to raise their heart rate slightly above the recommended threshold levels in order to test the email notification system. During the test, two of the MATLAB analysis apps that were coded were ran. The figures below display the outcomes of each analysis as well as the email that ThingSpeak sends to the specified email address in the system.

Fig. 12. Maximum and minimum heartrate after MATLAB analysis

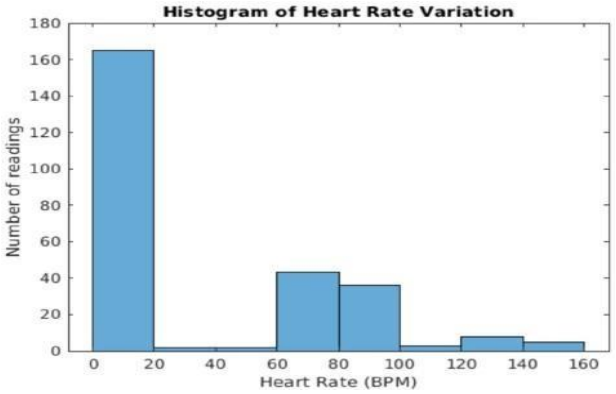

Fig. 13. Histogram for heartrate variation over a period of time

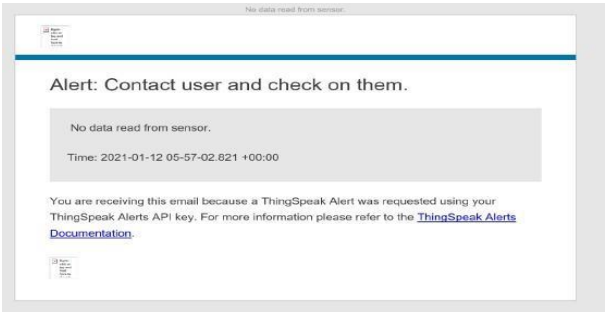

Fig. 14. Email notification sent to given address

It is possible to conclude that the ThingSpeak implementation for the system is operating rather effectively based on the findings shown in Figs. 12, 13, and 14. Figure 12 demonstrated that the maximum heartrate recorded in the previous 24 hours of data saved, when the MATLAB analysis app that was coded for the sensor data saved on their servers was run, was 148 BPM. The lowest heartrate, which was likely an outlier value that was recorded by the sensor during the day, shows zero. The coded MATLAB visualization software is depicted in Fig. 13. It gathers data from the last 24 hours and compiles a summary of all the various readings that the system is capable of taking. This histogram displays the frequency of the heart rate range that peaked over the specified period of time. In this instance, the 0 to 20 BPM range is displayed as the highest because the user left the device running without wearing it for a period. However, ranges of 60 to 80 and 80 to 100 BPM were greater when he was wearing it, which can indicate a normal heart rate for the majority of the day. The email received from the ThingSpeak server is displayed in Fig. 14. This email was sent as a result of the email notification system scanning the database and sending out a notice via email if the heartrate changes too much or too little, along with the most recent measurement. This may be helpful in the event that the user experienced a catastrophic event and their pulse rate dropped to zero, potentially indicating cardiac failure. But in this case, it stated that no data was captured, which was only because the user removed the sensor right before the email was sent. The TimeControl parameter, which runs the analysis code at a certain frequency, allows the user to customize the checking interval, which is currently set at 15 minutes.

CONCLUSION

At the end of the project, it is essential that the goals that were established at the outset are fulfilled. In order to avoid storing data on the cloud for remote access, Blynk was selected for mobile applications and ThingSpeak for online applications. Both platforms provide straightforward user interfaces that are easy for anybody to use. The app notifies everyone who has the app loaded and logged in immediately on their phone notification about the wearer's update on if they are too high or too low. The notification system was also divided into two areas for improved accessibility. Similarly, ThingSpeak would send emails to any address entered into the system depending on the database entries. Heartrate is a complicated metric to assess a person's health because it can vary greatly among people in terms of what constitutes normal. To extract a little bit more data from the normal, MATLAB coding tools were used in certain analysis methods. Without them, it would be impossible to sort through the vast number of values that are stored in the database in a reasonable amount of time.

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An appraisal of Demand-Side Management within the Residential Sector

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Abstract— Demand-side management (DSM) plays a pivotal role within smart distribution systems by enabling informed decision-making from both consumers and suppliers regarding energy consumption. It aims to reshape load profiles and reduce peak demand. This comprehensive review delves into DSM strategies, encompassing demand response and energy efficiency policies. The primary objective of this paper is to outline the key elements essential for strengthening effective DSM, particularly in the context of residential energy demand and the constraints posed by energy indicators. Additionally, it explores the substantial untapped potential and obstacles hindering energy efficiency improvements, aiming to formulate more robust policy responses. Furthermore, it examines a portfolio approach involving integrated strategies to bolster residential measures and address their vulnerabilities within the power market. The paper concludes by presenting holistic measures derived from various findings and attributes, which reinforce DSM strategies to enhance energy management and cost-effectiveness. Additionally, it provides insights into architecture, optimization problem formulation, and various methodologies to guide researchers in maximizing total system peak demand, overall load factor, utility revenue, while minimizing customer electric bills.

Keywords— (demand side management ,demand response program ,linear regression ,optimization, Linear programming)

1 Introduction

In the realm of power system operations, there exist two distinct strategies for addressing the anticipated total load demand: one involves expanding electricity generation to introduce new physical supply-side energy resources, while the other revolves around employing management measures to create virtual demand-side resources. The initial strategy is pursued when the aim is to provide additional energy capacity to meet the escalating load demand arising from modernization or economic growth. In contrast, the second strategy avoids increasing energy supply and instead concentrates on preserving efficiency within the energy sector by implementing appropriate management measures and postponing the expansion of generation capacity. The concept of demand-side management (DSM) has emerged from these managerial measures designed to generate resources on the demand side by influencing load demand. The term "demand-side management" was introduced by Clark W. Gellings in the 1980s. A reliable, secure, and economically viable energy supply has become essential during the past few decades as a result of efforts made to meet the issues brought on by the rapid rise of energy demand[1] As a result, DSM programs incorporate demand-focused policies aimed at influencing the amount and trends of energy consumption. Demand-side response (DSR) and energy efficiency programs constitute their two main parts. These steps help reduce investments in energy infrastructure, minimize electricity costs, improve energy security, reduce environmental pollution, and produce a number of other benefits in the present microgrid setting. compared to the preceding elements, the integration of renewable energy to support DSM and the reorganization of the electrical grid further increase the analysis's complexity by posing fresh and important problems[2]. The residential sector plays a crucial role in figuring out energy consumption, and satisfying the demand for consumption-Side Management (DSM) is crucial to improving customer satisfaction. Demand Response (DR) has several benefits from many angles when it is integrated into managing and operation of microgrids. As 1: Shifting peak loads within the system can help alleviate the need for immediate construction of additional power plants, thereby mitigating potential adverse environmental consequences.2: Demand Response (DR) implementation offers Transmission System Operators (TSOs) several advantages, such as enhanced power transmission reliability, a decrease in forced outages frequency, and an elevation of system reserves to pre-contingency levels. Integrating Demand Response (DR) into Distribution System Operators (DSOs) at the intelligent micro-grid distribution level yields positive outcomes, addressing issues related to voltage-constrained power transfer, alleviating congestion at distribution substations, streamlining outage management, and enhancing electricity supply quality. Operational stress during congestion or peak periods is alleviated by implementing Demand Response (DR), leading to improved service quality, reliability, and reduced load curtailment. The management of Demand Response (DR) contributes to a comprehensive reduction in the tariff framework by integrating energy markets and implementing spot pricing through energy forecasting. The evolving electricity markets bring financial advantages to both consumers and utility providers. Incorporating renewable energy sources into the intelligent distribution system enhances energy distribution performance through efficient energy resource harnessing via Demand Response (DR) management [4-5]. The benefits of employing Demand-Side Management (DSM) across various dimensions, including economic, electricity market, technical, environmental, and social factors, are illustrated in Fig. 1.

A recent survey indicates that the residential sector's energy consumption constitutes approximately 20-30% of the total global energy usage.[5] In-depth information about Demand-Side Response (DSR) in residential settings is provided in this document. Section 2 elucidates the primary

features of residential energy demand. Section 3 investigates the obstacles impeding energy efficiency in the residential sector. Section 4 introduces policies concerning demand-side management and their formulation in this context. Optimization models for Demand-Side Management (DSM), encompassing their formulation and constraints, are delineated in Section 5. Finally, Section 6 outlines prospective research directions with the goal of expanding the study's scope in this field.

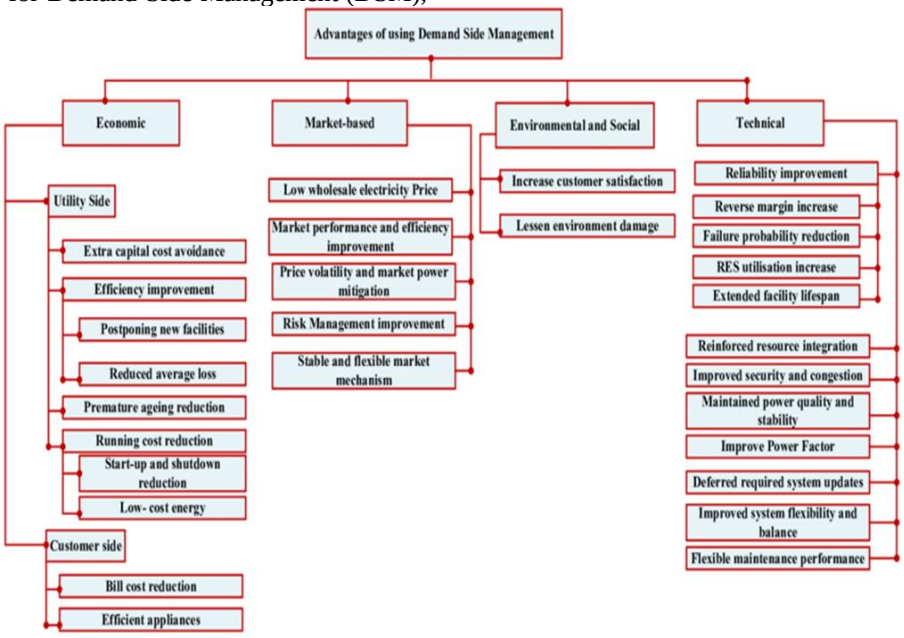

Fig. 1. Benefits of employing Demand Side Management

2 Primary Aspects of Residential Energy Consumption.

2.1 Demand response program

The core objective of demand response (DR) schemes is to motivate consumers to alter their energy consumption behaviors, leading to a necessary adjustment in the overall system's response and thereby improving overall efficiency. Newly developed DR programs can be classified into different categories, including: 1) incentive-based and 2) cost-based DR plans, as depicted in FIG 2.Many authors have also given these programs new names, such as "direct & indirect DR," "emergency-based & economic based DR,"or"system-led & market-led DR." ” [4-6].

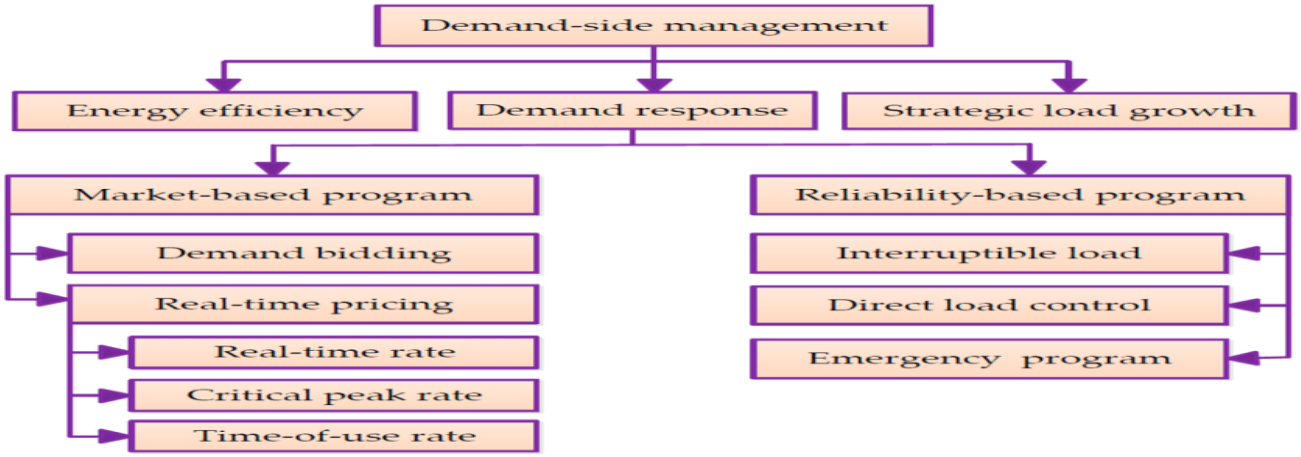

Fig. 2. Various DSM techniques

In incentive-based demand response (DR) programs, customers are motivated through various means to modify their consumption patterns. This affects the total efficiency of energy utilization as well as the cost of energy consumption. Examples of these programs include direct-load controls (DLCs), interruptible tariffs, demand-bidding initiatives, and emergency programs. All of these programs have the capacity to be deployed as needed. Demand-bidding programs are the only ones among these projects that have changeable rates; the others have static rates. While the utility provider implements and oversees DLCs and emergency programs, customers are in charge of the other two. These programs each have a unique set of benefits and drawbacks. [4, 7] However, by utilizing

the benefits of other schemes, composite systems may lessen the constraints.

Within price-based demand response schemes, customers are incentivized to adjust their electricity consumption patterns according to time-varying rates that mirror the value and cost of electricity at different times. Examples of such schemes include Time-of-Use (ToU), Critical Peak Pricing (CPP), and Real-Time Pricing (RTP). ToU and RTP programs are non-dispatchable, indicating they do not involve external control, whereas the CPP scheme can be either dispatchable or non-dispatchable. Furthermore, ToU and RTP programs feature variable rates, while the CPP scheme maintains a static rate. All of these schemes involve actions taken by customers to manage their electricity usage [8-9]. The limitations linked to these schemes remain a subject of ongoing research, prompting researchers to dedicate their efforts to address them in the future.

maintains a static rate. All of these schemes involve actions taken by customers to manage their electricity usage [8-9]. The limitations linked to these schemes remain a subject of ongoing research, prompting researchers to dedicate their efforts to address them in the future.

Effective load scheduling and residential load planning are essential components of Demand Response Management (DRM) schemes, as they enable customers to manage their loads in response to price fluctuations or emergency scenarios. Customer loads can be broadly classified into two categories: loads that can be shifted and loads that cannot be shifted. Depending on the nature of the load, customers can create an optimized schedule to impact their energy costs while helping utility companies balance consumer-level demand. In the realm of DR systems, three common control strategies are typically employed based on the circumstances: centralized, hierarchical, and distributed approaches [10-11].

The successful implementation of Demand Response (DR) within the smart grid framework is significantly facilitated by the pivotal role of information and communication technology. In this scenario, bidirectional communication systems are utilized to transmit DR marketing and emergency signals, contributing to the improvement of power quality, increased reliability, and a reduced risk of blackouts as a precautionary measure. This two-way communication benefits both consumers and utility providers, as it facilitates the exchange of information regarding DR events, enabling them to collaborate for more effective load management. Looking ahead to future technologies, the integration of the Internet of Things (IoT) is anticipated to further enhance the cooperation between customers and utilities in efficiently regulating energy consumption. This will be achieved through the monitoring of energy usage and the adjustment of consumption patterns to optimize cost savings and energy efficiency[4,13]

2.2 Architecture and components of DSM.

The fundamental structure of Demand-Side Management (DSM) architecture consists of the essential components shown in fig .3

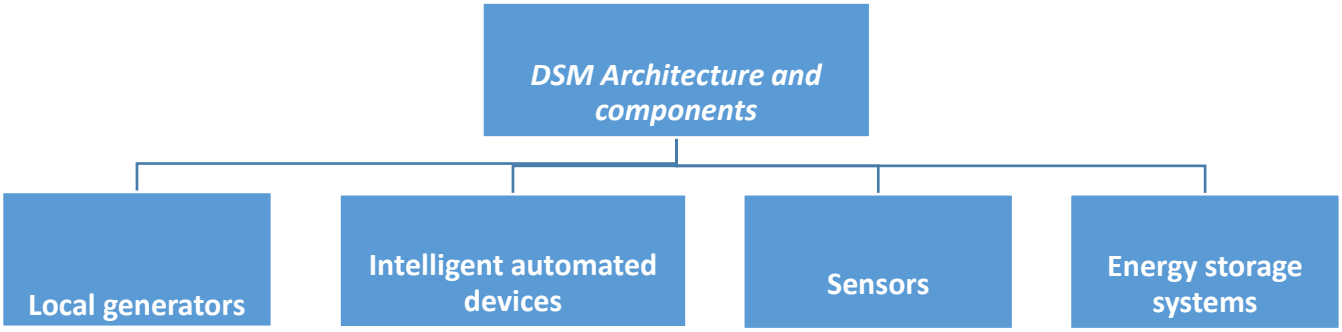

Fig. 3 DSM Architecture and components

(1) Local generators have the capability to operate in dual modes, serving the purpose of either injecting power locally or feeding it into the grid, (2) Smart automated devices with remote monitoring and control capabilities, (3) Sensors designed to observe crucial data and manage appliances accordingly, (4) Utilization of energy storage systems to store energy, enhancing power consumption flexibility and ensuring high reliability with a focus on security, (5) The Energy Management Unit (EMU) supervises various system segments by facilitating data exchange and implementing intelligent Demand-Side Management (DSM), (6) The realms within the smart grid encompassing distribution, operations, market, service providers, and customer sectors. [14].

2.3 DSM Technique

Fig.3 outlines a variety of widely employed DSM (Design Structure Matrix) methodologies. These approaches are categorized as follows:

1:Peak Clipping: A technique employed to reduce load demand during peak hours.

2:Valley Filling: The process involves increasing the load during off-peak hours, modifying the system load factor.

3:Load Shifting: This process aims to decrease load demand during peak hours and increase load during off-peak hours.

4:Flexible Load Shape: This procedure allows users to consume energy based on their needs, such as on an as-needed basis.

5:Strategic Growth: The process involves adding or building the load when there is excess electricity available.
6: Conservation: A technique used to lower utility loads throughout the day.
DSM needs to select one of these approaches to formulate planning and strategies for enhancing energy control and management to achieve higher efficiency, depending on the goals and potential applications. [15].

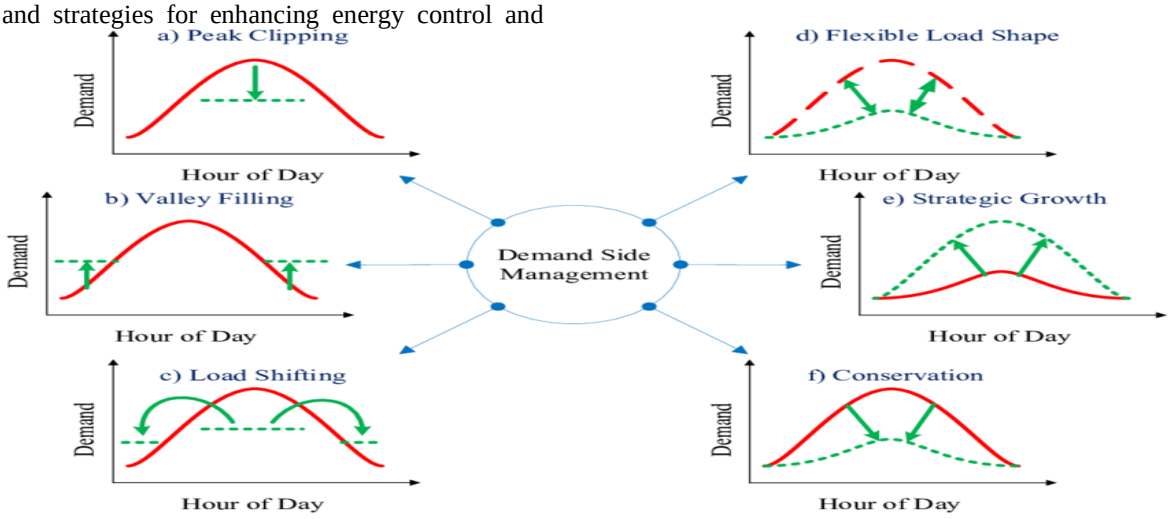

Fig. 3 Various DSM techniques

2.4 Methods for conserving energy in residential sector

Improving energy efficiency is a fundamental requirement for addressing challenges and obstacles within the energy sector. To do this, we need to make a big step forward from where we are now. Reducing energy consumption for a given service or activity level while keeping end-user service at the same level is what is meant by energy efficiency enhancement. The following significant insights can be drawn from this situation. [16].

- The GDP to aggregate ultimate consumption ratio is one measure of a nation's overall energy efficiency in terms of demand reduction.
- Policies are developed and carried out in accordance with local circumstances, taking into account the intricate political, economic, and cultural contexts. Therefore, additional analysis of this issue is required for better DSM implementation.
- Insufficient data collection often poses a challenge in accurately assessing the success or failure of a policy and its impact on performance. This is especially true in the domestic energy consumption sectors where infrastructure is lacking

The residential sector holds a crucial position in a demand-side energy strategy that strives for cost-effective, reliable, and secure power consumption by implementing DSM. The barriers and challenges outlined above highlight the significance of prioritizing enhanced DSM implementation, especially in demand response, particularly within residential sectors.

2.5 Energy efficiency obstacles in the residential sector

Four main hurdles exist in realizing energy efficiency within residential sectors. Firstly, from a market failure perspective, major barriers include flawed information, the lack of a market, and a lack of consideration for the consumer's best interests, along with split incentives. Secondly, from a market barrier perspective, substantial challenges include a high ratio of investment costs to the value of energy savings, the oversight of risk factors in financial flows, and the omission of both actual and perceived costs in financial considerations.. Thirdly, within the realm of behavioral economics, two major hindrances to address are bounded rationality and the low priority or interest in energy-related matters. Fourthly, in addition to the aforementioned issues, there are also political and structural barriers that must be confronted to achieve successful DSM implementation in residential energy sectors.

3 ARTIFICIAL NEURAL NETWORKS TO DEMAND SIDE MANAGEMENT IN RERSIDENTIAL SECTOR

The advent of the smart grid environment has led to a wealth of real-time data in the electricity sector, offering promising opportunities for enhancing electrical system management. By harnessing the power of appropriate tools, consumer profile data can be integrated with the capabilities provided by DSM (Demand Side Management) to influence consumer behavior positively and guide policy development aimed at optimizing the system for greater efficiency and sustainability.

The performance of the artificial neural network tool in rating load curves, as demonstrated in this study, is deemed

satisfactory. It can be further employed to gain deeper insights into the electric process within this evolving environment, enabling a range of applications. These applications include identifying the most appropriate DSM strategies for different load types, optimizing the system, and implementing dynamic pricing models based on consumer behavior.[18]

Here, the emphasis is on developing a system for controlling the demand side in residential situations, notably when Distributed Generation is present. A home automation system, a grid connection, a local PV energy generation system, and an electricity storage system are some of the parts of this electrical system. The two main components of this distributed control system are a neural network-powered scheduler and a coordinator. This control system's main objective is to increase the local energy efficiency through effective task scheduling driven by the user and efficient use of locally produced energy.[19]

An artificial neural network (ANN) is linked to an information processing system that employs a mathematical model inspired by the functioning of biological neurons. With input from internal or external sources, an ANN has the capacity to adjust, acquire knowledge, and modify its architecture to establish a precise relationship between different variables. The neural network basic scheme is illustrated in Fig .4

In the ANN model, neurons, which are the nodes, are interconnected directly to create a neural network that enables distributed parallel processing. a feedforward architecture with three layers, including the input layer, hidden layer, and output layer, with a specific number of neurons in each, was employed. Notably, the Levenberg–Marquardt Algorithm proved to be the more effective training algorithm.[19]

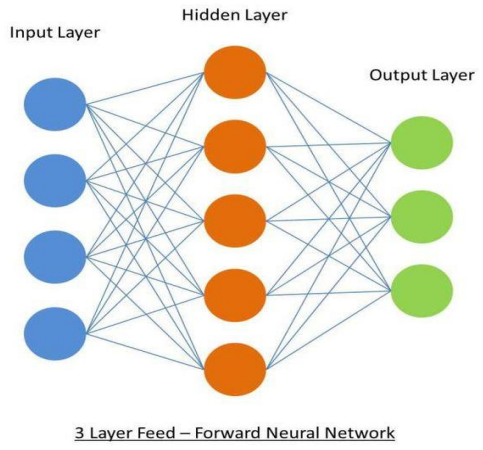

Fig. 5 The neural network basic scheme

4 BARRIERS TO ENERGY EFFICIENCY IN THE RESIDENTIAL SECTOR.

To successfully implement the DSM technique in a microgrid and smart grid environment, a more effective approach and strategic planning are necessary to overcome numerous barriers. Some of the critical challenges can be succinctly summarized as follows 1: A monopoly in the structure of the power market brought about by privatization or a lack of coordination between the public and private utility ,2: Insufficient competition can result in an antiquated and ineffective tariff system, 3; Inertia or lack of understanding on the part of consumers about the economical use of energy,4: Without a setting or construction that is energy-efficient5: significant discrepancy between energy supply and demand,6: Insufficient motivation to modify consumer demand patterns and the utilization of inefficient appliances..7:It's possible that the stability, security, power quality, and protection of the current power system won't allow DSM deployment,8: Insufficient cooperation amongst all the DSM implementation drives, such as demand response, time-based rates, distributed generation, energy efficiency, electric vehicles, and energy storage devices,9: Lacking of norms and standards to offer appropriate direction throughout the implementation phase,10: Absence of infrastructure that is required,11: Lacking of government-funded and regulatory support for the restructuring process,12: The operation of the electricity system becomes more difficult with the integration of DSM,13: Finance and initial cost of technology

5 RESIDENTIAL DEMAND -SIDE MANAGEMENT POLICIES AND POLICY FORMULATION.

Crafting policies is essential to overcome the barriers hindering energy and economic efficiency in the residential demand sector. Currently, residential consumers do not have access to several demand response (DR) advantages such as adjusting to varying generation prices throughout the day, conserving energy by shifting loads, exploring energy-saving opportunities, and effectively managing and utilizing resources to improve reliability by aligning demand with supply. Thus, incorporating demand response and energy efficiency measures into DSM requires well-structured policy development and implementation to ensure that residential consumers can access all these benefits.

6 OPTIMIZATION MODELS

The challenges and issues associated with Demand Side Management (DSM) in residential applications can be formulated mathematically as problems involving maximization and minimization. The objective functions are structured according to the problem's goals. In some cases, the objective function may result in multiple or numerous objective formulations. Incorporating real-time limitations, constraints, and boundary conditions into the problem can be achieved through the utilization of equality or inequality equations. Optimal selection of variables or parameters becomes essential for achieving the best solution to objective functions, taking into account their varying ranges and levels of impact.

Addressing these issues is typically complex due to the involvement of time-varying parameters, nonlinear characteristics, dynamically changing elements, and a highly

interconnected network of overlapping factors. This section provides an overview of successful optimization techniques used in recent times for DSM-related problems. However, due to limitations in space, the detailed mathematical representations and formulations are intentionally omitted.

A comprehensive examination of DSM architectures and algorithms was undertaken. Optimization methods for demand-side management can be categorized according to three primary characteristics, as shown in fig. 6

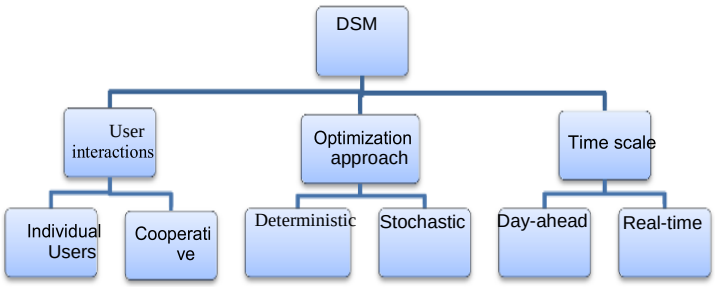

Fig .6 Classification of DSM based on optimization model

DSM methods		Features
User interactions	Individual users	- Converge rapidly -Consumers energy plan are defined locally without coordination -May cause undesirable effect on grid as there is no coordination between consumers
	Cooperative users	-Security and privacy concerns. -Optimize system wide performance by inciding supply and demand
Optimization approach	Deterministic	-Converges fast -Poor solution for inaccurate data -Easy to solve
	Stochastic	-Computation issues because of uncertain data -Less sensitive to error in dataforecast-ing -Can be applied in large scale problems
Time scale	Day ahead	-Sensitive to error in data forecasting
	Real time	-Provides less accurate solution -Offer best performance when used Comple-ment day ahead methods

Table 1. Various DSM methods and features.[20]

The objective function in residential Demand Side Management (DSM) can be structured in three distinct ways. Firstly, the emphasis is on minimizing bills, with the goal of decreasing the overall expense of energy consumption for consumers. Secondly, the focus is on minimizing discomfort by giving priority to reducing consumer concerns related to the reliability, security, and power quality of the supplied energy. Effective energy management in varying time and conditions is pivotal in this context. Thirdly, there's the emphasis on maximizing local generation use.

In this context, the emphasis is on integrating local generation and storage techniques into the conventional power distribution system, aiming to facilitate the effective implementation of DSM within the smart distribution system. [21]

7 CONCLUSION

The following succinct summary of the main conclusions from this review represents useful insights.1: The main focus of future strategy will be on load shifting approaches to schedule loads that can manage numerous diverse loads under real-time conditions,2: Improving the measurement, sensor, and communication infrastructure for AMI systems in a smart home is essential for the effective implementation of DSM approaches,3: When analyzing and formulating DSM-related smart grid security and privacy policies, new concerns and difficulties must be taken into account,4:Under dynamic electric price conditions, the load profile significantly influences the home energy management system, contributing to a more economical overall energy consumption. (i.e., overall economic operation),5: By examining their mutual dependence and cooperation, utilities and customers can reach a balance of advantages.6: The use of Artificial Neural Networks (ANNs) in demand-side management shows great promise. Their implementation provides improved demand forecasting optimization and prediction skills, enabling effective resource allocation and energy use.

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54.

“Object detection for Military Spying using ESP32 Microcontroller”

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Abstract- **This project aims to develop an automatic missile detection and destruction system using intelligent sonar-based object tracking. It features two modes: Automatic and Manual, with the former handling detection and firing autonomously. Utilizing ultrasonic radar and a DC geared motor driven firing unit controlled by a Microcontroller, it ensures accurate targeting. Additionally, an accelerometer enables gesture-controlled firing. Integration of a live stream camera and IoT communication enhances monitoring capabilities. The system's design reduceshuman error and improves accuracy, optimizing missile defense. The programming is conducted in Embedded 'C', ensuring efficient operation. Overall, this project streamlines missile defense, offering a comprehensive solution for automated threat detection and neutralization.**

Keywords- *Embedded “C”, Python IDE, IoT Communicator, ESP32 Microcontroller and Camera, Ultrasonic Sensor, Bluetooth, Laser*

I. INTRODUCTION

The purpose of this project is to design and construct automatic object or missile detection and destroying system. This system is designed to detect the target (missile/object) moving in multiple directions. The target destroying system moves automatically in the direction of missile and fires it upon fixing the target. This system consists of an intelligent sonar based object tracking system that continuously monitors the target. Continuous Live streaming can be seen by Central Control System using esp32 camera. Upon detecting the target it checks for temperature of object to check for human presence and if found danger sends the target‟s location to a Central Control System. The Central Control System takes the action of moving the firing mechanism in the direction of target (missile). Upon fixing the direction, it sends the control command to firing system for attacking the target. In this project we are making use of ultrasonic radar system and adc motor driven firing unit interfaced with a Microcontroller based control unit. We prefer ultrasonic sensor to IR sensor, because the Ultrasonic sensors covers larger sensing distance andit can detect the target in all the lighting conditions (day or night). In this project there are two modes and for manual mode operation is done through gesture direction using accelerometer sensor. The programming of Microcontroller is done using Embedded „C‟. An embedded system is a combination of software and hardware to perform a dedicated task. Some of the main devices used in embedded products are Microprocessors and Microcontrollers Microprocessors are commonly referred to as general purpose processors as they simply accept the inputs, process it and give the output. In contrast, a microcontroller not only accepts the data as inputs but also manipulates it, interfaces the data with various devices, controls the data and thus finally givesthe result

II. LITERATURE SURVEY

The locally-developed integrated contraption uses a mix of infrared sensors radiating a grid of beams to detect any movement up to a distance of 80 metres ahead of the border fence. The distance between the fence and the LoC can vary from 50 metres to over 2km depending on the terrain. The sensors are linked to automatic guns mounted on rotors and mated to night-vision cameras providing live images to commanders manning workstations. A buzzer is sounded if the grid is broken, swiveling the weapon in the direction of the intrusion site[1].The proposed system works on capturing video and distributing with networked systems. And besides alerting the administration person via SMS alarm as required by the client. Their system was designed to work in a real-time situations and based on ESP 32 Uno SBC. Contrasting to other embedded systems their

real-time application offers client video monitor with the help of alerting module and SBC platform[2].

The goal is to implement the system (model) for a particular face. And distinguish it from a large number of stored faces with some real-time variations as well. It gives us efficient way to find the lower dimensional space. Further this algorithm can be extended to recognize the gender of a person or to interpret the facial expression of a person[3].This system that consists of a mobile robot, controlled by Internet, which has camera mounted and a PIR sensor for detecting the living bodies. User will be able to control the robot through internet, thus, providing the wireless control of robot.Also information regarding the detection of living bodies will be given to the user on the webpage from the PIR sensor.Simultaneously user will be able to access the video transmission from the robot[4].

III. SYSTEM DESIGN

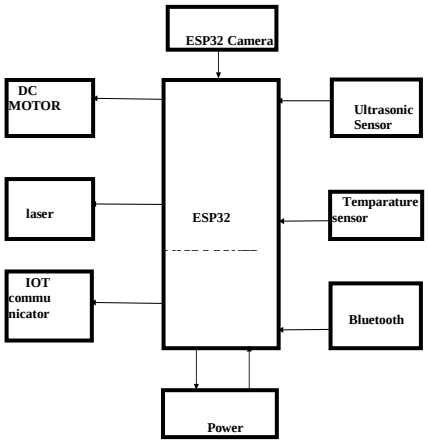

Fig 1 : Block diagram for object detection

To design and Construct automatic Object or missile detection and destroying system.System is built with intelligent Sonar and gesture Controlled System.Upon detecting Object checks for temperature of Object to ensure presence of human and any other creature.

Continuous live streaming of object will be obtained to Central Controlling System.If any unlikely object or missile is detected destroying system automatically turns in that direction of target and fires it upon fixing the target.

This proposed system uses a fully automated system and due to this valuable time can be saved.In this system it comes with Automatic and manual mode.The Ultrasonic sensor are used to detect the target.Bluetooth are used for controlled systems.Temperature Sensors are used for detecting humans or any other creature.

When object is detected the launching, machine will turn towards the degree of detected target and shoots.If the living things i.e., birds are detected by Live Stream camera the controller aborts the shooting process.For communication purpose we use IOT Communicator.

IV. HARDWARE AND SOFTWARE REQUIREMENTS

A. Hardware

- ESP32 Microcontroller: Main processing unit responsible for controlling and coordinating the various components of the system.
- UV Sensor: Detects ultraviolet radiation, which can be useful for certain surveillance applications.
- Temperature Sensor: Monitors ambient temperature, providing environmental data for analysis and decision-making.
- Bluetooth Module: Enables wireless communication with other devices or a central command unit for data transmission and control.
- DC Motor: Used for mechanical movement, potentially for adjusting the position of the surveillance system.
- Laser: Employed for precise pointing or marking of targets or areas of interest.
- IoTCommunicator: Facilitates connectivity to the Internet of Things (IoT) network for remote monitoring and control.
- Power Supply: Provides electrical power to all components of the system.
- ESP32 Camera: Captures images or video for object detection and surveillance purposes.

B. Software

- Python IDE: Integrated Development Environment used for programming the ESP32 microcontroller and other compatible components.
- Embedded C:The programming language utilized for the firmware development, particularly for low-level control andcontrol and optimization.

V. RESULTS AND DISCUSSION

The results of the research work is as follows, This user interface where we have three buttons namely ,select image, capture image and quit.

* Select image: It is used to select the image from the target.
* Capture image: It captures the image from the real time camera.

Fig 2. User interface for object detection

The selected and captured image is analysed. Where the analyse image is used to detect all the objects in the image and analyse weapon is used to detect weapon in the image. Clear is used to clear the selected image and by The selected image is analysed and the weapon is detected in the image.

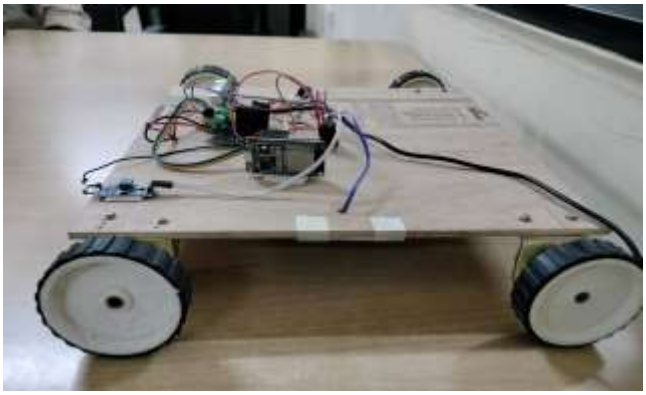

Fig 3 :Implementation of sensors in the rover

Above figure shows the interface of the sensors used in the bomb detection rover mainly it has Metal Detection sensor, IR sensor, Ultrasonic sensor interfaced to the ESP -32 microcontroller it has motor driver and DC motors to move the rover.

VI. CONCLUSION

In this paper we have attempted to use ultrasonic sensor for implementation of RADAR and got results that exceeds our presumed expectations. With some enhancements the system can be used for real time purposes. The project “Object detection for military spying” is mainly intended to operate design and construct automatic missile detection and destroying system. The system is designed to detect the target (missile) moving in multiple directions. The target destroying system moves automatically in the direction of missile and fires it upon fixing the target. . We also add ADXL Sensor for gesture based control of system, which is used for obstacle detection and firing .By connecting wireless camera to the system, then we can see the outer world from our personal computer only by using Live stream camera. We can use this system at so many fields and we can use to handle so many situations.

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Mind Over Wheels – AI Based WheelChair with an Alert and Disinfection System

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Abstract - ***This project discusses an endemic-built hand-free wheelchair for disabled persons. Physically disabled and mentally disabled people like a person who is suffering from paralysis face difficulties in daily life because of their body impairment from their birth or due to an accident or some illness. The proposed system is based on a Head Motion Recognition technique using a MEMS Sensor (Acceleration Sensor). Conventional physical wheelchairs are generally powered by joysticks or hand gesture devices that can not address the needs of almost entirely disabled people who have limited limb movements and can barely move or turn their heads. The MEMS sensor is used for head gesture recognition and the NRF24L01 TX module is used for smart wireless control. Through the adjustment of the head motion, the information goes wirelessly to the Arduino Nano-dependent motor driving circuit to control the rotation of the Wheel Chair in four different modes, including FRONT, BACK, RIGHT, and LEFT. The project's goal is to design a wheelchair that could function for a disabled person who cannot move other parts of the body correctly, keeping their words in mind with the help of head movements. The prototype of the wheelchair performs head motion through an Arduino Nano. The DC motors will drive the wheelchair during the gesture of control mode. The motors will not work, and consequently, the wheelchair will not run when the head is neutral, and only when there is head movement the wheelchair will automatically move. A head motion-controlled wheelchair is an intelligent wheelchair with facilities for navigating, recognizing obstacles, and moving automatically by managing detectors and motions.***

Keywords - AI-based wheelchair, Alert system, Disinfection system, Mobility assistance, Assistive technology.

I. INTRODUCTION

A Human being has been revered with the immunity to work and think independently. But there is a certain amount of people in the world who are being dispossessed from this privilege. Many people around the world are suffering from physical and mental disability. Disability is a continuing condition that restricts everyday activities freely. Around 10% of the world's population, or roughly 650 million people are affected by physical impairment. In most of the OECD countries, females have higher disability rates than males. Disability can be different types such as defective body parts, near-sightedness, limited hearing capacity, deafness, Intellectual disability, Blindness etc. In these circumstances, the disable people need assistance of some instruments or need a helper to move from one to another place. John Dawson from England first designed a wheelchair in 1783 and George Klein invented the first power wheelchair for quadriplegia injured people in World War II . Over the years, there have been few improvements of some specific mobility's apparatus. Presently, mobility's materials such as wheelchairs and crutches are traditionally used by the disabled people. Many research works have been come out with evolving various ceremonial solutions. such as joystick-controlled wheelchair, Hand gesture, Android controlled wheelchair. But these are not enough for limiting the problem where the disable people cannot perform task like normal people. In such case, a smart wheelchair can accommodate impaired people with better manner of movement. Head gesture navigation is a fanatical arrangement by which a disable person can enjoy easy movement using only his head. The system is supplementary for those who lack of many body parts. Obstacle detector is helpful for blind people. And it also helps for all disabled peoples not only for the mentally disabled persons.

II.OBJECTIVE

Introducing an ingenious at the intersection of technology and accessibility: the AI-based wheelchair equipped with head gesture control, alert systems, and an integrated disinfection mechanism. This cutting-edge solution is designed to revolutionize mobility for individuals with limited motor function, ensuring not only seamless movement but also health and safety management. Imagine a wheelchair that understands and responds to a person's head gestures, empowering users to navigate effortlessly through their surroundings. By harnessing the power of artificial intelligence, this wheelchair Analyzes head movements, allowing users to guide, stop, and artifice with remarkable carefree precision. But that's not all. This advanced futuristic wheelchair goes beyond basic functionality. It incorporates an intelligent alert system that enhances safety by detecting obstacles, notifying the user, and impulsive adjusting the wheelchair's path to prevent collisions. Moreover, in today's health-conscious world, hygiene is preponderant. This AI-based wheelchair integrates a state-of-the-art disinfection system, ensuring a clean and sanitized environment for the user. Utilizing advanced technology, it autonomously sanitizes surfaces, minimizing the risk of infections and promoting a healthier environment for everyone. This innovative blend of AI-driven control, safety alerts, and proactive disinfection not only represents a leap forward in mobility assistance but also showcases the potential of technology to enhance the quality of life for individuals with diverse needs. With this AI-based wheelchair, we're not just redefining mobility; we're empowering independence, safety, and hygiene, fostering a world where technology serves as a catalyst for inclusivity and well-being.

Aim of the Work

The purpose of the project is to integrate a state-of-the art disinfection system. It automatically sanitizes surfaces, ensuring a clean and germ-free environment for the user, minimizing the risk of infections and promoting wellness. This groundbreaking innovation not only redefines mobility but also composes accessibility, safety, and health. It represents a fusion of technology and compassion, empowering individuals with limited mobility to navigate the world with confidence, comfort, and peace of mind. Moreover, in an era where cleanliness and hygiene are of utmost importance, this wheelchair doesn't just facilitate mobility it actively contributes to maintaining a sanitized environment. Enclosed with a smart disinfection system, it continuously sterilizes surfaces, reducing the risk of infectious agent and providing users with peace of mind. By combining these features, this AI-based wheelchair not only redefines mobility for individuals but also addresses their health and safety concerns, promoting a more inclusive and hygienic experience.

III.METHODOLOGY

The core idea for this Mind Over Wheels is physically impaired people can easily operate this wheel chair without any person's assistance. The system used in this Mind Over Wheels is split into two parts. One is a transmitting hand and the other is a receiver. The section of transmitter will be placed in the head band and the section of receiver well be placed in the wheelchair.

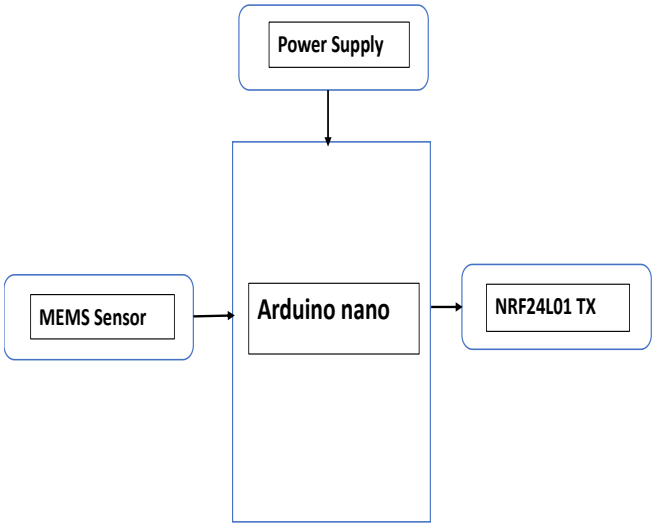

Fig 1: Section of Transmitter

The figure 1, shows the transmitter side consists primarily of three parts Arduino Nano, a MEMS sensor, and a NRF24L01 transmitter. In this wheelchair, we control the forward, backward, left, and right movement of the wheelchair. We are using a MEMS sensor to detect the motion of the head. Based on the person's requirement they can simply change the position of the head. The head motion will be detected by the sensor and these signals will be sent to Arduino Nano and then it will be sent to the receiver through the NRF24L01 transmitter.

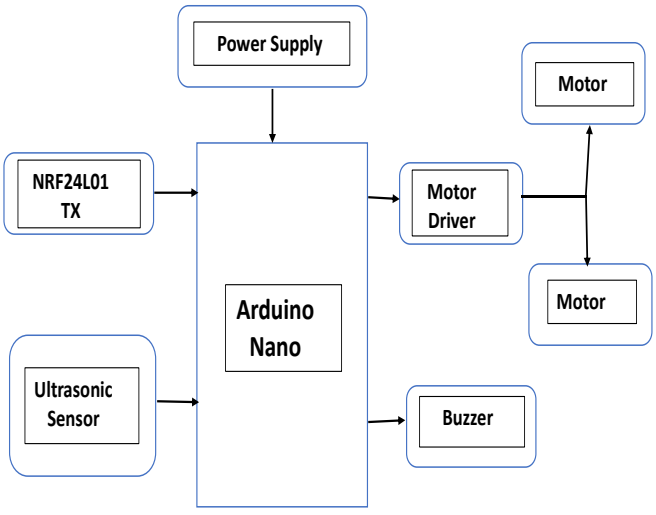

Fig 2: Section of Receiver

Figure 2, it shows the receiver side which consists of NRF24L01 receiver, ultrasonic sensor, Arduino Uno, motor driver, buzzer and motors. Here Arduino is the heart of the project, based on the sensor data Arduino is going to control the chair. The signal will be received through NRF24L01 receiver from the transmitter. And then signal will be send to the Arduino Uno after processing it will be sent to motor. From the motor driver signal will be sent to the motors. The processor must take the decision because it is pre-programmed to monitor both the motor and the wheelchair route. Motor 1 and Motor 2 was added to explain the course of change in direction. Ultrasonic sensor is used to detect the obstacle, if any obstacle detected then buzzer will activate and gives the beep sound through the buzzer.

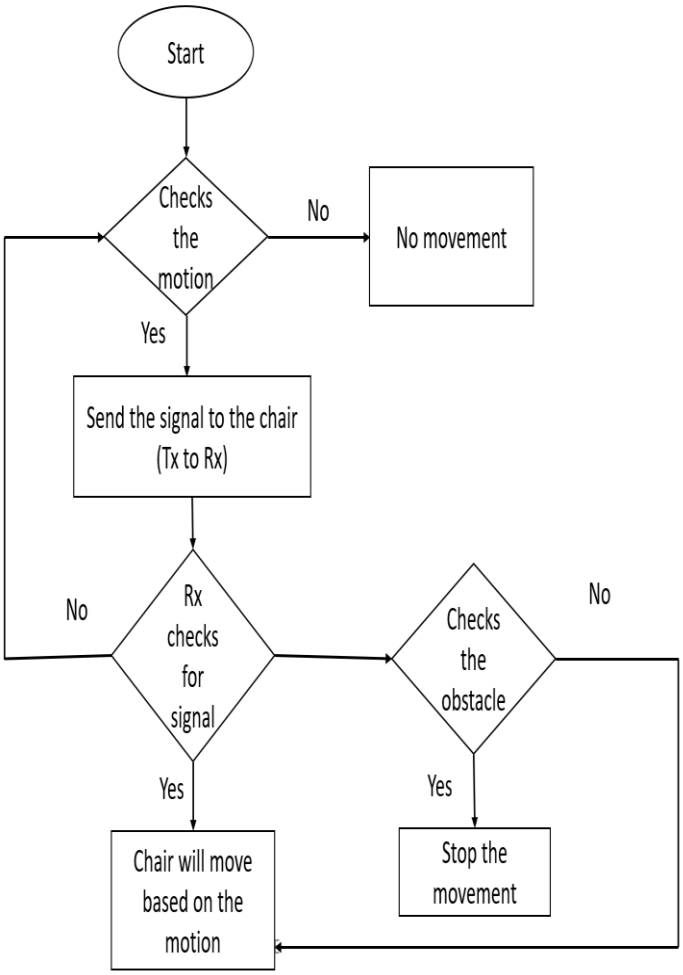

Figure 3: Flow chart of Head Gesture Control Wheelchair

Figure 3, illustrates the project workflow; When the patient is seated in the wheelchair and wears the headband. First, it checks the motion of the head, if movement is detected then the signal is sent from the transmitter to the receiver of the NRF24L01 module. The received signal will be rechecked and processed the signal, if not the signal will be sent back to the transmitter. Only when the received signal is proper, the chair will move in the required direction. Suppose if any obstacle is detected the wheelchair will be stopped.

IV.CONCLUSIONS

The head gesture control wheelchair project represents a significant advancement in assistive technology aimed at enhancing the mobility and independence of individuals with physical disabilities. Through the integration of innovative head gesture recognition technology with wheelchair controls, this project has successfully demonstrated the feasibility and effectiveness of controlling a wheelchair using simple head movements. One of the primary conclusions drawn from this project is the potential of head gesture control systems to offer a viable alternative to traditional joystick-based control mechanisms. By harnessing the natural movements of the user's head, such systems can provide a more intuitive and ergonomic method of navigation, particularly for individuals with limited dexterity or mobility in their hands. This not only promotes greater autonomy and freedom of movement but also reduces the physical strain associated with operating conventional wheelchair controls, thereby enhancing user comfort and convenience. Furthermore, the development and implementation of the head gesture control system have underscored the importance of personalized and adaptive technology solutions in the field of assistive robotics. Through extensive user testing and feedback iterations, the project has highlighted the significance of tailoring the system to individual user needs and preferences, ensuring optimal usability and user experience. This emphasis on customization and user-centered design principles has paved the way for more inclusive and user-friendly assistive technologies, capable of catering to a diverse range of user abilities and requirements. Additionally, the successful deployment of the head gesture control wheelchair prototype underscores the potential for broader applications of gesture recognition technology in assistive robotics and beyond. Beyond wheelchair navigation, similar systems could be adapted for controlling other mobility aids, as well as for interfacing with smart home devices, computers, and other digital interfaces. This opens up exciting possibilities for enhancing accessibility and autonomy across various domains, empowering individuals with disabilities to fully participate in everyday activities and live more fulfilling lives. In conclusion, the head gesture control wheelchair project represents a significant step forward in the ongoing pursuit of innovative assistive technologies. By leveraging the power of head gesture recognition technology, this project has demonstrated the feasibility of intuitive and ergonomic wheelchair control systems, while also highlighting the importance of personalized, user-centered design approaches. Moving forward, continued research and development in this field hold the potential to further enhance the quality of life and independence of individuals with disabilities, ushering in a new era of inclusive and empowering assistive technologies.

V.ADVANTAGES AND DISADVANTAGES

Advantages:

1. Increased Mobility: Individuals with limited mobility can navigate their environment more independently, enhancing their quality of life.
2. Improved Safety: AI can help anticipate obstacles and adjust wheelchair movements accordingly, reducing the risk of accidents.
3. Customization: AI algorithms can adapt to the user's behavior and preferences, providing personalized assistance.
4. Hands-Free Operation: Users can operate the wheelchair without the need for manual controls, freeing up their hands for other tasks.
5. Integration with Smart Devices: Integration with AI allows for seamless interaction with other smart devices and environments, enhancing overall accessibility.

Disadvantages:

1. Complexity and Reliability: The technology may be complex and require frequent maintenance, leading to potential reliability issues
2. Learning Curve: Users and caregivers may require training to effectively operate and troubleshoot the system, which could be time-consuming.
3. Cost: Initial setup costs and ongoing maintenance expenses can be significant, limiting access for some individuals.
4. Privacy and Security Concerns: Brain-controlled systems raise privacy and security concerns related to the collection and use of sensitive neural data.
5. Dependency on Technology: Overreliance on AI-driven control may diminish users' ability to independently navigate in non-automated environments, potentially limiting their skills and confidence.

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Wireless Power Transfer System for Charging of Electric Vehicles and Automatic Billing

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ABSTRACT: This paper presents a comprehensive study on the integration of wireless charging technology with electric vehicles (EVs) and the implementation of automatic billing systems. The rapid proliferation of EVs necessitates efficient and convenient charging solutions to overcome the limitations of traditional plug-in charging. Wireless charging offers the promise of seamless charging experiences without the need for physical connections. Additionally, the integration of automatic billing systems streamlines the payment process, enhancing user convenience and promoting widespread adoption of EVs. This paper discusses the technical aspects, challenges, and potential solutions associated with wireless charging technology and automatic billing systems for EVs.

Keywords: *Wireless charging, Electric vehicles, Automatic billing, Inductive charging, Electric vehicle infrastructure.*

I . INTRODUCTION

The global transition towards sustainable transportation has led to a surge in the adoption of electric vehicles (EVs). However, one of the primary challenges hindering the widespread acceptance of EVs is the inconvenience associated with traditional plug-in charging infrastructure. To address this challenge, wireless charging technology has emerged as a promising solution by enabling convenient and automated charging experiences for EV owners. Moreover, integrating automatic billing systems with wireless charging infrastructure further enhances user convenience and promotes the seamless integration of EVs into existing transportation ecosystems. The wireless charging is implemented to electric vehicles. Here wireless EV charging uses resonant electromagnetic induction to transmit electrical current, a process which is also known as inductive charging. The vehicles are charged using the transmitter and receiver coils. The integration of automatic billing systems with wireless charging infrastructure is crucial for enabling seamless payment transactions for EV charging services. This paper explores the architecture, functionalities, and implementation strategies of automatic billing and wireless charging of electric vehicles. Topics covered include payment authentication methods, billing models for electric vehicles that can be integrated in the road.

II. SIGNIFICANCE OF THE STUDY

Now-a-day the term ‘wireless’ becomes the most advanced and innovative research field. This will help the people to be free from annoying wires and to avoid them from exposing to hazardous accidents which occur due to the usage of cables**.** It will help the user for using the electronic devices without any interpretation and limitations. It will be hybrid the solar energy implemented in the automobiles will make the vehicles eco-friendly to the surrounding. This wireless power transfer also has both stationary and dynamic charging of the Batteries

II. HARDWARE IMPLEMENTATION.

1 . BLOCK DIAGRAM

The below figure 1 depicts the block diagram of the Wireless power transfer system for charging of electric vehicles and automatic billing. An open-source micro controller board based on the Microchip ATmega328p is used.

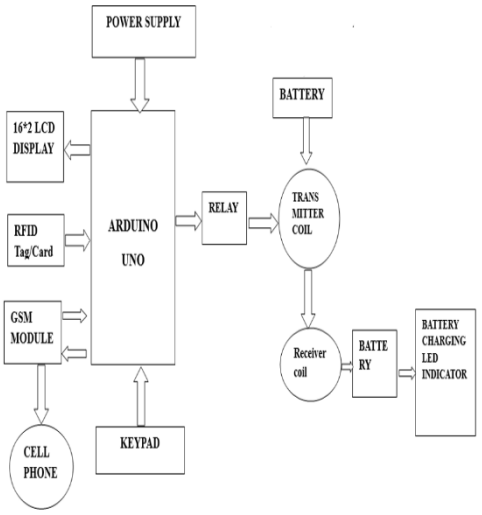

Fig 1: Block diagram of wireless power transfer and automatic billing

Wireless EV charging, also known as inductive charging, works through electromagnetic induction. Here's a simplified overview of how it works:

Charging Pad: A charging pad, typically installed on the ground or a surface, contains a coil of wire that generates an alternating electromagnetic field when electricity is supplied to it.

Vehicle Receiver: The electric vehicle (EV) is equipped with a receiver coil located on the underside of the vehicle. This coil is tuned to resonate at the frequency of the electromagnetic field generated by the charging pad.

Inductive Coupling: When the EV is parked over the charging pad, the alternating electromagnetic field induces a current in the high-frequency AC signal, which is then fed into the transmitter coil through the relay. The relay is controlled by the Arduino microcontroller, which also monitors the charging process and displays the charging status on the LCD display. When the electric vehicle approaches the energy station, the RFID card id registered and the details of the vehicle is sent to the Arduino microcontroller. The microcontroller then activates the relay, which switches on the power supply to the transmitter coil. This generates a magnetic field, which induces a current in the receiver coil of the electric vehicle. This current is then converted into electricity, which charges the EV's battery.

Billing: When the charging process is completed, bill is generated automatically based on the total number of units charged, and the amount to be paid and the message is sent to the user through GSM.

Notification: The GSM module is used to send the charging status of the electric vehicle, which can be accessed remotely by the user through a smartphone This provides the user with real-time information on the charging process, including the charging status, amount to be paid and total units charged

Alignment: Proper alignment between the charging pad and the receiver coil in the EV is essential for efficient power transfer. Some systems use sensors or automated alignment mechanisms to ensure precise positioning.

Charging Process: The charging process begins automatically when the EV is parked over the charging pad and the charging system detects the presence of the vehicle. Charging continues until the battery reaches its desired level or until the charging process is manually stopped.

In summary, the charging station of an electric vehicle using solar panels, Arduino microcontroller, LCD display, relay, GSM module, battery, DC power supply, receiver coil, and transmitter coil works by converting solar energy into electrical energy, storing it in a battery, and then using a DC power supply to convert it into a high-frequency AC signal, which is then transmitted wirelessly to the electric vehicle using a transmitter coil. The electric vehicle then receives the power using a receiver coil, rectifies and regulates the current, and charges its battery. The charging status is monitored and displayed on an LCD display, and can also be accessed remotely using an GSM module.

2. CIRCUIT DIAGRAM

The fig 2 shows the circuit diagram of the wireless power transfer system of electric vehicles and automatic billing. In our project AT Mega328p microcontroller acts as the brain of the controlling device in this setup, which consists of 32 pins in which 22 pins are associated with input and output in which 14 pins are true digital I/O pins which can be configured as user application.And 6 pins are analog input pins .The LCD display,RFID card reader,GSM and relay are interfaced with the Arduino board as shown in fig 2.

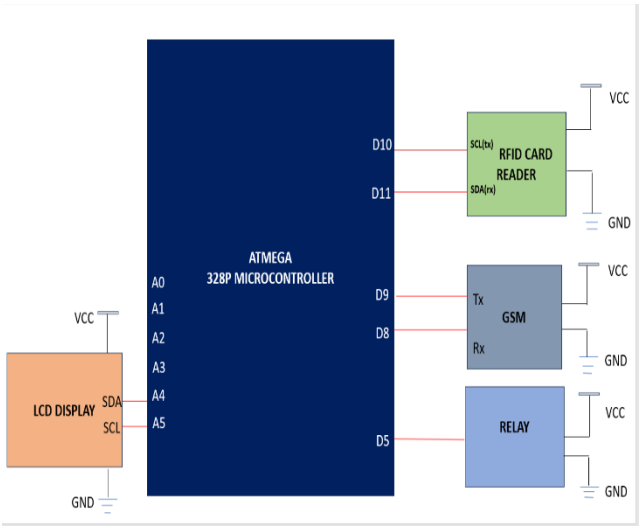

Fig 2: Circuit of wireless power transfer

III. SOFTWARE INTERFACE

1. FLOW CHART

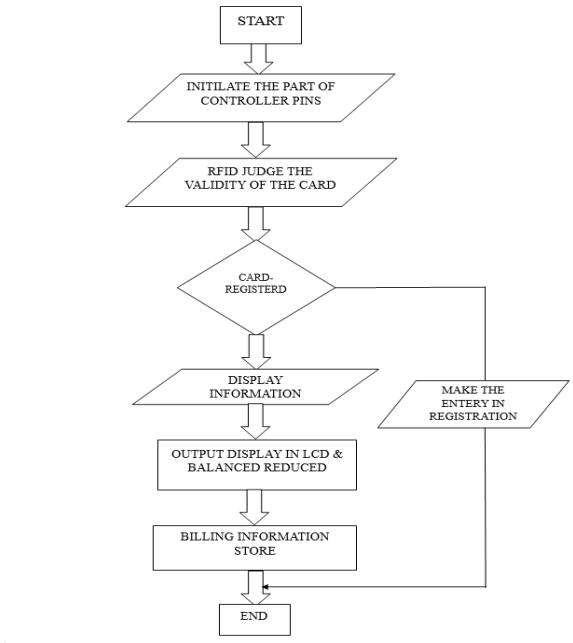

Fig 3: Flowchart of the wireless power transfer system with automatic billing

IV. FUTURE DIRECTIONS.

The evolution of wireless charging technology and automatic billing systems for electric vehicles is an ongoing process, driven by technological advancements and market demands. Artificial intelligence plays a crucial role in optimizing charging infrastructure for electric vehicles (EVs). AI algorithms can analyse data on factors like traffic patterns, energy demand, user behaviour, and weather conditions to determine optimal locations for charging stations, predict usage patterns, and dynamically adjust charging rates to minimize grid strain. Additionally, AI can optimize fleet charging schedules for businesses and help balance energy loads to support renewable energy integration. Overall, AI enables smarter, more efficient, and sustainable charging infrastructure deployment and management.

V. EMERGING TRENDS.

Longer Range Charging: Longer-range wireless charging systems, such as those that can charge vehicles while they are in motion, could extend the driving range of EVs and reduce the need for large onboard batteries.

Smart Grid Integration: Integration with smart grid technologies and AI algorithms can optimize charging schedules based on factors like energy demand, grid capacity, and renewable energy.

VI. HARDWARE RESULT

This figure shows the whole experimental setup which includes the solar panels, microcontroller boards and the various hardware parameters of the hardware setup. After the completion of the hardware, moved to the further testing process for checking the efficiency of the hardware. It gives nearly good results compared to the existing system.

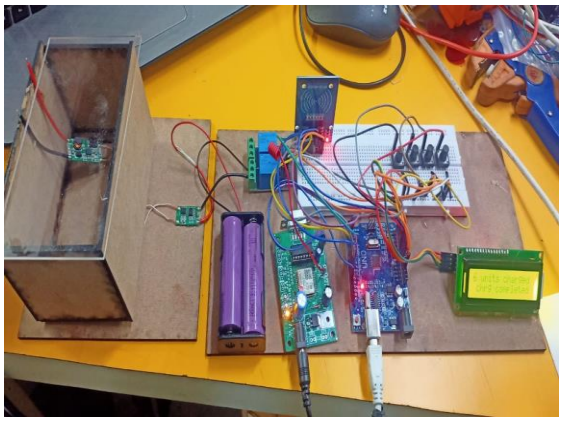

Fig 4: Experimental setup of wireless power transfer system of electric vehicles and automatic billing

The AC supply will be given to the primary coil gets energize creates the magnetic field or flux in the primary side. Flux created in the primary side links the secondary coil and the EMF will be transferred wirelessly between the coils. Transferred power in the secondary coil and the charging status is indicated by the LED's.

Fig 5 :Charging station status before scanning the RFID card.

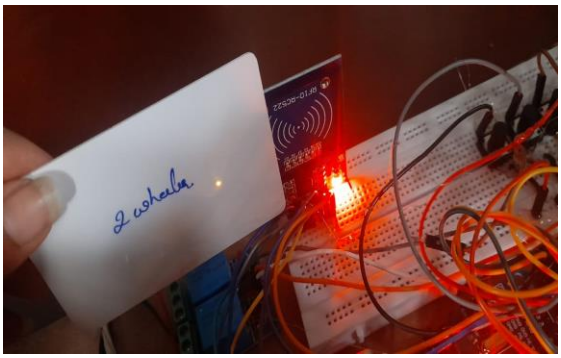

Fig 6: Scanning RFID card to the RFID scanner

Fig 7: LCD output after completion of the charging of 4 units.

After completion of the charging process automatic bill will be generated according to the number of units charged and the message is sent to the users phone number using GSM module. The message received will consists of the number of units consumed, total bill amount and remaining amount in the RFID card.

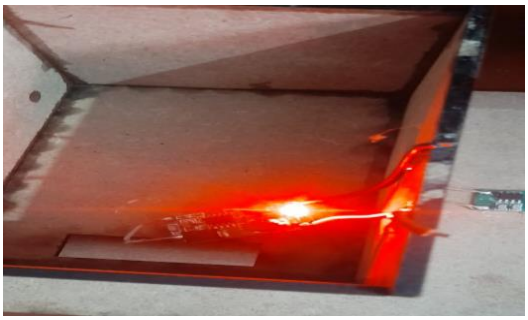

Fig 8: Wireless charging of the receiver coil indicated through LED

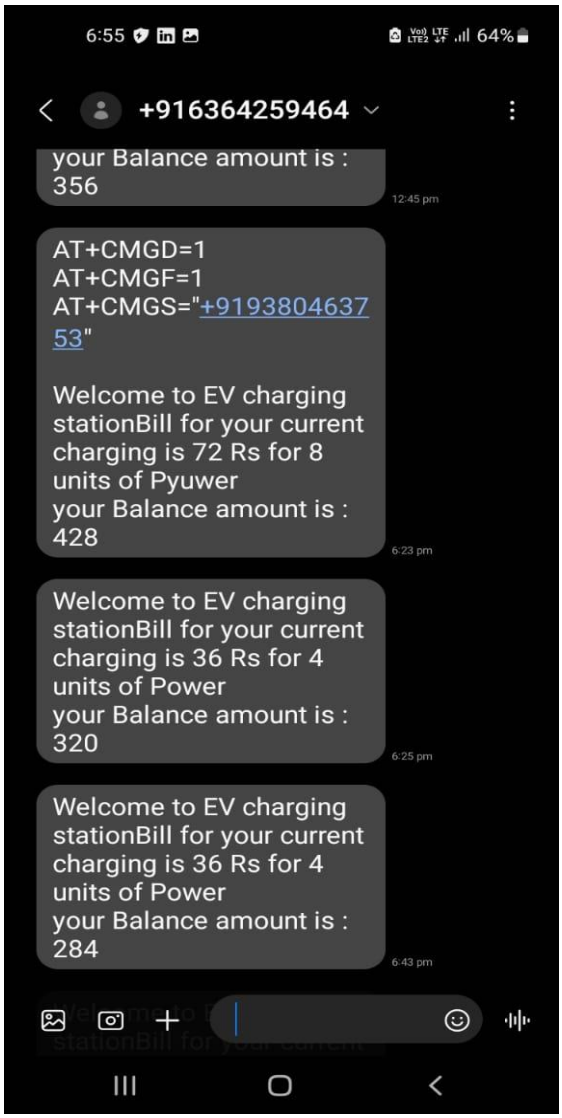

Fig 9: SMS received on the user phone number through GSM.

VII. CONCLUSION.

The global transition towards sustainable transportation has led to a surge in the adoption of electric vehicles (EVs). However, one of the primary challenges hindering the widespread acceptance of EVs is the inconvenience associated with traditional plug-in charging infrastructure so a wireless power transfer system was implemented in which electric vehicles are charged without the usage of wires. The integration of solar panels into wireless EV charging infrastructure enhances accessibility and convenience for EV owners. With wireless charging, drivers no longer need to physically connect their vehicles to charging stations, streamlining the charging process and eliminating the hassle of handling cables. This simplicity encourages more widespread adoption of EVs by addressing concerns related to charging convenience and infrastructure availability.

The wireless power transfer system for electric vehicles and automatic billing was implemented and the results were viewed. When the vehicle enters the charging station the RFID card is scanned and in LCD display it is displayed weather it is two-wheeler, three-wheeler, or four-wheeler. Number of units the vehicle needs to be charged is entered by the user and the vehicle is being charged, the principle behind the charging process is inductive coupling which uses wireless coils, the charging process is indicated by the led. After the charging process is completed, the bill is generated based on the number of units charged. The total price, the number of units charged, and the amount deducted from the RFID tag is sent to the users phone using GSM.

In conclusion, wireless charging for EVs using solar panels represents a promising solution that combines sustainability, convenience, and energy independence. While there are challenges to overcome, the potential environmental and practical benefits make this technology a compelling option for the future of electric transportation. Continued research and development in this field will be crucial to optimizing efficiency, addressing challenges, and expanding the adoption of wireless solar charging for EVs on a larger scale.

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Unmanned E-Vehicle Charging Station Using RFID Card

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***Abstract*—Technological advancements always played a major role in transforming the automobiles; From handpulled carts to autonomous cars. The fuel powered vehicles are one of the greatest inventions the world has ever seen, but the negative impact caused by them on the environment has laid a new path for the invention of Electric Vehicles. The electric vehicles are emission less vehicles that are powered and run on electricity solely. Like fuel pumps, these EV's require charging stations. This work provides infrastructure and maintenance of charging stations. Charging stations have been installed in various parts of the world till date. Level 1, Level 2 and fast EV charging stations have been installed in various places respectively. Detailed infrastructure report on installation and maintenance is required. Maintenance is required for any EV charging station to run efficiently. The various factors which effect the efficiency of charging stations are frequency of usage, climatic conditions, exposure of charring unit to atmosphere. This work provides detailed overview of various power options, technologies, energy management techniques and maintained of charging stations that are optimal for the Indian market**

Keywords—EV, RFID, charging, Unmanned.

I. INTRODUCTION

The government of India came up with National Electric Mobility plan in 2012. It states to manufacture 6 to 7 million HEV's and EV's by 2020 and recently in 2017 it is also announced that fuel powered vehicles should be banned by 2030. Many cities in India have extreme levels of air pollution in form of oxides of Nitrogen and Carbon. Transport sector majorly contribute to the air pollution accounting for about 51% in India and this figure goes to 75--80%. The alternative fuel vehicles, EV's reduces negative impact of transport sector on environment.

Smart electric vehicle charging: Security analysis" likely sets the stage for the research by providing background information on smart grid technologies, electric vehicle charging systems, and the importance of security in these systems. It may also outline the specific objectives and scope of the study [1].

EV charging stations is split into 3 stages (i.e., the demonstration stage, public promotional stage, and business utilization stage). Then, associate degree improvement model for the planning of EV charging stations is planned with the interval distance magnitude relation, charging capability redundancy, and charging power redundancy, zonal pattern of base-load generation capacities for the years from 2009 to 2025 [2].

It is likely begins with an introduction discussing the evolution of electric vehicle (EV) charging technology, current industry standards, and the importance of standardization for the widespread adoption of EVs. It may also touch upon the role of charging infrastructure in supporting the growth of the electric vehicle market and the challenges and opportunities associated with developing and implementing charging standards [3].

It provides an overview of the context and purpose of the report. It may discuss the increasing adoption of electric vehicles in India, the importance of establishing standardized charging infrastructure to support this growth, and the role of the committee in developing specifications for public EV chargers to ensure interoperability, safety, and efficiency across different charging networks and EV models [4].

Given the aforementioned background, the optimal planning of EV charging stations is becoming a big problem to be resolved. EVs cannot only increase energy utilization and reduce pollution emission, but also smooth the load curve by peak load shaving and, hence, enhance the safety and economics of the facility system concerned by coordinating with intermittent renewable energies, like wind power [5].

It explores the potential vulnerabilities and risks associated with integrating plug-in electric vehicles (PEVs) into the electric grid, particularly regarding cyberattacks. The introduction likely provides background information on the increasing adoption of PEVs.[6]

These vehicles are either pure electric vehicles (EV), plug-in hybrid electric vehicles (PHEV), or extended-range electric vehicles (EREV). With the growth in electric vehicle industry, the need for the design and implementation of secure and reliable charging stations for public use is necessary. A smart electric vehicle charging station is considered a critical infrastructure that functions like a fuel station for a combustion engine vehicle and smart grid.

Welcome to the era of autonomous charging with unmanned electric vehicle stations. These innovative hubs redefine convenience by allowing users to effortlessly charge their EVs without any human intervention. Through streamlined digital interfaces, powering up your electric vehicle becomes a hassle free and futuristic experience.

II. OBJECTIVE

Main objective of the project is to build a prototype of charging station for electric vehicle. An authentication is also used for the card in case of any loss. The complete process of the charging is completely done by using a RFID which automatically deduct the amount recharged in the card. By this method the vehicle can be charged without any human intervention. Efficient Charging Infrastructure: Develop a charging station that efficiently charges unmanned e-vehicles, optimizing charging times and minimizing downtime. Scalability: Design the charging station with scalability in mind, allowing for the integration of additional charging points to accommodate a growing number of unmanned e-vehicles. Integration with Renewable Energy Sources: Explore options to integrate renewable energy sources, such as solar, to enhance sustainability and reduce reliance on traditional power grids.

III. METHODOLOGY

Figure 1: Block Diagram

The proposed methodology uses two types of energy sources as a supply to the project i.e. Solar and the main supply. Basically, power supply plays an important role in any of the electronic devices because each and every component needs to function properly. Arduino is the controller used here for the functionality of the complete proposed system. All the other hardware components like relay, 16*2 lcd, gsm, keypad and RFID is interfaced to the controller. Once when a user comes with his/her EV to charge in a station, firstly he should have been registered in the station for charging his vehicle. He will be received a RFID card from station to scan the card and make his vehicle charge. RFID is used for cashless payments which is new technology been implemented. OTP technology is also been implemented for giving security to the card which is been provided. Keypad is used to select the options and to enter the respective Otp which is been received in the registered mobile number. By considering all these processes we can charge the vehicle using fast charging module.

IV. HARDWARE COMPONENTS

Arduino UNO

Figure 2: Arduino UNO

Arduino is an open source and company for planning, making and connecting customers planning and making single-board microcontrollers and microcontroller packages for building modern devices. Content material is concerned to the gnu lesser widespread public license (LGPL) or the gnu popular public license (GPL), which lets in for the introduction of Arduino sheets and termination of applications via each person. Arduino sheets are presently available in a preassembled construction or as you are making your personal with the assist of other gadgets devices.

Arduino board systems use chip time and controllers. Sheets are fitted with front row sets and straight data/crop (I / O) sets that can be interrupted on various continuous sheets ('shields') or breadboards (for prototyping) and various circuits. Sheets include a series of interconnected communications, including Universal Serial Bus (USB) to the undisputed models, used for installing applications on PCs. Microcontrollers can be replaced using C and C ++ vernaculars.

Relay (2-channel)

Figure 3: Relay 2-channel

A 2-channel relay refers to a device that controls two separate circuits using electromagnetic relays. Relays are switches that are operated electrically, allowing them to control one electrical circuit by opening and closing contacts in another circuit. The term "2-channel" indicates that there are two independent relay channels within the device, each capable of controlling a separate load or circuit. Here are some key points about 2-channel relays:

Functionality: A 2-channel relay typically consists of two separate relays integrated into a single unit. Each relay can be controlled independently, allowing you to switch two different circuits or loads on and off. Electromagnetic Relay: Relays are often electromagnetic in nature, with an electromagnet that controls the opening and closing of the switch contacts. When an electrical signal is applied to the relay coil, it generates a magnetic field that activates the switch, connecting or disconnecting the circuit.

Applications: 2-channel relays are commonly used in various applications where you need to control two different electrical devices or circuits.

Solar Panel

Figure 4: Solar panel

Solar panels, also known as photovoltaic (PV) panels, are devices that convert sunlight into electrical energy. Here are some key points about solar panels:

Photovoltaic Effect: Solar panels operate based on the photovoltaic effect, which is the process of converting sunlight into electricity. This phenomenon occurs when certain materials generate a flow of electrons in response to exposure to sunlight.

Composition: Solar panels are made up of individual solar cells, which are typically made from silicon. Silicon is a semiconductor material that is widely used in the electronics industry. There are two main types of solar panels: monocrystalline and polycrystalline, each with its own manufacturing process and characteristics.

Solar Panel Efficiency: The efficiency of a solar panel refers to its ability to convert sunlight into electricity. Higher efficiency panels can generate more electricity in the same amount of sunlight. Efficiency is often a crucial factor in determining the cost-effectiveness of a solar power system.

Solar Array: Multiple solar panels are often connected together to form a solar array. The combined output of the panels in an array determines the overall power output of the solar system.

Inverter: The electricity generated by solar panels is direct current (DC), but most household appliances and the electrical grid operate on alternating current (AC). Therefore, solar power systems include an inverter to convert DC into AC.

Environmental Benefits: Solar power is a clean and renewable energy source, producing electricity without emitting greenhouse gases. The use of solar panels contributes to reducing dependence on fossil fuels and mitigating climate change.

RFID Card

Figure 5: RFID Card

RFID (Radio-Frequency Identification) cards are a type of contactless smart card that uses radio- frequency technology to communicate with RFID readers. These cards contain an embedded RFID chip and an antenna, allowing them to transmit and receive data wirelessly. Here are some key points about RFID cards: Components: An RFID card typically consists of two main components:

RFID Chip: The integrated circuit (IC) or chip contains information such as a unique identifier and possibly other data. It is the brain of the RFID card.

Contactless Technology: Unlike traditional magnetic stripe cards or smart cards with embedded chips that require physical contact with a card reader, RFID cards operate on a contactless basis. They can be read by RFID readers without the need for direct physical contact.

Frequency Bands: RFID systems operate on different frequency bands, including low-frequency (LF), high frequency (HF), and ultra-high-frequency (UHF).

Access Control: RFID cards are commonly used for access control systems, allowing users to gain entry to secured areas by presenting their RFID cards to card readers.

Identification: RFID cards are used for identification purposes in applications such as employee badges, student cards, and membership cards.

Payment Systems: Some RFID cards are used for contactless payments, where users can make transactions by tapping or waving their cards near a compatible reader.

RFID Reader

Figure 6: RFID Reader

An RFID reader is a device that wirelessly communicates with RFID tags or cards to read and gather information stored on the tags. RFID readers use radiofrequency technology to communicate with RFID tags, which contain data such as unique identifiers or other relevant information. Here are some key points about RFID readers: Functionality: The primary function of an RFID reader is to read data from RFID tags or cards. The reader emits radiofrequency signals that activate the RFID tags in its vicinity, and the tags respond by transmitting their stored information back to the reader.

Types of RFID Readers:

Fixed Readers: Installed in a specific location, fixed RFID readers are commonly used for applications such as access control, inventory management, and manufacturing.

Handheld Readers: Portable RFID readers are handheld devices that allow users to move around and read RFID tags in different locations. They are often used for tasks like inventory audits and field data collection.

Integrated Readers: Some devices, such as smartphones and tablets, have integrated RFID reader capabilities, enabling them to read RFID tags using built-in components or accessories.

RFID readers use radio-frequency technology to communicate with RFID tags, which contain data such as unique identifiers or other relevant information.

Portable RFID readers are handheld devices that allow users to move around and read RFID tags in different locations. They are often used for tasks like inventory audits and field data collection.

Power Supply

A power supply is a device or system that provides electrical energy to an electric load. It is a fundamental component in various electronic devices and systems, converting electrical energy from one form to another to meet the requirements of the connected equipment. Here are key points about power supplies:

Types of Power Supplies:

Linear Power Supply: Linear power supplies use a linear regulator to maintain a constant output voltage. They are simple and provide low-noise output but are less efficient, especially when dealing with large voltage differences.

Switched-Mode Power Supply (SMPS): SMPS, also known as switch-mode power supplies, are more efficient than linear power supplies. They use a switching regulator to control the output voltage and handle varying input voltages more effectively.

DC Power Supply vs. AC Power Supply:

DC Power Supply: Provides a constant direct current (DC) output. Many electronic devices, such as computers and mobile phones, require DC power.

AC Power Supply: Provides alternating current (AC) output. Some devices, like household appliances, use AC power directly, while others may convert it to DC using internal power supplies.

GSM (Global system for Mobile Communication)

GSM, which stands for Global System for Mobile Communications, is a widely used standard for mobile telecommunications systems. It is the most prevalent standard for second-generation (2G) cellular networks and has played a key role in the global adoption of mobile communication. Here are key points about GSM: Standard and Network Technology:2G Technology: GSM is a 2G technology that replaced the earlier analog mobile networks. It introduced digital communication, enabling improved voice quality, better security, and the ability to send text messages (SMS). Standardization: GSM is a set of standards developed by the European Telecommunications Standards Institute (ETSI) to ensure interoperability among mobile networks and devices.

Frequency Bands: Frequency Division Multiple Access (FDMA): GSM divides the frequency spectrum into multiple channels, allowing multiple users to share the same frequency band. Time Division Multiple Access (TDMA): GSM also uses TDMA to divide each channel into time slots, allowing multiple users to transmit in the same frequency band by taking turns.

Voice and Data Communication: Voice Calls: GSM is primarily designed for voice communication. It uses circuit switched technology for voice calls, establishing a dedicated connection for the duration of the call. Short Message Service (SMS): GSM introduced SMS, allowing users to send short text messages between mobile devices.

SIM Cards: Subscriber Identity Module (SIM): GSM uses SIM cards to uniquely identify subscribers on the network. The SIM card contains information such as the user's identity, contacts, and network-related information.

Interchangeability: The use of SIM cards allows users to easily switch GSM-compatible phones by moving the SIM card from one device to another. Roaming and International Compatibility: Roaming: GSM enables users to make and receive calls when traveling between different GSM networks, a feature known as international roaming.
Global Compatibility: GSM's global standardization allows for international compatibility, ensuring that GSM devices work seamlessly on networks worldwide.

Fast Charging Model

It seems like there might be a small typo in your question. If you intended to ask about "fast charging models" or "fast charging methods," I can provide information on that. Fast charging refers to technologies and methods that allow devices, such as smartphones, tablets, and electric vehicles, to charge at a much quicker rate than conventional charging methods. When using fast charging, it's important to use compatible chargers and cables provided by the device manufacturer to ensure safe and efficient charging. Here are key points about fast charging:

Voltage and Current: Fast charging typically involves delivering higher voltage and/or current to the device's battery compared to standard charging. This allows for faster electron flow, resulting in quicker charging times. Battery Safety: Fast charging technologies are designed to prioritize safety. They often include features like temperature monitoring to prevent overheating, and they adjust charging rates based on battery conditions. Heat Management: Fast charging can generate more heat compared to standard charging. Manufacturers implement heat management systems, such as thermal sensors and cooling mechanisms, to prevent damage to the device and battery. Charge Time: The main advantage of fast charging is the reduction in charging time. With compatible devices and chargers, users can significantly decrease the time it takes to charge their devices. Compatibility: Fast charging technologies are often proprietary, meaning that a device and its charger must both support the same fast-charging standard for optimal performance. However, some standards like USB Power Delivery are more universal.

Wireless Fast Charging: In addition to wired fast charging, there are also wireless fast-charging standards, such as Qi wireless fast charging. These systems use induction to transmit power without the need for physical connectors. Impact on Battery Lifespan: While fast charging is convenient, frequent use of high-speed charging may impact the long-term health of a battery. However, advancements in battery and charging technology aim to minimize these effects. chargers and cables provided by the device manufacturer to ensure safe and efficient charging.

V. EXPECTED OUTCOME

An Unmanned Electric Vehicle (E-Vehicle) Charging Station Project is likely to have several expected outcomes, contributing to the advancement and adoption of electric mobility and sustainable transportation. Here are potential outcomes of such a project:

Convenience and Accessibility, 24/7 Charging, Unmanned charging stations provide electric vehicle owners with the convenience of charging their vehicles at any time, day or night, without dependence on station attendants.

Accessible Locations: Deploying unmanned charging stations at strategically located areas, such as highways, urban centres, and parking lots, enhances the accessibility of electric vehicle charging infrastructure.

Scalability and Replicability: Scalable Model: If successful, the unmanned charging station project may serve as a scalable model for the deployment of similar stations in other regions, contributing to a broader and more interconnected electric vehicle charging network.

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Advanced Footstep Power Generation with RFID Based Charging

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Abstract*—Utilization of power turns to be necessary for every work in today's world. To comfort our daily routines the devices are used in large numbers. The benefits of roadway energy harvesting systems are potentially excellent. Energy harvesting is defined as capturing minute amounts of energy from one or more of the surrounding energy resources. To generate the power through footsteps as a source of renewable energy sources that we can obtainwhile walking on a certain arrangement like stepping foot on piezoelectric tiles. an advanced footstep power generation system proposed here uses the piezoelectric sensors. To generate a voltage from footstep the piezo sensors are mounted below the platform. To generate maximum output voltage the sensors are placed in such an arrangement. This is then forwarded to our monitoring circuitry. The circuit is the micro-controller based monitoring circuit thatallows users to monitor the charges and voltage a connected battery to it and this power source has many applications. It also displays the charge generated by our footstep and displays it on an LCD. Also, it consists of a USB mobile phone charging point where a user may connect cables to charge the mobile phone from the battery charge. The current is distributed using (radio- frequency identification) RFID cards so that only an authorized person can use the generator for charging. Thus we charge a battery using power from footsteps, display it on LCD using a micro-controller circuit and allow for mobile charging through the setup. Our projectmodel cost is effective and easy to implement and also it is green andnot harmful to the environment.

It is well-known fact that with a daily hike in population graph of the country the power consumption is also increased simultaneously in parallel to the increased consumption its wastage also has risen to the higher side so the transformation of waste energy brings back to usable form is not only major task as well as itis needed of hour. With increased population density and development of Technology has more diverging to the use of the more and more electronic gadget, devices, on the other hand, conventional power generation method is going short day by day hens and urgent need a ride to search for an alternate method of power generation E.g.: solar energy (renewable energy) at the same time it's time to consider about power wasted through human action to overcome this crisis the waste energy is converted to useable form with the help of piezoelectric sensor As the pressure exerted on the sensor is converted into voltage by using energy conservation method footstep power generation is used for charging a gadgets likemobile phone through USB cable.

Keywords— Piezoelectric, Renewable Resources, LCD, Battery, Micro-controller, USB, RFID.

I. INTRODUCTION

Energy is nothing but the ability to do work. Power has turned into help for the human populace nowadays. Its request is expanding rapidly. In day to day, life innovation needs an immense measure of electrical power for its different activities. Power generation is the single largest wellspring of contamination in the world. Due to which numerous energy resources are produced and wasted. Electricity is generally generated from resources like water, wind, coal, etc. for generating the electricity from these resources development of big plants that are needed having high maintenance and high cost.In like manner, it is the target of the present development to give the technique for electrical power generation from which regularly expanding human populace that does not adversely affect the natural resources. This innovation depends on a rule called the piezoelectric effect impact, in which certain materials can develop an electrical charge from having weight, the strain applied to them. The piezoelectric effect is the effect of specific materials to generate the electric charge in response to applied mechanical stress on it. It is the effect in which mechanical vibrations, pressure or strain applied to the piezoelectric material are converted into electrical form. Piezoelectric alludes to the capacity of a few materials to produce an electric potential in light of connected weight. The inserted piezoelectric material can give the enchantment of the changing overweight applied by moving individuals into the electric current, which is stored in a battery and further distributed using RFID cards. For an alternate method to generate electricity there are number of methods by which electricity can be produced, out if such methods footstep energy generation can be an effective method to generate electricity. Walking is the most common activity in human life. When a person walks, he loses energy to the road surface in the form of impact, vibration, sound etc, due to the transfer of his weight on to the road surface, through foot falls on the ground during every step. This energy can be tapped and converted in the usable form such as in electrical form. This device, if embedded in the footpath, can convert foot impact energy into electrical form. Ninety-five percent of the exertion put into pedal power is converted into energy. Pedal power can be applied to a wide range of jobs and is a simple, cheap, and convenient source of energy. However, human kinetic energy can be useful in a number of ways but it can also be used to generate electricity based on different approaches and many organizations are already implementing human powered technologies to generate electricity to power small electronic appliances [5]. Proposal for the utilization of waste energy of foot power with human locomotion is very much relevant and important for highly populated countries like India and China where mobility of its masses will turn into boon in generating electricity from its footsteps.

II. OBJECTIVE

The objectives of advanced footstep power generation with RFID-based charging encompass a multifaceted approach to sustainable energy harnessing and technological innovation. Primarily, this initiative aims to leverage human locomotion as a renewable energy source by installing specialized flooring equipped with piezoelectric materials that generate electricity through footstep-induced pressure. This technology seeks to address the growing demand for clean energy solutions by tapping into the ubiquitous movement of individuals in various public spaces. Moreover, integrating Radio-Frequency Identification (RFID) technology into this system serves the purpose of efficient and wireless charging. By embedding RFID tags within footwear or wearable accessories, the system can accurately track and identify users, facilitating seamless energy transfer and charging processes. This objective aligns with the need for user-friendly, convenient, and accessible charging methods to encourage widespread adoption of sustainable energy practices. Furthermore, this initiative aims to promote environmental sustainability by reducing reliance conventional power sources and lowering carbon footprints. By encouraging the integration of footstep power generation and RFID- based charging systems in high-traffic areas such as transportation hubs, malls, or stadiums, the objective is to harness the collective energy of human movement while providing a convenient and eco-friendly means of charging devices or powering essential systems. In summary, the objectives of advanced footstep power generation with RFID-based charging converge on harnessing kinetic energy from human footsteps, facilitating wireless and efficient charging through RFID technology, and promoting sustainable energy practices to address environmental concerns while meeting the growing energy needs of modern society.Advanced footstep power generation with RFID-based charging aims to harness human motion for renewable energy generation. By integrating RFID (Radio-Frequency Identification) technology into footstep mechanisms, the system captures and converts kinetic energy from footsteps into electrical power. The primary objectives revolve around sustainability, efficiency, and convenience. Firstly, the system aims to provide a sustainable energy source by utilizing the otherwise wasted energy from human movement. Secondly, it aims for efficiency in energy conversion, optimizing the technology to efficiently capture, store, and convert kinetic energy into usable electrical power. Lastly, the integration of RFID-based charging streamlines the process, allowing for convenient wireless charging of devices through the harvested energy, enhancing the practicality and accessibility of renewable energy in everyday scenarios. This innovative approach aligns with the broader goal of promoting green energy solutions while offering a seamless and user- friendly experience.

III. METHODOLOGY

The following figure shows the block diagram of an advanced footstep power generator using RFID for charging. After applying weight on piezoelectric plates voltage is developed across the plates. That voltage is applied to the battery for charging purposes. This is then provided to our monitoring circuitry.LCD is interfaced with a piezo sensor using a micro-controller that allows the user to monitor the voltage and charges a connected battery by it. Also, RFID is interfaced witha micro-controller to know authorized users & it consists of a USB mobile phone charging point where the user may connect cables to charge the mobile phone from the battery charge.

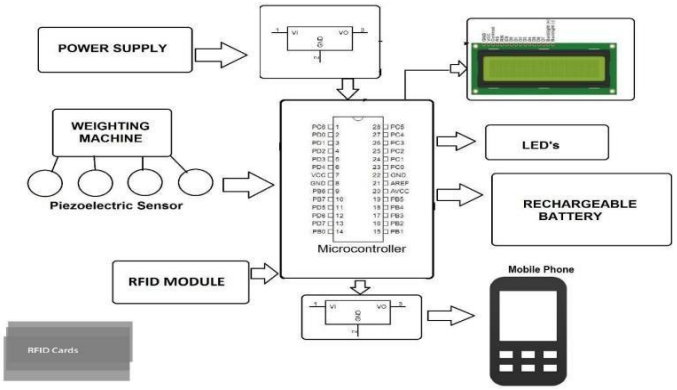

Figure 1: Block of Proposed System

The Footstep power generator works on the principle of piezoelectric effect impact. Piezoelectric Effect is the ability of certain materials for generating electric charges in response to applied mechanical stress on the piezoelectric plate. Thus, squeeze certain crystals and you can make electricity flow through them. In most crystals, the unit cell is symmetrical in piezoelectric crystals. Normally, the piezoelectric crystals are electrically neutral and atoms inside the piezoelectric plate may not be symmetrically arranged, but their electrical charges are perfectly balanced, the positive charge in one place cancels out a negative charge nearby them. However, if you squeeze or stretch the piezoelectric crystal, you deform the structure, negatively, and causing net electrical charges to appear. This effect carries through a whole structure so net positive and negative charges appear on the opposite, outer faces of the crystal. Normally, the charges in the piezoelectric crystal are exactly balanced, even if they are not symmetrically arranged. If you squeeze the crystal (massively exaggerated in this picture!), you force the charges out of balance. Now the effects of the charges are no longer eliminated one another out and net positive and negative charges appear on opposite crystal faces. By squeezing a crystal, you have produced the voltage across its opposite faces and that's piezoelectricity. In this project, we have used the same phenomenon of producing piezoelectricity from the piezoelectriccrystal in the form of a coin shape disc.

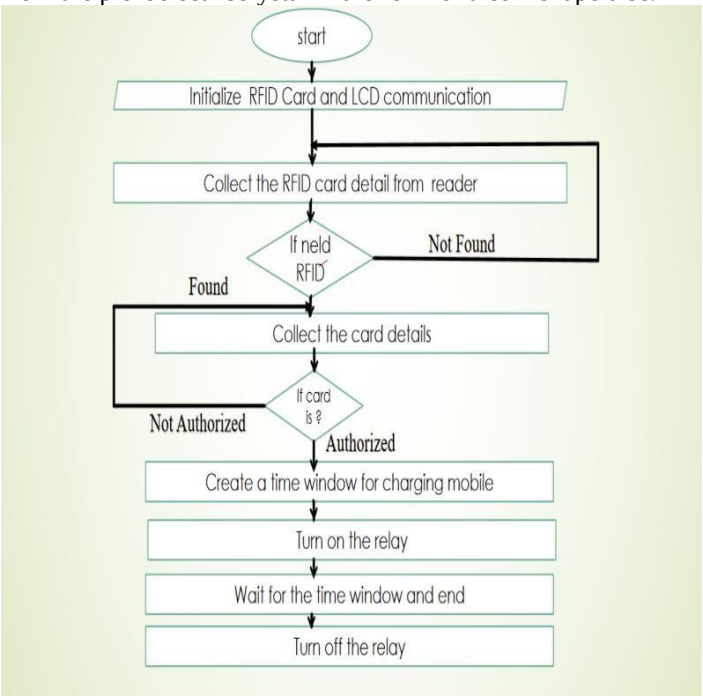

Figure 2: Flow Chart of RFID Interface

In this footstep power generation project, we are generating power with the help of human's footsteps; this power is then used to charge battery. The power is stored in a battery that can be used to charge a mobile phone using RFID card. When we swipe the card and if the user is authorized, the system turns on for charging and will charge the Mobile phone.If the user is un-authorized then the system will display as unauthorized user, just in case if the user wants to stop the charging in midway the user needs to swipe the card again. As soon as the card is swiped again, the remaining time balance is displayed and the charging stops. In order to recharge a card, we need to press recharge button which is on the system, and then system will ask to swipe the card, once the user swipes thecard, it adds more 5 minutes to the particular card of the user.

IV. RESULTS

The result of an advanced footstep power generation system is the generation of electrical energy by harnessing the kinetic energy produced from human footsteps.This technology aimsto convert the mechanical energy generated by individuals walking or running into usable electrical power. The advanced footstep power generation system utilizes specialized devices such as piezoelectric sensors or electromagnetic generators embedded in the flooring or footwear These devices convertthe vertical movement or pressure exerted by foot impact into electrical energy. The system has several potential benefits, including the ability to generate clean and sustainable energy inhigh-traffic areas or public spaces. It can be used to power low-energy devices such as lighting systems, charging stations for mobile devices.

In **1 square ft**. we have used 8 piezo sensors.
As piezo sensors the power generating varies at different steps, hence we get
Min volt= 1V per step
Max volt = 10.5V per step
Also taking an **average of 50Kg weight** pressure that from a single person.
Likewise considering the steps of a 50Kg weighted single person, the average calculation comes out to be:
Increase of 1V charge in the battery it takes 800 steps
So, increment of 12V **in battery total steps** needed are
= (8*800) = 6400 steps
And if implementation our project is done in a populated area where footstep as source will be available, we took an **average of 2 steps in 1 second**.
For **6400 steps** time needed
= **6400/ (60*2) =53 minutes.** (Approx.)

Figure 3: Advanced Footstep Power Generation with RFID Based Charging

V. ADVANTAGES AND DISADVANTAGES

Advantages:

Renewable Energy Source: Footsteps are a renewable energy source, making this method environmentally friendly andsustainable.

Efficiency: RFID technology can efficiently capture energy from footstep vibrations, converting it into electrical energy.

Cost-effective: Once installed, RFID-based footstep power generation systems can be relatively low-cost to maintain compared to other renewable energy sources.

Accessibility: Footsteps are a ubiquitous energy source, making this technology accessible in various environments, suchas public spaces, malls, and transportation hubs.

Versatility: RFID technology allows for flexibility in deployment, as it can be integrated into existing infrastructure like floors, walkways, or pavements without significant modification

Disadvantages:

Limited Power Generation: Footstep energy generation, evenwith RFID technology, produces relatively low amounts of power compared to other renewable sources like solar or wind.

Interference: RFID systems may experience interference from electromagnetic fields or metallic objects, affecting their efficiency and reliability.

Initial Installation Cost: While maintenance costs may be low, the initial installation cost of RFID-based footstep power generation systems can be relatively high.

Weather Dependency: Unlike some other renewable energy sources, footstep power generation is dependent on human movement, which may vary depending on weather conditions or time of day.

Wear and Tear: High-traffic areas may experience faster wear and tear on RFID sensors embedded in floors or pavements, requiring frequent maintenance and replacement.

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Heart Attack and Alcohol Detection Sensor Monitoring in Smart Transportation System using Internet of Things

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Abstract*—Accidents caused due to drunken drive are increasing tremendously in this modern world. To prevent these kinds of accidents, we propose an IoT based health monitoring system with alcohol detection and control. The proposed project is designed to reduce accidents caused due to drunken driving. Globally the cases of accidents are increasing due to this aspect. In order to prevent these accident cases, in this project an IoT based method has been designed. In that Arduino, Alcohol Sensor, Heart beat rate sensor, Global System for Mobile communication, Wi-Fi modem, are utilized. Once the alcohol rate and heart beat rate are exceeding the specified limit, the command will be given to the ignition system of the vehicle to stop the operation of the vehicle.

Keywords— heart monitoring, GSM, IOT, Arduino UNO.

I. INTRODUCTION

IoT (Internet of things) based health monitoring with alcohol detection and control is an innovative system that combines the power of IoT, alcohol detection, and engine control to improve safety and health in various industries, including transportation, healthcare. The system is designed to monitor the health status of individuals, particularly those who work in hazardous environments, such as drivers. It uses senor, such as heart beat rate sensor to collect the data on the user's health status in real-time. The alcohol detection feature of the system uses alcohol sensor (MQ-135) to detect the alcohol levels in the users breathe. This feature is used to control the drunken drive accidents. The engine control feature of the system is designed to prevent accidents caused by impaired drivers. The system can detect if the user has consumed alcohol above a certain threshold, and in such cases, it can automatically disable the engine of the vehicle, preventing the user from operating.

Overall, IoT based health monitoring with alcohol detection and control is an innovative system that can significantly improve safety and health in various industries. It can help prevent accidents caused by impaired drivers, reduce the risk of health-related incidents in hazardous conditions. Mugila et al proposed that wearing smart helmet to prevent any mishap is suggested by writer which have certain deficiencies. Firstly, restrictions on the use of helmets to only 2 wheelers. Secondly, microcontrollers are software based mega system in comparison to the economical siren that are open-source hardware. Pavan Shukla et al [2] proposed that the design and implementation of an Alcohol Detection with Engine Locking for cars using the Ultrasonic Sensor and Arduino UNO as the MCU (Master Control Unit). The system will continuously monitor level of alcohol concentration in alcohol detection sensor and thus turn off the engine of vehicle if the alcohol concentration is above threshold level.

The model will also send the message of whereabouts of the vehicle through SIM900A. The project provides an efficient solution to control accidents due to drunk driving. Pramod Gadekar et al [3] proposed that by integrating alcohol sensor with Arduino board. Arduino processor ATmega328 is able to handle more functions than conventional microcontrollers. The alcohol sensor used in this project is MQ3. which to detect the alcohol content in human breath. Since sensor has fine sensitivity range around 2 meters, it can suit to any vehicle and can easily be hidden from the suspects. This project is fitted inside the vehicle.

II. OBJECTIVE

The project titled Heart Attack and Alcohol Detection Sensor Monitoring in Smart Transportation System using Internet of Things aims to enhance the safety of drivers and vehicles by using three types of sensors: Heartbeat sensor, Traffic light sensor, and Level sensor. The heartbeat sensor is used to monitor the driver's heartbeat rate constantly and prevent accidents by controlling through IoT. IoT conveys the emergency message to the owner, ambulance, and the police. The traffic light sensor is used to follow the traffic rules and regulations by the driver. If the red light is in the ON state, then the vehicle automatically stops before it reaches the white line. The fuel level sensor is used to measure the vehicle's fuel level and calculate whether the available fuel is enough to reach the destination or not. If it is not enough, then the map will suggest the driver reach the nearby petrol bunks. The project is aimed at providing a safe and secure transportation system by using IoT technology.

III. METHODOLOGY

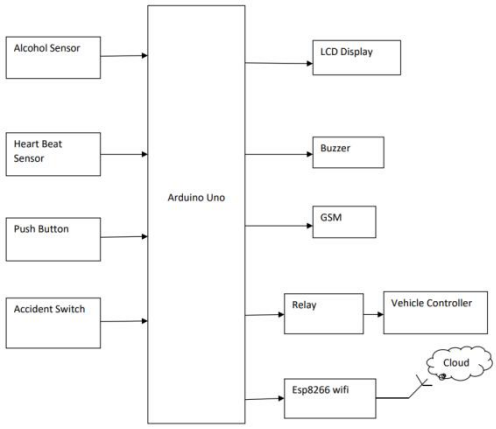

Figure 1: Block Diagram

In this project Arduino uno is used as a micro controller and all components are interfacing with Arduino uno. Alcohol sensor is used to measure the alcohol content in driver, if alcohol detect vehicle will not start. Pulse sensor is used to measure heart beat of driver, if heart beat is low on that time message will send to family members through GSM and buzzer will ON. If any accident happened, if press the switch on that time message will send through GSM and buzzer will ON. All sensors data display on LCD display and stored data in thing speak app by using wifi in the form of graph

IV. ADVANTAGES

The proposed module can reduce the accidents due to drunken drive. The module is useful to observe the user's position whether they drunken or not. In the module the accident switch button is added additionally to send the message with help of GSM to the respective mobile numbers and will upload in the thinks view app. In this, the module is connected to the ignition switch of the vehicle and it stops the operation as off when the value exceeds the limit within 4 seconds which is very fast when compared to other modules. This module can be very helpful for police to decrease the drunken drive accident cases. The app can be installed by mobile users and enter the channel ID to see the current status

V. RESULTS

we have proposed the smart car system using IOT, GSM and sensors like heartbeat sensor, Fuel level sensor, traffic light sensor and alcohol sensor for prevent the persons and driver travelling in the car from accident. We used "Prevention is better than cure" proverb International Conference on Energy, Communication, Data Analytics and Soft Computing (ICECDS-2017) 886 which makes our life safe and secured. Our Government asked drivers to follow the Traffic rules, but drivers refused to follow road rules like buckle up seatbelt, don't drink and drive vehicle, stop in red signal. If we implement the concept described in this modern world then surely there will be reduction in accidents. When driver wears the seat belt, Heartbeat sensor starts monitoring while driving and if any abnormal change in the heartbeat is found, then the vehicle gradually decreases the speed and will automatically stop the vehicle by initiating the Parking light.

VI. CONCLUSIONS

In conclusion, the proposed IoT-based health monitoring system with alcohol detection and control provides an efficient and reliable way of monitoring alcohol intake and preventing drunken drive cases. With the help of this module, the respective mobile number users can monitor their alcohol consumption using the Think's View App and by using the GSM the SMS sends to the user contact numbers

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Lungs Breath Respiratory Health Analyzer And Monitoring

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Abstract—Spirometers are used to measure lung capacity and the response of the lungs and chest during physical therapy. Current spirometers possible concerning business are high-priced. Due to this high cost, many physicians undertaking in underdeveloped countries like India, cannot produce Spirometry supplies. Thus, the growth of a low-cost trustworthy spirometer would admit these physicians to evaluate their patient's pulmonary well-being. All these factors experienced to the growth of a device that addresses cost issues in addition to mechanics accuracy. A calculating located made smaller spirometer plan is Designed expected realized that would use a stable-state pressure sensor. An original of Computer located Spirometer method has happened earned which would engage a complete-state alone traffic pressure sensor. A loyal parallel signal procurement and deal with channel have happened created and tested in addition to the dependable-state pressure sensor. Spirometry is the method to measure the flow and book of air recording and leaving the alveoli. A spirometer is used to conduct a set of medical tests that help to identify and quantify defects and abnormalities of various lung conditions in the human respiratory system. These tests also help monitor the lungs' response to medical treatment. With the help of a spirometer, COPD may be discovered well earlier. Monitoring cough and hissing cannot provide a correct evaluation of the asperity of asthma in a patient. With the help of the respiring tests attended utilizing a spirometer, the answer and bettering in an asthma patient's condition all the while the situation can be listened to correctly.

Keywords – Arduino Uno, Computer-based Spirometer, Pulmonary health, Sensors, IoT.

I. INTRODUCTION

Spirometers are used to measure lung capacity and response of the lungs and chest during physical therapy. Current spirometers available in the market are expensive. Due to this high cost, many physicians practicing in developing countries like India, cannot afford Spirometry equipment. As a result, millions of people with chronic obstructive pulmonary disease, or COPD, are unable to be effectively monitored or treated for their disease. Thus, the development of a low-cost reliable spirometer would allow these physicians to assess their patient's pulmonary health. All these factors led to the development of a product that addresses cost issues as well as technical accuracy. A computer-based miniaturized spirometer system is Designed to be realized which would use a solid-state pressure sensor. A prototype of a computer based Spirometer system has been realized which would employ a solid-state single port pressure sensor. A dedicated analog signal acquisition and processing channel have been designed and tested along with the solid-state pressure sensor. Calibration of the pressure sensor for known values of applied pressure has been performed for linearity tests. The MSP430 is employed in designing the micro-controller firmware program for digitization and transmission of the signal to the computer. Dedicated computer software for data acquisition, display, and analysis was developed in the .NET platform. Spirometry is the technique to measure the flow and volume of air entering and leaving the lungs. A spirometer is used to conduct a set of medical tests that help to identify and quantify defects and abnormalities of various lung conditions in the human respiratory system. These tests also help in monitoring the response of the lungs to medical treatment. With the help of a spirometer, COPD can be detected well in advance. Monitoring cough and wheezing may not provide an accurate assessment of the severity of asthma in a patient. With the help of the breathing tests conducted using a spirometer, the response and improvement in an asthma patient's condition during the treatment can be monitored accurately. This helps in improving the quality of treatment by reducing judgment errors. These breathing

tests can be classified into two types, depending on the lung characteristics that they measure. These are Gas Exchange Functions and Dynamic Lung Functions. The 2 dynamic lung functions test the Forced Vital Capacity (FVC), Flow-Volume Curves, Maximum Voluntary Ventilation (MVV), and airway resistance are the most common test and are highly informative and useful in most cases.

II. OBJECTIVE

The aim of this project is to design and construct a suitable Smart spirometer.

To Obtain this aim the following objectives are set.

i. Provides patient with their breathing status.

ii. Spirometry is the traditionally used diagnostic tool in the assessment of pulmonary function. To construct and test the designed device.

iii. It is a physiological test that measures individual exhalation and inhalation chest volumes as a function of time.

iv. Spirometry, although a powerful tool that plays a substantial role in the early diagnosis of lung damage and its associated buildings, is effort dependent.

v. It sometimes becomes complex to ensure cooperation and attain completion of the test in geriatric, foreign-language subjects, and young children.

vi. Asthma and Chronic obstructive pulmonary disease (COPD) are both respiratory conditions that are chronic and affect a person's breathing.

vii. If bronchial asthma is not dealt with, it could business lead to severe assaults. Within this paper, we have reviewed various design topologies involved in spirometry implementation.

III. METHODOLOGY

The spirometer design is used to measure and study the physiology of the lungs. Here the patient is allowed to blow air in and out with the help of a mouthpiece with maximum effort. The spirometer design consists of a differential pressure sensor that measures and converts the pressure advance. Monitoring cough and gasping cannot support a correct estimate of the asperity of asthma in a patient. With the help of the respiring tests conducted utilizing a spirometer, the reaction and bettering in an asthma patient's condition all the while the situation may be listened to correctly. This helps in improving the quality of treatment by reducing judgment errors. Pulmonary function tests (PFTs), or breathing tests, are used to identify and quantify defects and abnormalities in the function of the respiratory system. These signals are filtered and processed by the microcontroller. The output from the microcontroller is then interfaced with the desktop (Lab-view) for easy access. The data are then studied, diagnosed, and interpreted on the move by the pulmonologist for easier access. The components used in this system are classified into three sections: A) Design of the mouthpiece along with the placement of the pressure B) Sensor interface to the Arduino Uno microcontroller unit C) Serial transmission

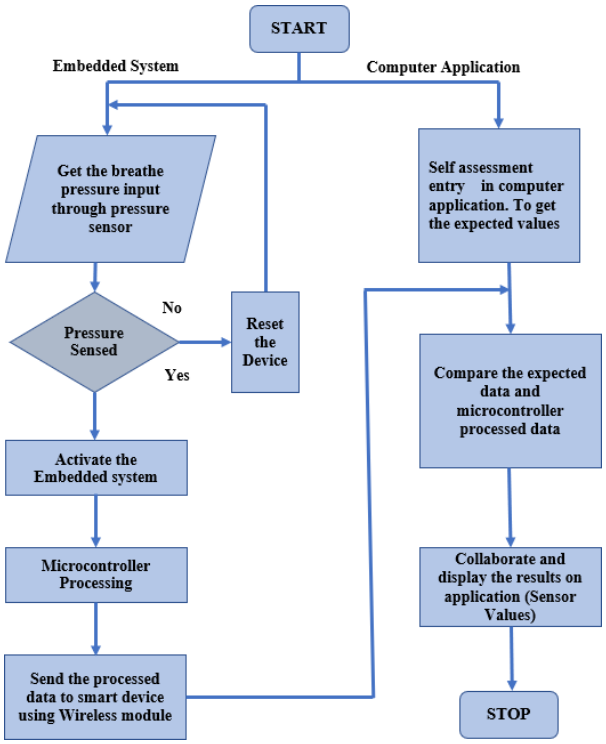

Figure 1: Flow chart of respiratory health analyzer and monitoring

Body temperature tells a lot about a patient's health, hence it becomes vital to measure it. For this purpose, in this project, we're using 89015 LM35DZ. It comes from the LM35 family, but unlike LM34 and LM355, LM35DZ gives output readings in °C. It has three pins, low self-heating, and an accuracy of 0.4°C. The Wi-Fi chip. It comes with a TCP/IP protocol stack which gives it the power to connect to a Wi-Fi network. Each chip is programmed with an AT command set, making it easier for users to connect it to the Arduino device. It is compact, lightweight and inexpensive, and this is what makes it so popular for IoT application. Computer application helps collect, visualize and act on the real-time data collected by the device connected to Thing Speak via the internet. Incentive Spirometer(or Spirometer) is used routinely in hospitals for patients with chest and/or lung ailments. Patients blow air in the tube attached to the spirometer and try getting a good score on the spirometer. Required flow rates in all three glass columns are 600cc, 900cc and 1200cc respectively. The amount of airflow generated by the patient is indicated by the number of balls reaching the column tops. For example, if all three balls have reached their respective column tops, then maximum airflow, i.e. 1200cc, was generated, similarly for two balls and a single ball, airflow of 900cc and 600cc was generated. Pulse Sensor: The pulse sensor used here is to measure the heart beat or pulse rate of the user. The user has to place their finger on the heart shaped sensor. You must place your finger and not press it on the sensor. Make sure the finger is clean and has no cuts or wounds. The readings will be displayed on LCD.

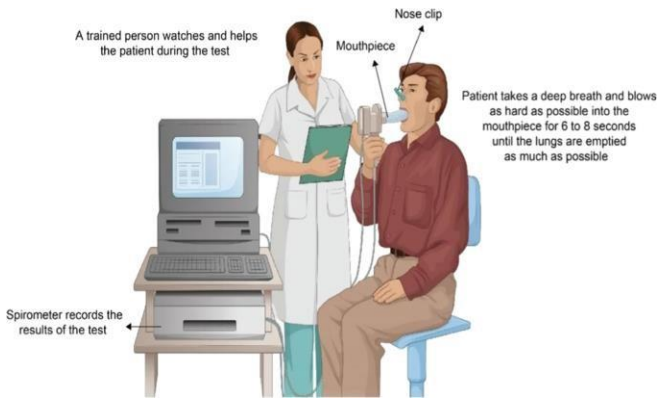

Figure 2: Performing spirometry

. It can also assist doctors in determining whether or not the patient is receiving appropriate treatment. In emergency situations, the patient can take an online exam and communicate immediately with the doctor. The spirometer is linked to the internet via web server pro-posed unsupervised home spirometry technology, and it is also linked to the doctor byethernet. These spirometers have a drawback in that they can only be used in conjunction with a computer.

RESULTS

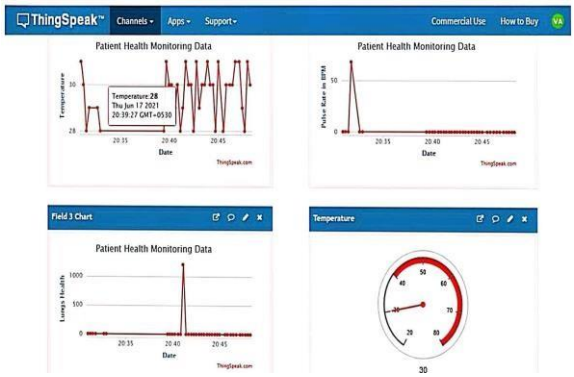

Figure 3: Outcome

Basic Respiratory Rate Monitoring**:** Measure and display the respiratory rate (breaths per minute) based on sensor input. LED or display indication for normal, high, or low respiratory rates.

Real-time Data Display**:** Display real-time respiratory data on an LCD or LED screen for easymonitoring.

Alert System: Implement an alert system for abnormal respiratory patterns, such as exceeding apredefined threshold.

Data Logging: Incorporate an SD card module to log respiratory data over time for analysis. Graphical Representation: Create graphical representations of respiratory data trends over time.

Integration with Health Platforms: Explore integration with health platforms or cloud services for long-term data storage and analysis.

Educational Tools: The project can serve as an educational tool, helping individuals understand respiratory health concepts and the impact of lifestyle on breathing patterns**.**

IV. ADVANTAGES AND DISADVANTAGES

Advantages:

Affordability: Arduino components are relatively inexpensive, making the project cost-effective compared to commercial spirometers.

Customizability: You can tailor the spirometer to specific requirements and even add features like data logging or mobile app integration.

Accessibility: The open-source nature of Arduino allows for widespread availability and easy replication of the project.

Learning Opportunity: Building a smart spirometer with Arduino provides a valuable educational experience, teaching about both electronics and respiratory health.

Real-time Data: It can provide immediate feedback on lung function, aiding in monitoring and managing respiratory conditions.

Disadvantages:

accuracy and Calibration: Achieving medical-grade accuracy can be challenging, and calibration may be required for reliable measurements.

Regulatory Compliance: Commercial medical devices need to adhere to strict regulatory standards, which might not be met by a DIY project.

Safety Concerns: Ensuring safety and sterility in a DIY medical device can be difficult, potentially posing risks to users.

Limited Features: A DIY spirometer might not have the advanced features or capabilities found in professional medical devices.

Support and Maintenance: Troubleshooting and maintaining a DIY spirometer can be more challenging without professional support.

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Landmine Detection Robotic Vehicle using Arm Cortex

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Abstract*—The main purpose of our landmines detecting robotic vehicle is to identify the landmines for the defense field for the maximum possible area. If the landmines explode it causes severe damage to the soldiers and even causes toxic pollutants to the environment. Conventionally the robots before they are exploded in the war-based area. Here, the land mine detecting robots plays a vital role in aving the lives of soldiers. A slight modification in the conventional work is proposed here, which gives a key to solving the landmine issues in the defense field with an additional power setup for the robotic vehicle. Here the proposed work is implemented by using an ARM CORTEX microcontroller arrangement in a robotic vehicle . Thus, Landmine Detection Robotic vehicle detects buried mines to avoid human interruption in buried mines by sending alert messages to the control center of the defense force by sharing the location with the identification of land mines using the Global Positioning System. Hence Landmine Detection Robotic vehicle is useful for monitoring the defense area by the control center of the defense force.

keywords-Robotic vehicle,Real-time processing,Sensor integration

I. INTRODUCTION (*HEADING 1*)

The robotic vehicle is to detect landmines, offering crucial support to the military in avoiding these hazardous devices across expansive areas. The detonation of landmines not only inflicts severe harm on soldiers but also releases harmful toxins into the air. In conflict zones, conventional practice involves deactivating robots before detonation, making the identification of landmines a pivotal element in safeguarding soldiers' lives.Landmine removal stands as a critical challenge faced by numerous countries globally, further compounded by natural disasters and ongoing land development. The urgency lies in the detection and safe removal of landmines, a process that commences with the identification of these hidden threats in the ground. Non-contact-based detection methods are imperative for ensuring the safety of those involved in the removal process.The consequences of landmines extend beyond the immediate harm caused to individuals and other living beings.These concealed explosives create enduring disasters, impacting both the economy and state of nations. The battles between countries have escalated the landmine issue into a global crisis, demanding substantial financial
investments for resolution. Agricultural nations affected by hidden explosives allocate significant resources, both in terms of gross public expenditure and human effort, to mitigate the repercussions of these hidden threats.Despite ongoing technological advancements, manual landmine removal remains highly preferred due to its consistency and reliability. The cost-effectiveness and efficiency of deploying landmines make them a favored choice in conflict situations, yet their removal becomes a costly and perilous endeavor. Currently, it is estimated that there are approximately 110 million landmines buried globally, with the potential to remain active for up to 50years after deployment.

II. OBJECTIVE

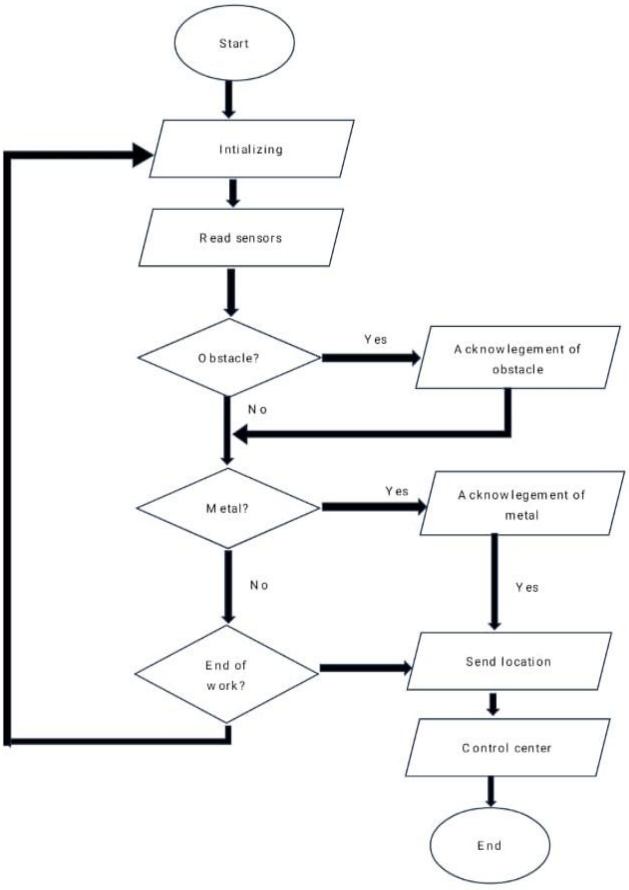
The objective of the LANDMINE DETECTION ROBOTIC VEHICLE USING ARM CORTEX Using ARM Cortex is to develop an autonomous and efficient solution for detecting and locating landmines. The project employs an ARM Cortex-based microcontroller fordata processing and control. Key goals include the implementation of advanced sensors for precise landmine detection, autonomous operation to reduce human exposure to danger, and integration of GPS technology for accurate positioning of identified landmines.The ARM Cortex microcontroller enhances the vehicle's decision-making capabilities, contributing to real-time and accurate detection results. The project aims to improve safety for military personnel and civilians by providing a reliable robotic system capable of navigating diverse terrains. The inclusion of GPS technology ensures the precise tracking of detected landmines, facilitating subsequent demining operations.The project aspires to offer a cost-effective solution, making the technology accessible for widespread deployment in regions affected by landmines. By achieving these objectives, the project seeks to make a substantial contribution to global efforts in mitigating the hazards posed by landmines, ultimately enhancing the efficiency and safety of demining operations worldwide.

III. METHODOLOGY

The methodology for the "LANDMINE DETECTION ROBOTIC VEHICLE USING ARM CORTEX Using ARM Cortex" project. This involves ARM Cortex microcontroller, specialized sensors for landmine detection,

and GPS technology for accurate positioning.

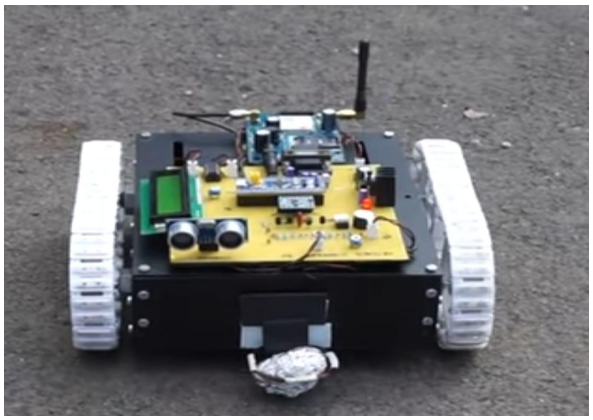
Securing our nation is paramount, and ensuring the safety of our soldiers is crucial. The threat of enemy-laid mines poses a significant risk, emphasizing the need for effective detection and neutralization. Our solution, the LANDMINE DETECTION ROBOTIC VEHICLE USING ARM CORTEX with GPS Positioning Using ARM, addresses this concern.This innovative system efficiently scans rectangular areas for hidden landmines, employing a metal detector for detection. Upon identifying a mine, the robotic vehicle stops, and the ARM Cortex controller processes the data, ensuring a swift response. The GPS technology then tracks the mine's precise location and sends an SMS alert,enhancing communication and response capabilities. Guided by the ARM Cortex Board, the robotic vehicle systematically scans the entire area, providing a vital layer of defense for our soldiers. By combining robotics and metal detection, this project plays a crucial role in saving lives in regions where enemy-laid landmines pose imminent dangers. It is a practical step towards strengthening the security of our soldiers who selflessly protect our nation



. Figure 1: Flow chart

IV. RESULTS

Using an Arm Cortex-based system in a landmine detection robotic vehicle yields significant benefits. It enables high-performance data processing for real-time analysis of sensor data, enhancing detection accuracy and operational efficiency. The system's versatility supports integration with various sensors and communication modules, adapting to different terrains and landmine types. Energy-efficient design ensures prolonged battery life and reliable long-term operation. Scalability allows for optimal performance customization, while cost-effectiveness makes it an attractive choice for integrating advanced technology into robotic vehicles without exceeding budget constraints. Overall, Arm Cortex-based systems enhance the effectiveness and reliability of landmine detection operations.



V. ADVANTAGES AND DISADVANTAGES

Advantages:

With the help of GPS, location can be mapped accurately.Avoids the human interference in detecting landmines which may put their lives into danger.Locations of detected landmines can also be accessed via mobile phone through SMS Landmine detection robotic vehicles provide several key advantages over traditional manual methods. Firstly, they significantly enhance safety by removing the need for human operators to physically enter hazardous areas, reducing the risk of injuries or fatalities. This safety aspect is particularly crucial in conflict zones or areas with extensive landmine contamination.Secondly, robotic vehicles offer unparalleled efficiency in landmine detection operations. They can cover large areas in a systematic and thorough manner, significantly speeding up the detection and clearance process compared to manual methods. This efficiency is crucial for minimizing the time and resources required for landmine clearance efforts. Robotic vehicles are equipped with advanced sensors and detection technology, leading to higher accuracy in identifying landmines. This increased accuracy helps in reducing false alarms and ensures that potential threats are reliably detected and neutralized.

Disadvantages:

Cost Implementation and maintenance of automated navigation systems with object recognition can be expensive, limiting accessibility for smaller entities.

Dependency on Technology: Reliance on technology makes systems vulnerable to technical failures, which could result in disruptions or accidents.Landmine detection robotic vehicles, while offering advantages in safety and efficiency, face several drawbacks. These include high costs associated with development, deployment, maintenance, and training. The complexity of these vehicles, with advanced sensor and communication systems, can lead to technical issues requiring specialized expertise for resolution. Terrain accessibility remains a challenge, as some areas may be difficult for robotic vehicles to navigate effectively, impacting their ability to detect landmines in all locations.

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DESIGN AND ANALYSIS OF PATTERN RECONFIGURABLE CIRCULAR PATCH ANTENNA FOR ULTRAWIDEBAND APPLICATIONS

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***Abstract* -A circular patch antenna with reconfigurable patterns has been meticulously developed for ultra-wideband applications. Notably, the antenna demonstrates an impressive shared impedance bandwidth of 48% across both operational modes. What sets this antenna apart is its remarkable reduction in side lobes within the broadside radiation patterns along the E-plane. The achieved side lobe-free bandwidth reaches an impressive 39%, surpassing existing works on wideband pattern diversity antennas utilizing a single radiating patch. To substantiate the antenna's performance, a prototype was fabricated and tested, confirming its exceptional characteristics. Furthermore, numerical analysis was conducted when the antenna was positioned in front of a parabolic reflector antenna, particularly for applications in monopulse radar, enhancing its versatility.After the fabrication the comparision between conventional and the aimed antenna is done and analysed.**

Keywords— Circular antenna, Patch antenna, Sidelobes, Pattern diversity, Ultrawideband, HFSS , Circular patch antenna, Radiation pattern.

I. INTRODUCTION

A specific kind of antenna called a pattern reconfigurable patch antenna is made to change its radiation pattern or beam shape in response to shifting operating needs. Usually, these antennas are made up of a patch-like radiating element and a device that allows the electrical characteristics of the antenna to be changed to produce various emission patterns. Engineers and designers can optimize signal coverage, directivity, and reception properties of an antenna to meet the needs of certain communication or radar applications by modifying the antenna's configuration. Wireless communication systems, radar systems, and other domains where adaptive and flexible antenna performance is crucial find use for pattern reconfigurable patch antennas. In dynamic and challenging contexts, this adaptability enables higher signal quality, decreased interference, and increased communication-reliability.

Here the unwanted E-plane side lobes in the radiation patterns are negotiated to a greater degree in a wideband V-slotted circular patch antenna with pattern diversity attributes. The radiation pattern reconfigurability is accomplished by feeding the antenna with two symmetrically-placed Tshaped probes of equal magnitudes and out-of- and in-phase excitations to realize symmetrical broadside and conical radiation patterns, respectively. The shared impedance bandwidth for both the broadside and conical modes is in the order of 48%, from 3.5 to 5.7

GHz. Moreover, the realized bandwidth range with no side lobe levels (SLLs) is about 39% from 3.5 to 5.2 GHz, which is astoundingly much wider than its counterparts. The antenna is fabricated and its characteristics are measured for validation. The high gain characteristics of the proposed antenna are also numerically studied by placing it at the focal point of an electrically-large parabolic reflector antenna.

II. LITERATURE SURVEY

Earlier in 1901 Marconi built a radio antenna for the first time. The history of Antenna can be traced from the start of 1887, when Hertz built the first antenna (Hertzian Dipole) and proved the electromagnetic waves experimentally. A transition mechanism between the direct wave and a free space wave and vice versa could be described by an antenna. Once reciprocity theorem in antennas ends, one can assume that it is similar to the transmitting antenna, considering that nonlinear and unilateral antenna systems do not use the radiation properties of the receiving antennas. Nevertheless, theorem of reciprocity does not allow the equal output of both the antenna reception and transmission.

The design of an antenna component for wireless communication applications meets a range of criteria, such as compactness, bandwidth, radiation levels, polarization and multifunctional characteristics on the given planes. Consequently, various versions of antenna elements have been designed or adopted in both fixed station applications as well as in portable systems either in their basic configurations or in its specified modified form. In order to save money and time, various electromagnetic solvers such as IE3D, ADS, CST and HFSS were developed with a computer technology development.

In the late twentieth century, advances during wireless communication began, which moved the antenna technology for better end efficiency. The frequency range is vast every day and new developments in wireless architecture are taking place. The most important element in the wireless system is the capacity to send and receive power-magnetic waves, which makes lightweight smart antennas state-of - the-art. A lot of research is now in progress on reconfiguring antennas that could operate with the same aperture region at different frequencies [1-7].

Deschamps introduced the idea of microstrip radiat ors in 1953. Microstrip Patch Antennas (MPA) are conducting patch on all substrates of a flat or non-flat configuration. On the other side of the substrate a conducting ground plane is being used. A patch Antenna typically has an improvement in beam widths of about 5 dB and 3 dB between 70 °-90 °. The rectangles, circles, ellipse, rings and disk are widely used but also other geometries like the elliptical circle and the semifinal, square, pentagon, hexagonal, circular H-shape, U-shay, L-shape, triangular, rectangular, inner circular, isosceles triangle, cross-jointing, T-shaped, trapezoidal and so on. Radiation is induced by fringing fields produced in the edges of patch and ground floor antennas. A large number of vector parameters are present in microstrip antennas compared to traditional. Wide-speaking microstrip antennas can be divided into microstrip patch antennas, microstrip slot antennas and microstrip antennas [8].

Developments of microstrip antennas accelerated during 1970s because of availability of various substrates with desired thermal and mechanical properties, advances in photolithography and improved analytical antenna design models. The first practical microstrip antenna was proposed in [9, 10]. Since then practical antenna development continuous efforts are being made to explore various advantages of patch antennas like light weight, low cost, low volume, conformability, compatible with integrated circuits etc. The review of most of the work done initially on microstrip antennas can be found in several references [11-16]. A comprehensive list of various microstrip antennas being used is given in some references [12].

III. CONFIGURATION OF THE ANTENNA

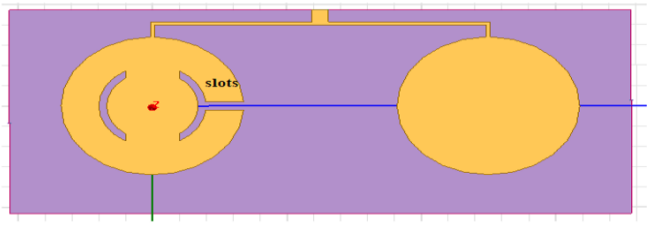

Fig 1 : Proposed microstrip patch antenna array

Through etched holes on the surface of one patch, a unique microstrip circular patch antenna array is proposed for pattern reconfiguration. Two semi-spherical slots in the resulting array construction change the resonance frequency of the antenna. Optimizing slot thickness reduces frequency deviation. The radiation pattern is additionally modified by a horizontal slot on the same surface. Antenna performance can be customized for particular needs through precise control over slot dimensions and positioning. The antenna configuration (Fig. 1) makes use of a FR4 epoxy substrate measuring 115.7 x 50 mm. As radiating elements, there are two circular patches with a radius of 17 mm each. Power is distributed over transmission lines using the microstrip line feed technology, which is made possible by a power divider that guarantees uniform power distribution. Effective electromagnetic wave transmission and reception are made possible by this arrangement, making it appropriate for a variety of wireless communication-uses.

IV.DESIGN EQUATIONS AND PARAMETERS

The design equation to calculate the radius of a patch antenna depends on several factors, including the operating frequency, substrate material properties, and desired antenna characteristics.In circular microstrip patch antenna (CMPA) the radius of the patch is given by

Where, h is the height of the substrate

$$a = \frac{F}{\sqrt{1 + \frac{2h}{\pi . \varepsilon r . F[\ \ln\left(\frac{F\pi}{2h}\right) + 1.7726\ ]}}}$$

$$F = \frac{8.791 \times 10^9}{f_r \cdot \sqrt{\varepsilon_r}}$$

The width of the feed line in a microstrip patch antenna design is a crucial parameter that affects the impedance matching and overall performance of the antenna. It is typically determined using empirical formulas or numerical simulations based on the desired impedance, substrate material properties, and operating frequency. To calculate the width of the feedline , the formula given below is used

$$Zo = \begin{Bmatrix} \frac{60}{\sqrt{\varepsilon_{reff}}}\ ln\left[\frac{8h}{W_f} + \frac{W_f}{4h}\right] & for\ W_f/h \le 1 \\ \frac{120}{\sqrt{\varepsilon_{reff}\left[1.393 + \frac{W_f}{h} - \frac{2}{4}\ln\left(\frac{W_f}{h} + 1.444\right)\right]}} \end{Bmatrix}$$

A microstrip transmission line's characteristic impedance equation contains a number of important variables and their relationships, all of which are essential for creating effective patch antennas. The dielectric constant (εeff) of the microstrip line depends on the dielectric constant (εr) of the substrate and the geometry of the microstrip, which affects the speed at which signals propagate. The capacitance per unit length is determined by the substrate thickness (h), which also affects impedance. Characteristic impedance is directly impacted by the width of the microstrip line (w), with wider lines corresponding to lower impedance. This width is adjusted by engineers to maximize impedance matching between the transmission line and antenna. For effective power transfer, the characteristic impedance (Z0), which should ideally match the impedances of the transmission line and

antenna, is essential. Operating frequency additionally affects impedance through signal propagation effects that are not explicitly included in the equation.

V.RESULTS AND DISCUSSION

At the same frequency band, a new antenna design is compared to a traditional circular patch antenna. Resonance at 2.4 GHz and 4 GHz, with return loss values of -15 dB and -8 dB, respectively, is seen in the S11 plot. Greater negative return loss values indicate minimal power reflection and better impedance matching. When evaluating the antenna's performance for uses such as wireless communication or radar systems that operate in these frequency ranges, this characterisation is crucial.

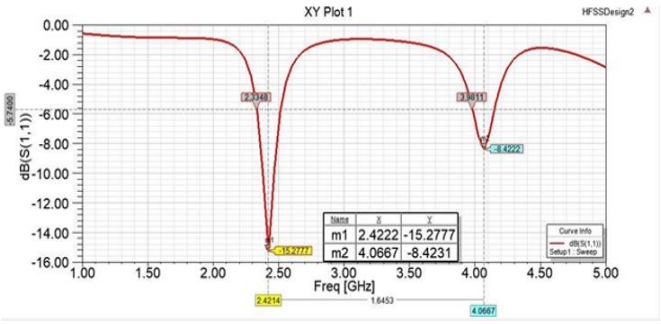

Fig 2: Return Loss Plot of CMPA array

The VSWR plot, which shows VSWR continuously below 2 over the intended frequency range, provides important information about antenna performance. Power transfer efficiency is shown by VSWR, with lower values denoting improved impedance matching and decreased power loss. Excellent impedance matching, which ensures effective power supply and minimum reflections, is shown by a VSWR of less than 2. To maximize antenna system dependability and efficiency during signal transmission or reception, this feature is essential. The plot's indication of favorable impedance matching provides reassurance regarding the antenna's suitability for the intended use and boosts trust in the device's dependability and performance.

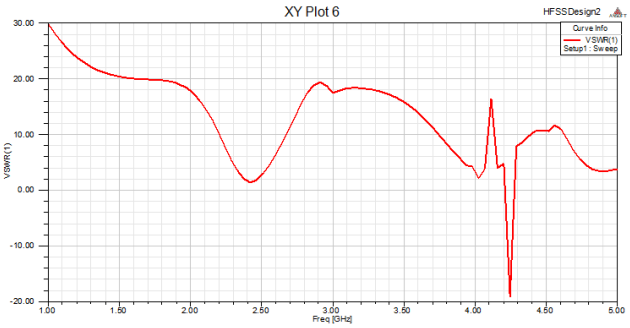

Fig 3: VSWR Plot of CMPA array

The Circular Microstrip Patch Array (CMPA) array's return loss plot (Figure 4.3) shows a broad frequency response from 0.5 GHz to 5 GHz. By adding slots to one side of the antenna, its electromagnetic properties are changed, increasing its frequency range of operation. The impedance and resonance characteristics of the antenna are affected by the added capacitance and inductance that these slots introduce. The resonant frequency is altered via semi-spherical slots that are etched onto the antenna surface, which disturb the distribution of the electromagnetic field. By carefully adjusting the thickness of these slots, the antenna's resonant frequency can be precisely controlled, reducing variations from the intended operating frequency. An indication of the antenna's superior impedance matching capabilities is the achievement of a VSWR (Voltage Standing Wave Ratio) below 2 in the operating frequency band. The antenna's input impedance and the characteristic impedance of the transmission line or system it is linked to are closely aligned, as indicated by the low VSWR. By reducing power reflection at the antenna terminals, this matching promotes effective energy transfer.

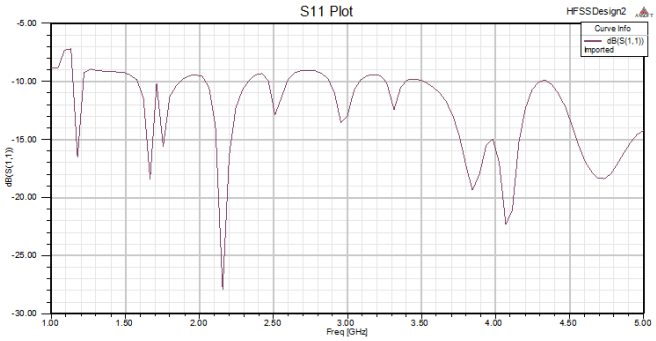

Fig 4: Return loss (S11) plot of Proposed array

This impedance harmony is greatly enhanced by the antenna's inclusion of slots on one side. By carefully planning and adjusting the dimensions of these slots, the antenna's impedance is adjusted to match the transmission line or system impedance throughout a wide range of frequencies. As a result, the VSWR stays low all the time, suggesting strong power transfer and low signal reflection in the intended frequencyrange.

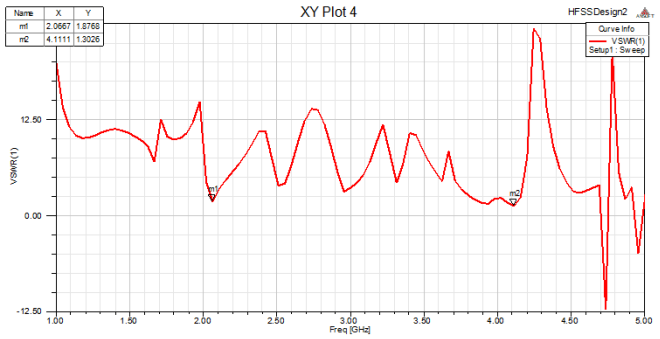

Fig 5: VSWR Plot of Proposed CMPA array.

VI.CONCLUSION

In conclusion, this research has shed important light on how slot inclusion affects antenna radiation patterns. It has been shown by theoretical analysis and experimental validation that adding slots above the antenna structure can drastically change the distribution of currents and electromagnetic fields, resulting in changes to the radiation pattern. The efficiency of slots in directing the radiation of the antenna in a certain direction is demonstrated by the phenomena of a tilted radiation pattern at a 30-degree angle. Particularly in applications where directed radiation patterns are sought, these findings have practical consequences for antenna design and optimization. All things considered, the results of this thesis provide the groundwork for future studies on the impact of slots on antenna radiation patterns. with the potential to advance antenna design and technology in various fields of wireless communication and beyond.

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Smart Shopping System Using RFID and Arduino UNO

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Abstract*—In the ever-evolving landscape of retail, the Smart Shopping System using Radio-Frequency Identification (RFID) technology and the Arduino UNO platform emerges as a groundbreaking solution. This innovative system redefines the shopping experience by seamlessly merging RFID technology with Arduino UNO's capabilities. Traditional shopping systems often grapple with issues such as long checkout queues, inventory discrepancies, and a lack of personalized customer interactions. In response, our proposed system harnesses the potential of RFID tags and readers, working in tandem with Arduino UNO to provide an efficient, convenient, and data-driven shopping experience. This paper offers an in-depth exploration of the existing challenges in conventional shopping systems, introduces our cutting-edge solution, outlines the essential hardware components, highlights its numerous advantages and versatile applications, shares preliminary results, and concludes by envisioning the transformative impact of this technological advancement in the realm of retail. The Smart Shopping System stands poised to revolutionize the retail landscape by improving operational efficiency and customer satisfaction, ushering in a new era of retail excellence.

Keywords*—component, formatting, style, styling, insert (key words***)**

I. Introduction

Retail, as we know it, is undergoing a profound transformation, driven by technological advancements that promise to redefine the way we shop. Traditional brick-and-mortar stores are facing new challenges in an era where consumers demand speed, convenience, and personalized experiences. In response to these evolving expectations, the Smart Shopping System emerges as a beacon of innovation, poised to reshape the retail landscape. For decades, retail systems have relied heavily on manual processes, often resulting in long checkout lines, inventory inaccuracies, and missed opportunities for enhancing customer satisfaction. Conventional systems have struggled to keep pace with the ever-increasing demands of modern consumers who seek seamless, efficient, and engaging shopping experiences. In this context, the fusion of Radio-Frequency Identification (RFID) technology with the Arduino UNO platform presents an exciting paradigm shift. The Smart Shopping System leverages RFID technology's capabilities for real-time product tracking and combines it with the computational power of Arduino UNO to offer an intelligent, data-driven approach to shopping. This amalgamation promises to address the shortcomings of traditional systems and provide a solution that is not only efficient but also highly responsive to customer needs. This report delves into the world of the Smart Shopping System using RFID and Arduino UNO, exploring its potential to revolutionize the retail industry. We will examine the limitations of existing shopping systems, introduce the concept of our innovative solution, outline the critical hardware components that make it possible, elucidate the advantages it brings to both consumers and retailers, discuss its versatile applications, present preliminary results, and conclude with the potential ramifications of this technological leap for the retail sector. In a world where convenience and efficiency are paramount, the Smart Shopping System represents a significant step forward. It promises to make the shopping experience not just more manageable but more enjoyable, enhancing the way we interact with physical stores and unlocking new opportunities for retailers to thrive in an increasingly digital world. As we embark on this journey into the future of retail, the Smart Shopping System is a beacon of hope, pointing towards a more streamlined and satisfying shopping experience for all.

II. Methodology

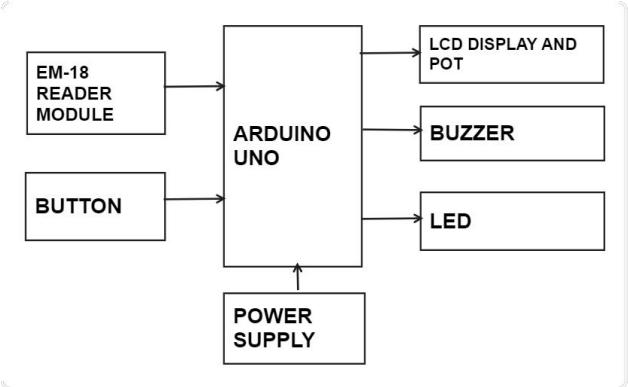

Figure 1: Block Diagram

MFRC522 RFID Reader: SS_PIN (Slave Select or SDA) - Connected to Arduino digital pin 10. RST_PIN (Reset) - Connected to Arduino digital pin 9.

Liquid Crystal I2C Display: The Liquid Crystal I2C module is connected via I2C communication.SDA - Connects to the Arduino's A4 (analog pin 4) for data.SCL - Connects to the Arduino's A5 (analog pin 5) for clock.

Buttons or Switches (Assuming External Buttons): A button is used to trigger actions when pressed. One terminal of the button is connected to Arduino digital pin 3. The other terminal of the button is connected to ground (GND).

Buzzer (Piezo Buzzer): The buzzer is used to provide sound feedback. The positive (anode) terminal of the buzzer is connected to Arduino digital pin 6. The negative (cathode) terminal of the buzzer is connected to ground (GND) as shown in figure 1.

III. HARDWARE COMPONENTS

Arduino UNO

Arduino is an open source and company for planning, making and connecting customers planning and making single board microcontrollers and microcontroller packages for building modern devices. Content material is concern to the gnu lesser widespread public license(lgpl) or the gnu popular public license (gpl), which lets in for the introduction of Arduino sheets and termination of applications via each person. Arduino sheets are presently available in a preassembled constructing or as you are making your personal with the assist of other gadgets (diy)devices.

Arduino board systems use chip time and controllers. Sheets are fitted with front row set sand straight data / crop (I / O) sets that can be interrupted on various continuous sheets ('shields') or bread boards (for prototyping) and various circuits. Sheets include a series of interconnected communications, including Universal Serial Bus (USB) to the undisputed models, used for installing applications on PCs.

Microcontrollers can be replaced using C and C ++ vernaculars. In addition to using conventional interlocking metal chains, the Arduino sensor provides a set-up (IDE) setting that monitors processing language processing. Arduino enjoy began in 2005 as a scholar software underneath the interplay layout institute ivrea in ivrea, Italy, which required to provide insignificant attempt and simple preparation for college students and professionals to create demanding situations that discuss their situation using sensors and actuators. Frequent times of such conflict are suggested by young professionals to join head robots, house controllers and head identifier as shown in figure 2.

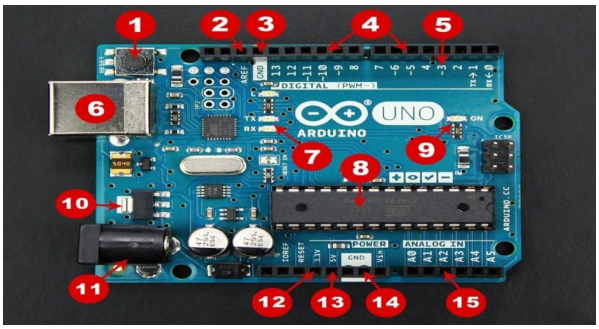

Figure 2: Arduino UNO

LCD 16*2 screen

That is the lcd 16x2 parallel liquid crystal display that offers a truthful and successful answer for including 16x2 white to rgb liquid crystal display in your paintings.The 16-line 2-line show has clear and differentiating high white substance over a blue/foundation light as shown in figure 3.

Figure 3: LCD Display

That is a vibrant lcd show with a blue background. Great for Arduino paintings. This show of lcd 16x2 parallel lcd with back backlight is not tough to connect to Arduino or different microcontroller.

MFRC522 RFID

The MFRC522 RFID scanner is a versatile module used for Radio-Frequency Identification (RFID) applications. Operating at 13.56 MHz, it enables the reading and writing of data to RFID tags and cards, making it suitable for diverse applications like access control systems, inventory management, and identification systems. This module communicates with microcontrollers, such as Arduino, through the Serial Peripheral Interface (SPI) protocol, allowing for seamless integration into various electronic projects. Compatible with RFID tags adhering to the ISO 14443A standard, the MFRC522 offers a read/write range typically spanning a few centimeters to a few inches, depending on tag specifications. Libraries and code examples are readily available for popular microcontroller platforms, simplifying the task of interacting with RFID-enabled objects. The MFRC522 plays a vital role in modern technology, facilitating secure and convenient interactions with RFID-equipped items and finding applications in the Internet of Things (IoT) and embedded systems projects as show in figure 4 and figure 5.

Figure 4: MFRC522 RFID scanner

Figure 5: MFRC522 RFID TAG (left) and Card (right)

IV. RESULTS

Our goal is to implement a smart patient health monitoring system that can monitor the heartbeat and body temperature. The smart patient health care monitoring system developed by us has numerous applications. These types of healthcare systems can be implemented in hospitals as well as at home places where a person needs to have immediate medical attention whenever his/her health goes unstable. As we are using the Thing Speak IoT platform with the help of Thing Speak we can easily capture sensor data. This allows to keep a track of patient's heartbeat and body temperature value with change in time. This would give the doctor a more wide perspective of treating the patient in a much effective way within less time. The system developed patient monitoring based on Internet of things, is an alternative that can be used to help patients with chronic

diseases. Likewise with this set of solutions the aim is to improve the quality of life of patient's, not just monitoring them,but also to enable direct them to improve their eating habits and workout routines. The context model developed for the system proved to be efficient when making inferences related to the context, such as recommendations for taking measures through sensors, as well as recommendations and workout routines tips to improve the eating habits of patients as shown in figure 6 and 7.

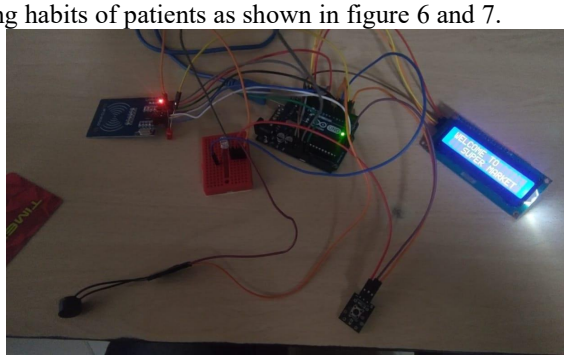

Figure 6: Physical Implementation

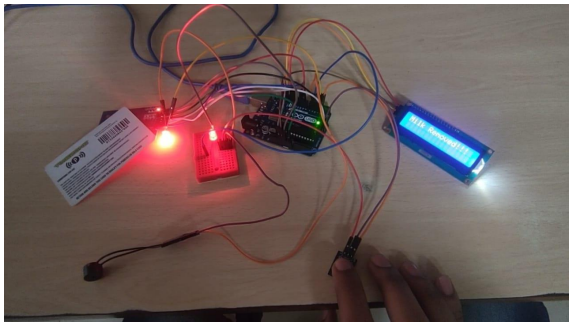

Figure 7:Physical Implementation

V. Advantages and Disadvantages

Advantages

Efficient Checkout Process: One of the primary advantages of this system is the significant reduction in checkout times. Customers can complete their purchases quickly through selfcheckout, leading to shorter wait times and improved customer satisfaction.

Real-Time Inventory Tracking: RFID technology allows for real-time monitoring of inventory. Retailers can easily track the movement of products within the store, reducing instances of stock outs and overstocking, which can lead to cost savings.

Personalized Customer Experiences: The system can analyze customer preferences and shopping habits, offering personalized product recommendations and promotions. This enhances the overall shopping experience and increases the likelihood of repeat business.

Enhanced Security: RFID technology improves security by reducing theft and fraud. Items leaving the store without being scanned are immediately detected, reducing the incidence of shoplifting.

Data-Driven Insights: The system generates valuable data about customer behavior and purchasing patterns. Retailers can use this data to make informed decisions about product placement, pricing, and marketing strategies.

Environmentally Friendly: By reducing the need for printed receipts and paper-based processes, the system contributes to environmental sustainability by minimizing paper waste.

Disadvantages

High Initial Setup Costs: Implementing the Smart Shopping System can require a significant upfront investment in RFID infrastructure, hardware, and software, which may be a barrier for smaller retailers.

Technical Complexity: Maintaining and troubleshooting the RFID and Arduino UNO components can be technically challenging, requiring skilled personnel and ongoing maintenance.

Privacy Concerns: The system collects a considerable amount of data on customer behavior, which can raise privacy concerns if not handled properly. Retailers must be transparent about data collection and usage to maintain customer trust.

Dependency on Technology: The system relies heavily on technology, and any technical glitches or system failures can disrupt the shopping experience. Backup systems and contingency plans may be necessary.

Adoption Challenges: Customers and employees may require time to adapt to the new system, leading to potential resistance or confusion during the transition period.

Limited Applicability: The system may not be suitable for all types of retail environments or product categories. It is most effective in stores with a wide range of products and a high volume of customers.

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Arduino Based Thermoelectric Energy Generator

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Abstract*—Arduino-based thermoelectric energy generator project incorporates a diverse array of components to create a multifunctional system. Utilizing an MQ135 sensor for air quality monitoring, UV LEDs for specialized lighting applications, and a voltage sensor for monitoring circuit parameters ensures efficient operation and data collection. The inclusion of a relay module facilitates control over high-power devices such as 100W bulbs, while a CPU fan manages heat dissipation. Solar panels serve as the primary energy source, supported by a 12V battery for energy storage, all managed by an Arduino UNO microcontroller. The system is further enhanced with an LCD display for user interaction and an inverter for converting DC to AC power, enabling the operation of standard household appliances.

***Keywords*—CPU fan, LED, Battery**

I. INTRODUCTION

In the pursuit of sustainable energy solutions, the amalgamation of technology and innovation plays a pivotal role. This project endeavors to harness renewable energy sources, particularly thermoelectric and solar power, through the utilization of Arduino-based systems. By integrating a multitude of components ranging from sensors to energy storage devices, this endeavor seeks to create an efficient and versatile energy generation system. With a focus on practicality and functionality, the project aims to not only generate electricity but also monitor environmental parameters, facilitate user interaction, and enable the operation of standard household appliances. Through this introduction, we embark on a journey towards a greener, more sustainable future, driven by the ingenuity of technology and the dedication to harnessing the power of nature.

An embedded system is one kind of a computer system mainly designed to perform several tasks like to access, process, and store and also control the data in various electronics-based systems. Embedded systems are a combination of hardware and software where software is usually known as firmware that is embedded into the hardware. One of its most important characteristics of these systems is, it gives the o/p within the time limits. Embedded systems support to make the work more perfect and convenient. So, we frequently use embedded systems in simple and complex devices too. The applications of embedded systems mainly involve in our real life for several devices like microwave, calculators, TV remote control, home

II .OBJECTIVE

The objectives of an Arduino-based thermoelectric energy harvesting project could include: Energy Harvesting Efficiency Develop a system that efficiently captures and converts thermal energy into electrical power using thermoelectric generators.Arduino Integration:Successfully integrate Arduino as a central component for control, monitoring, and data processing within the thermoelectric energy harvesting setup. Optimized Power Management Implement effective power management strategies using Arduino to ensure optimal utilization of the harvested energy for connected devices Real-time Monitoring and Data Logging Enable real-time monitoring of temperature differentials, energy generation, and other relevant parameters using Arduino Implement data logging capabilities for further analysis.

III. METHODOLOGY

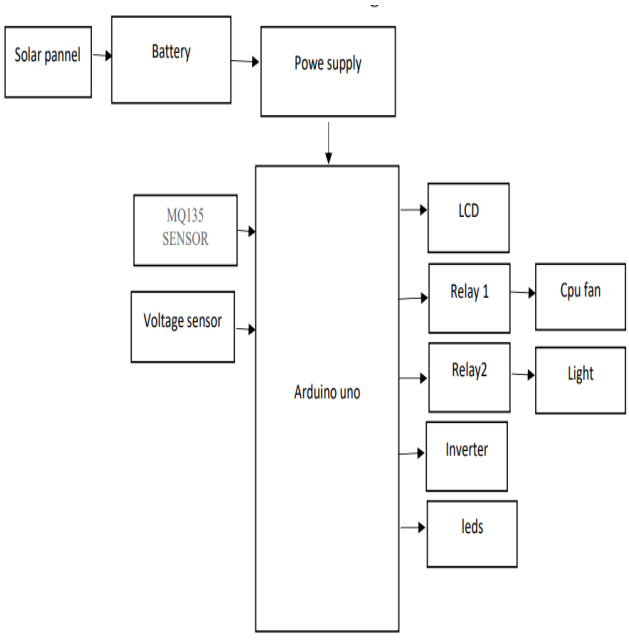

Figure 1: Block Diagram

The ATmega48PA/88PA/168PA/328P provides the following features: 4/8/16/32K bytes of In System Programmable Flash with Read-While-Write capabilities, 256/512/512/1K bytes EEPROM, 512/1K/1K/2K bytes SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible Timer/Counters with compare modes, internal and external interrupts, a serial programmable USART, a byte-oriented 2-wire Serial Interface, an SPI serial port, a 6-channel 10-bit ADC (8 channels in TQFP and QFN/MLF packages), a programmable Watchdog Timer with internal Oscillator, and five software selectable power saving modes. The Idle mode stops the CPU while allowing the SRAM, Timer/Counters, USART, 2-wire Serial Interface, SPI port, and interrupt system to continue functioning. The Power-down mode saves the register contents but freezes the Oscillator, disabling all other chip functions until the next interrupt or hardware reset. In Power-save mode, the asynchronous timer continues to run, allowing the user to maintain a timer base while the rest of the device is sleeping. The ADC Noise Reduction mode stops the CPU and all I/O modules except asynchronous timer and ADC, to minimize switching noise during ADC conversions. In Standby mode, the crystal/resonator Oscillator is running while the rest of the device is sleeping. This allows very fast start-up combined with low power consumption.

The device is manufactured using Atmel's high density non-volatile memory technology. The On-chip ISP Flash allows the program memory to be reprogrammed In-System through an SPI serial interface, by a conventional non-volatile memory programmer, or by an On-chip Boot program running on the AVR core. The Boot program can use any interface to download the application program in the Application Flash memory. Software in the Boot Flash section will continue to run while the Application Flash section is updated, providing true Read-While-Write operation. By combining an 8-bit RISC CPU with In-System Self-Programmable Flash on a monolithic chip.

IV. HARDWARE COMPONENTS

Arduino UNO

Figure 2: Arduino UNO

Arduino is an open source and company for planning, making and connecting customers planning and making single-board microcontrollers and microcontroller packages for building modern devices. Content material is concerned to the gnu lesser widespread public license (LGPL) or the gnu popular public license (GPL), which lets in for the introduction of Arduino sheets and termination of applications via each person. Arduino sheets are presently available in a preassembled construction or as you are making your personal with the assist of other gadgets devices.

Arduino board systems use chip time and controllers. Sheets are fitted with front row sets and straight data/crop (I / O) sets that can be interrupted on various continuous sheets ('shields') or breadboards (for prototyping) and various circuits. Sheets include a series of interconnected communications, including Universal Serial Bus (USB) to the undisputed models, used for installing applications on PCs. Microcontrollers can be replaced using C and C ++ ve.

Relay

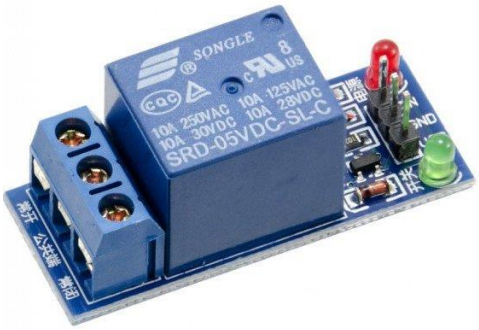

Figure 3: Relay

A relay refers to a device that controls two separate circuits using electromagnetic relays. Relays are switches that are operated electrically, allowing them to control one electrical circuit by opening and closing contacts in another circuit. The term "2-channel" indicates that there are two independent relay channels within the device Applications: 2-channel relays are commonly used in various applications where you need to control two different electrical devices or circuits.

Voltage sensor

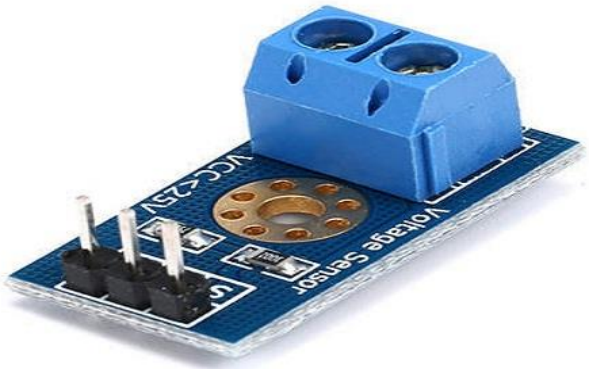

Figure 4: Voltage sensor

This sensor is used to monitor, calculate and determine the voltage supply. This sensor can determine the AC or DC voltage level. The input of this sensor can be the voltage whereas the output is the switches, analog voltage signal, a current signal, an audible signal, etc. Some sensors provide sine waveforms or pulse waveforms like output & others can generate outputs like AM (Amplitude Modulation), PWM (Pulse Width Modulation) or FM (Frequency Modulation). The measurement of these sensors can depend on the voltage divider.

Input Voltage (V)	0 to 25
Voltage Detection Range (V)	0.02445 to 25
Analog Voltage Resolution (V)	0.00489
Length (mm)	28
Width (mm)	14
Height (mm)	13
Weight (gm)	4

Gas Sensor

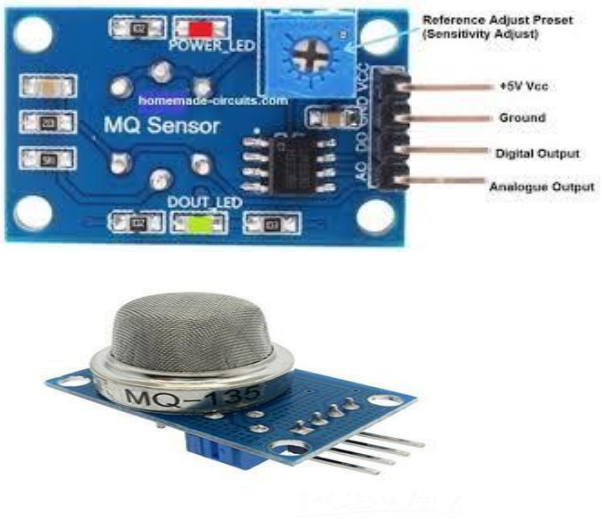

Figure 5:Gas sensor MQ135

This Module makes use of the MQ-135 air quality detector and hazardous gas detector chip. Other circuit components such as the LM393 analog comparator chip on this module makes it easy to integrate this module into a project that can detect hazardous gases. The Module requires a 5V power supply and provides a digital Logic output (1 or 0) and an analog level output (0-4V). The digital logic output is LOW (0) when no gas is detected but goes HIGH (1) when hazardous gas concentration in the environment reaches the set threshold set via a potentiometer on the module. The analog level output provides an output voltage within the range of 0 to 4V based on the concentration of the hazardous gas in the environment; 0V for 27 lowest concentration, 4V for maximum concentration. You can use it detects hazardous gases such as Ammonia, Nitrogen Oxide, Alcohol, Benzene, Smoke (Carbon Monoxide), Carbon Dioxide

LCD Display

Figure 6: LCD Display

The LCD can work in two striking modes, the 4-bit mode and the 8-bit mode. We send the information snack through snack in 4 bit mode, first upper chomp, by then lower snack. For those of you who don't have the foggiest idea what a goody is: a chomp is a four-piece gathering, so a byte's lower four bits (D0-D3) are the lower snack, while a byte's upper four bits (D4-D7) are the higher snack. This enables us to send 8 bit data. This connects with us to send 8 bit data. Whereas in 8 bit mode we can send the 8-bit information truly in one stroke since we utilize all the 8 information lines. You need to get it now; yes 8-bit mode is quicker and immaculate than 4-bit mode. In any case, the fundamental shortcoming is that it needs 8 microcontroller-related information lines. This will result in our MCU coming up short on I/O pins, so 4-bit mode is extensively utilized. To set these modes, no control pins are used.

LEDS

Figure 7: LEDs

The light emitting diode simply, we know as a diode. When the diode is forward biased, then the electrons & holes are moving fast across the junction and they are combining constantly, removing one another out. Soon after the electrons are moving from the n-type to the p-type silicon, it combines with the holes, then it disappears. Hence it makes the complete atom & more stable and it gives the little burst of energy in the form of a tiny packet or photon of light.

CPU Fan

Figure 8: CPU Fan

A CPU fan, also known as a heatsink fan or cooler fan, is an essential component in a computer's cooling system. Its primary function is to dissipate heat generated by the central processing unit (CPU) during operation. Here are some key points about CPU fans:

Heat Dissipation: The CPU is one of the most heat-intensive components in a computer. It generates heat as it processes data and performs calculations. Without proper cooling, the CPU can overheat, leading to reduced performance, instability, or even permanent damage.

Battery

Figure 9: Battery

Rechargeable batteries allow for multiple usages from a cell, reducing waste and generally providing a better long-term investment in terms of dollars spent for usable device time. This is true even factoring in the higher purchase price of rechargeable and the requirement for a charger.
A rechargeable battery is generally a more sensible anustainable replacement to one-time use batteries, which generate current through a chemical reaction in which a reactive anode is consumed.

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V.EXPECTED OUTCOME

The expected outcome of an Arduino-based thermoelectric energy generator would be to convert temperature differences into electrical power using a thermoelectric module. Arduino can be used to monitor the temperature differentials, control the system, and possibly store or display the generated electrical power. The efficiency of such a setup depends on factors like the quality of the thermoelectric module, temperature differentials, and overall system design.

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Radar Detector Using Arduino UNO

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Abstract— Radar is an object detection system which uses radio waves to determine the range, altitude, direction, or speed of objects. It can be used to detect aircraft, ships, spacecraft, guided missiles, motor vehicles, weather formations, and terrain. The radar dish or antenna transmits pulses of radio waves or micro waves which bounce off any object in their path. The object returns a tiny part of the wave's energy to a dish or antenna which is usually located at the same site as the transmitter. The modern uses of radar are highly diverse, including air traffic control, radar astronomy, air-defense systems, antimissile systems; marine radar start locate landmarks and other ships; aircraft anti-collision systems; ocean surveillance systems, outer space surveillance and rendezvous systems; meteorological precipitation monitoring; altimetry and flight control systems; guided missile target locating systems; and ground-penetrating radar for geological observations. High tech radar systems are associated with digital signal processing and are capable of extracting useful information from very high noise levels. The Arduino based project requires a ultrasonic sensor, the sensor released the waves which we want to measure the distance of a object. The microcontrollers of the Arduino board can be programmed using C and C++ languages. When a code is written in Arduino UNO IDE software and connected to the board through a USB cable, Arduino boards have lot of applications in the present day scenario..

Keywords—component, formatting, style, styling, insert (*key words****)***

I. INTRODUCTION (*HEADING 1*)

Radar using Arduino and ultrasonic sensors is a very good project in the electronic branch. It can detect any object in the path with the help of an ultrasonic sensor. Ultrasonic sensors rotate over the servo motor and almost cover all directions in rotatory motion. There is processing software that makes it possible. The ultrasonic sensor is very useful in many electronics projects. it uses in distance measuring and object detection. The radar system uses the ultrasonic sensor to detect the object in front of the sensor. and servo motor help to cover the distance by rotating itself slowly.

In this Arduino Radar project, we will share all the instructions and code, a circuit by which you can make the project by itself. Arduino radar is a very attractive and famous project in electronics and can be made in major projects. Although it is only for the learning purpose we can't use this project in the product as well.

As mentioned in the above paragraph the Arduino Radar detector project is popular nowadays and now we will understand what actually is it. It is just like mini radar it recognizes the object in the path and makes a red affected area near the object. so, this is called radar and it works on the Ultrasonic frequency. it consists ultrasonic sensor mounted over the servo motor and connected to software that shows the output on the computer screen. the interface of this software is pretty the same as the Radar interface

The ultrasonic sensor rotates with the servo motor and transmitted the ultrasonic waves during this time. and the whole time a graph interface make in the simulation software. and if any object comes under the range of the ultrasonic sensor it starts to detect the object. at that time the graph interface inside the software becomes red in the object area. ultrasonic sensor work as an object detector in this project. Radar using ultrasonic sensor works in software makes the reaction according to the waves received.ultrasonic sensors have two terminals one is a transmitter and another is the receiver. The transmitter terminal is known as the Trigger and the receiver terminal is known as the echo. Arduino continuously gives a command to the Servo motor to rotate. and the transmitter transmits the signal parallelly likewise the software also makes the graph. The ultrasonic sensor gave a different signal to the Arduino if anything comes in the path. then Arduino notifies the software for the affected region. the project depends on the ultrasonic sensor working. Radar using Arduino, ultrasonic sensor, and servo motor contents no other major components.

We know everything produces sound wave just by existence and effect flow of air around them with their natural frequency. These frequencies are beyond hearing range of humans. Wave of frequency range of 20000hz and thereabouts are called ultra-sonic wave and these waves can be detected by an ultrasonic sensor which helps us to get various knowledge. An Ultrasonic detector usually has a transducer which convert sound energy into electrical energy and electrical energy into sound energy. They are used for measuring object position and orientation, collision avoidance system, surveillance system etc. Ultrasonic technology provide relief from problem such as linear measurement problem, as it allows user to get non-contact measurements in this way distance between object and its speed etc can be easily measured. Speed of travel of sound wave depends upon square root of ratio between medium density and stiffness. Also, property of speed of sound can also be changed by natural environment condition like temperature. So basically, an ultrasonic sensor sends ultrasonic waves which travels in air and gets reflected after striking any object. By studying the property of reflected wave, we can get knowledge about objects distance, position, speed etc.

A processing software and an Arduino software is used with hardware system for detection of objects various parameters. One of the most common application of ultra-sonic sensor is range finding. It is also called as sonar which is same as radar in which ultrasonic sound is directed at a particular direction and if there is any object in its path it strikes it and gets reflected back and after calculation time taken to come back we can determine distance of object. in real life this method is used by bats.

The servo motor is a simple DC motor that can be controlled for specific angular rotation with the help of additional servomechanism. This motor will only rotate as

much we want and then stop. The servo motor is a closed-loop mechanism that uses positional feedback to control the speed and position.This closed-loop system includes a control circuit, servo motor, shaft, potentiometer, drive gears, amplifier, and either an encoder or resolver.

II. METHODOLOGY

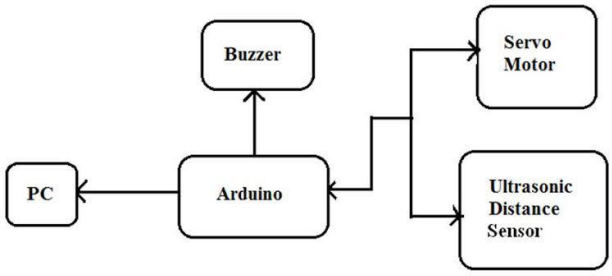

Figure 1: Block Diagram

A radar system has a transmitter that emits radio waves called a radar signals in predetermined directions. When these come into contact with an object they are usually reflected or scattered in many directions. Example:- let us take example for bat. Bat released the eco sound while travelling, if any object came in middle and it reflect back to the bat .

Applications and usages:- The development of the radar technology took place during the World War II in which it was used for detecting the approaching aircraft and then later for many other purposes which finally led to the development of advanced military radars being used these days. Military radars have a highly specialized design to be highly mobile and easily transportable, by air as well as ground. Military radar should be an early warning, altering along with weapon control functions. It is specially designed to be highly mobile and should be such that it can be deployed within minutes.

The ultrasonic sensor rotates with the servo motor and transmitted the ultrasonic waves during this time. and the whole time a graph interface make in the simulation software. and if any object comes under the range of the ultrasonic sensor it starts to detect the object.

III. HARDWARE COMPONENTS

Arduino Board

Figure 2: Arduino UNO

It is the most widely used and widely used one of the many Arduino's. It is the first choice for beginners. It is easy to learn. It operates with an ATmega328 controller. This type has 14 digital ports (I / O), 6 of which can be used as ports to control the " PWM Outputs ", the most important feature of this type is that the control chip" ATMEGA328 "is not fixed in the board, but installed on the holder of the integrated circuit" IC ". This feature makes it the best option for beginners so that if burned the slide while working on your project by mistake, you can Restore your work on the board as soon as you change the slide.The ATmega328 controller is similar to the same model. The first-ever type of Arduino's motherboard is the ATmega32u4 controller, which has a unique feature that contains a built-in USB connection, eliminating the need to use a secondary processor. The feature allows the panel as soon as it is connected to your device to appear as a keyboard and mouse.

Servo Motor

Figure 3: Servo Motor

The SG90 servo motor is a popular and widely used micro servo motor. It is compact, lightweight, and cost-effective, making it suitable for various applications such as robotics, remote-controlled vehicles, RC airplanes, and small-scale automation projects. The "SG90" name is commonly used to refer to a specific model of servo motor, but it's worth noting that various manufacturers produce similar servo motors with slightly different specifications.
The servo motor works based on the principle of closed-loop control. It receives electrical signals in the form of pulses, usually known as pulse-width modulation (PWM). The control circuitry interprets the incoming pulses to determine the desired position for the servo motor. The control circuitry compares the desired position with the current position obtained from the potentiometer feedback and generates a control signal to drive the motor. The motor rotates until the desired position is reached, and the potentiometer feedback helps the control circuitry to make continuous adjustments to maintain the position accurately.

Ultrasonic Sensor

Figure 4: Ultrasonic sensor

An ultrasonic sensor is a device that uses sound waves of high frequency to detect objects and measure distances. It operates on the principle of echolocation, similar to how bats navigate and locate objects in their environment.
The sensor consists of a transducer that emits ultrasonic waves and a receiver that detects the waves after they bounce off objects in the sensor's field of view. The transducer typically consists of a piezoelectric crystal that converts electrical energy into mechanical vibrations, creating ultrasonic waves. These waves travel through the air and when they encounter an object, they bounce back or get reflected.
The receiver of the sensor picks up the reflected waves and converts them back into electrical signals. By measuring the time it takes for the ultrasonic waves to travel to the object and return to the sensor, the sensor can calculate the distance between itself and the object using the speed of sound in air.

Breadboard

Figure 5: Breadboard

They consist of a grid of holes arranged in columns and rows, usually with 5 holes per row. The holes in each row are connected internally in groups, usually with a metal clip or strip running underneath the board. Most breadboards have two sets of vertical rails running along the sides, known as power rails, which are used for providing power and ground connections.
Connection Mechanism:
The holes in the breadboard allow for easy insertion of electronic components such as resistors, capacitors, integrated circuits (ICs), and wires. The metal clips or strips running underneath the board connect the holes in each row, allowing components and wires to be electrically connected.
Components with leads (legs) can be inserted into the holes, and the clips or strips make contact with the leads, establishing electrical connections. Components can be easily removed or repositioned without causing any permanent damage.

Jumper Wires

Figure 6: Jumper wires

Jumper wires are simply wires that have connector pins at each end, allowing them to be used to connect two points to each other without soldering. Jumper wires are typically used with breadboards and other prototyping tools in order to make it easy to change a circuit as needed. Fairly simple. In fact, it doesnt get much more basic than jumper wires.
Jumper wires are electrical cables that are used to create temporary connections between electronic components on a breadboard or a circuit board. They are often used in prototyping and experimentation to establish connections between various components such as microcontrollers, sensors, actuators, and other electronic modules.

IV. RESULTS

In this research paper we have mentioned that our system is designed consisting following components such as, a servo- motor, an ultra-sonic sensor and a micro-controller (Arduino). Systems objective is to track the distance and angle of the object and to represent this information graphically, means its output should be in graphical form which will be represented through processing software.

We can have an idea of an efficiency of this radar by testing objects at different levels and observe how faster or smoothly it detects an object that it finds in a way and gives us an expected range of the obstacle [3]. Following figure show the results of the monitor screen of our design when the sensor rotates through the area and detects obstacle in the way. The red area indicates the presence of obstacle and below the angle of incident and distance is being displayed. Testing of the system a) Object 1 is placed 30.5 far from the radar, radar gives the distance 32 cm, so: o error =(32-30.5)/30.5)*100= 4.918% o efficiency 1 = 100-error =95.08%.

The output of the system which we tested by placing objects. b) object 2 placed at a distance of 20.3 cm ,radar gives the distance 21 cm so: o error = ((21-20.3)/20.3)*100 = 3.44% o efficiency 2 =100-error= 96.55%.

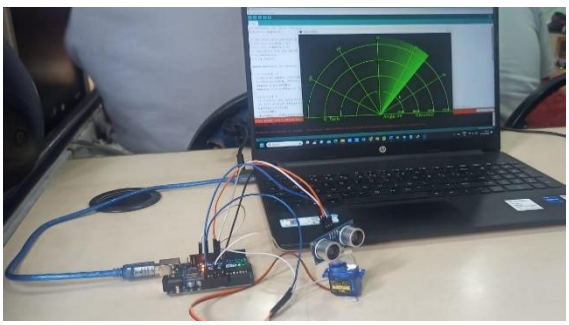

Figure 2: When there is no Obstacle

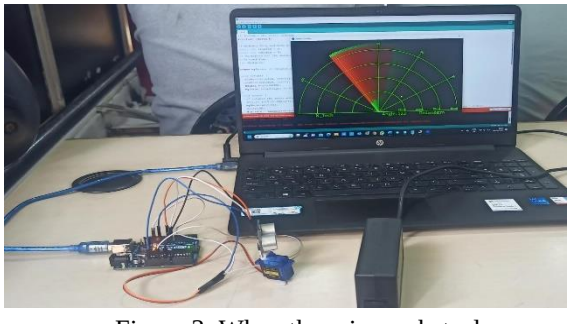

Figure 3: When there is an obstacle

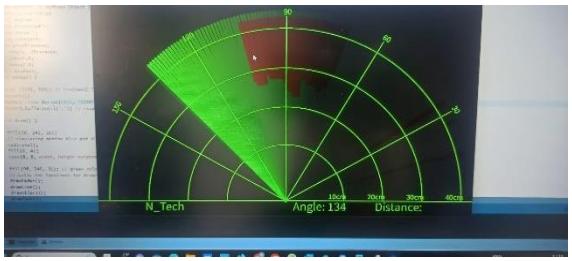

Figure 4: Display in PC

V. ADVANTAGES AND DISADVANTAGES

Advantages

Customization: Arduino provides a platform where you can customize every aspect of your radar detector, from the hardware components to the software algorithms. This allows you to tailor the detector to your specific needs and preferences.

Cost-effective: Arduino boards and components are relatively inexpensive compared to commercial radar detectors. By building your own detector, you can potentially save money while still achieving the functionality you desire.

Learning Experience: It's an excellent educational project for learning about electronics, microcontrollers, sensor technology, and signal processing. You'll gain valuable hands-on experience in programming and circuitry.

Flexibility: With Arduino, you have the flexibility to add or modify features as needed. You can easily expand your radar detector's capabilities by integrating additional sensors or enhancing the software algorithms.

Custom Alerts: You can customize the alert mechanisms according to your preferences. Whether it's visual alerts on an LCD display, audible alerts through a buzzer, or even wireless notifications to your smartphone, Arduino allows you to implement the alert system of your choice.

Community Support: Arduino has a large and active community of makers, hobbyists, and developers. You can find a wealth of tutorials, guides, and forums where you can seek advice, share your progress, and troubleshoot any issues you encounter during your project.

Fun and Satisfaction: Building something yourself can be immensely rewarding. As you see your radar detector come to life and perform as intended, you'll experience a sense of accomplishment and satisfaction that comes with creating a functional device from scratch.

Tailored Performance: By fine-tuning the algorithms and parameters, you can optimize the performance of your radar detector for specific use cases or environments. This level of customization is often not possible with off-the-shelf products.

Applications

Home Security: Arduino-based radar detectors can be used as part of a home security system to detect motion and alert homeowners of potential intruders or unauthorized entry.

Automotive Safety: Radar detectors can be integrated into vehicles to provide collision avoidance and blind-spot detection capabilities, helping drivers avoid accidents and improve road safety.

Traffic Monitoring: Radar detectors can be deployed at traffic intersections or along highways to monitor vehicle speed and traffic flow, enabling traffic management authorities to optimize traffic signals and enforce speed limits.

Industrial Automation: Radar detectors can be used in industrial environments for proximity sensing, object detection, and collision avoidance in automated machinery and robotics applications.

Environmental Monitoring: Radar detectors can be deployed in environmental monitoring systems to detect and track wildlife movement, measure vehicle traffic volumes, or monitor water levels in rivers and reservoirs.

Search and Rescue Operations: Radar detectors can be used in search and rescue operations to locate missing persons or detect signs of life in disaster-stricken areas, such as collapsed buildings or avalanche sites.

Drone Navigation: Radar detectors can be integrated into drones for obstacle detection and avoidance during autonomous flight, enabling safer and more reliable navigation in complex environments.

Weather Monitoring: Radar detectors can be used in weather monitoring stations to detect precipitation, measure rainfall intensity, and track storm systems for meteorological forecasting and research purposes.

Wildlife Conservation: Radar detectors can be deployed in wildlife conservation projects to monitor animal movements, study migration patterns, and prevent wildlife-human conflicts by detecting animal presence near human settlements or protected areas.

Smart Home Automation: Radar detectors can be integrated into smart home automation systems to enable gesture recognition, occupancy sensing, and activity monitoring for energy efficiency, security, and convenience purposes.

Disadvantages

Limited Features and Connectivity: Arduino boards may lack certain features and connectivity options found in commercial radar detectors, such as advanced signal filtering, GPS integration, or wireless communication capabilities.

Limited Detection Range: Radar sensor modules commonly used with Arduino boards often have limited detection ranges compared to commercial radar detectors. This limitation can affect the effectiveness of the detector, especially in scenarios where long-range detection is required.

Sensitivity and Accuracy: The sensitivity and accuracy of homemade radar detectors may not match those of commercial products. Factors such as sensor quality, circuit design, and signal processing algorithms can influence the detector's ability to accurately detect and differentiate between radar signals and background noise.

False Alarms: Homemade radar detectors may be prone to false alarms caused by environmental factors, interference, or signal reflections. Achieving reliable detection while minimizing false alarms can be challenging and may require sophisticated filtering and signal processing techniques.

Complexity and Technical Expertise: Building a radar detector using Arduino requires a solid understanding of electronics, programming, and signal processing concepts. The complexity of the project may be daunting for beginners or those without prior experience in these areas.

Cost of Components: While Arduino boards are relatively inexpensive, the cost of additional components such as radar sensors, display modules, and power supplies can add up. Depending on the desired performance and features, the

overall cost of the project may be comparable to or even exceed the cost of purchasing a commercial radar detector.

Legal and Regulatory Issues: The use of radar detectors is regulated or prohibited in some jurisdictions, and DIY radar detectors may not comply with legal requirements or standards. Users should research the legality of radar detector use in their location and ensure compliance with relevant regulations.

Reliability and Maintenance: Homemade radar detectors may be less reliable and robust than commercial products, particularly in terms of long-term performance and durability. Maintenance and troubleshooting may be required to address hardware failures, software bugs, or calibration issues over time.

Lack of Warranty and Support: DIY radar detectors do not come with warranties or technical support, unlike commercial products. Users are responsible for troubleshooting and resolving any issues that arise during the construction or operation of the detector.

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Study of the key performance parameters of CNTFET and CMOS-based 6T SRAM cell

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Abstract- SRAM holds significant importance in today's technological advancements. It faces limitations in performance due to the ongoing miniaturization of CMOS technology, particularly concerning stability and leakage power in 6T SRAM cells. As prospects for further enhancing future developments in MOSFET technology include Carbon Nanotube Field Effect Transistors (CNTFETs) as emerging affirmative substitutes. Using the Cadence Virtuoso Tool, we simulated conventional 6T SRAM cell in a 45 nm node. In this paper, we have done the simulation of a 6T SRAM cell and extracted some key performance parameters such as noise margins, read and write power, and read and write delay. We have then compared these parameters with that of a CMOS-based 6T SRAM cell at the same node and supply voltage. The CNTFET-based SRAM cell shows performance improvement compared to the CMOS SRAM cell.

Keywords- CNTFET, SRAM, and CMOS

I. INTRODUCTION

In modern microprocessors, cache memory consumes over half of the chip area, making it a significant contributor to power dissipation, primarily through leakage power. Scaling down supply voltage is a common strategy to reduce the loss of power. However, to maintain high performance, reducing threshold voltage is necessary, which consequently escalates the subthreshold leakage current exponentially, resulting in increased leakage power [1]. SRAM's stability has emerged as a significant worry about new technologies due to MOS scaling. Achieving an optimal design for the conventional 6T cell poses challenges as the read stability and Write margin need to be carefully balanced. Particularly at lower voltage supply, the 6T cell's read stability deteriorates [2]. The reduction in transistor size and the consequent speed enhancement have been key factors driving technological progress, aiming to fulfill density requirements and keep the integrated circuit (IC) growth projected by Moore's law. Nonetheless, as highlighted in ITRS 2009 version, **T**he entire additionally, downsizing the sub-22 nm range encountered significant challenges concerning fabrication techniques and device capabilities [3]. As the dimensions decrease, the transistor's insulator thickness also decreases. This creates the possibility of a short circuit, in which current can pass straight through thin gate oxide that divides gate from the channel, as well as from the source to the drain and the body. Furthermore, doping presents difficulties in this situation [4]. To some degree, these constraints will be addressed by changing channel content within the standard bulk MOSFET configuration, either by integrating a single carbon nanotube or a collection of them.

Each bit in a traditional 6T SRAM cell is stored using two cross-coupled inverters, which are made up of four transistors each. These inverters create two stable states, which stand for 1 and 0. While performing write and read operations, entry to storage cell is controlled by two additional access transistors. These access transistors are triggered by the word line (WL), which determines whether the bit lines (BL and BLB) should be connected to the cell for read and write data transfer. Both read and write data transfers are made easier by these bit lines. Three states are possible for an SRAM cell: writing when the contents are being changed, reading when data retrieval is taking place, and standby when the circuit is not in use. For the read and write modes to function properly, "Write stability" and "Read stability," respectively, are needed for the SRAM cell [5]. As illustrated in Fig. 1, the 6-T SRAM cell functions as follows:

The word line is not active during standby operation, which prompts the access transistors MAL and MAR to cut the cell

off from the bit lines. The pull-down transistor's strength for the pass-gate transistor has to be big enough for a read operation; this is known as cell Beta ratio. In order to perform a write operation, the cell gamma ratio a measure of pass-gate transistor's strength relative to the pull-up transistor be noticeably high [6].

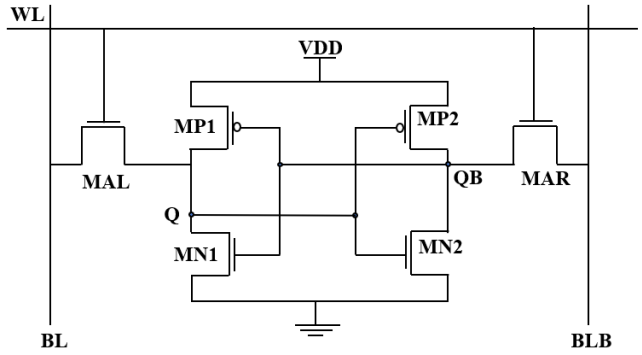

Fig. 1. Conventional 6T SRAM cell

II. A brief introduction to CNTFET

Carbon nanotubes consist of hexagonal graphene sheets, which are essentially individual Atoms of graphite rolled into layers to form a hollow cylinder. Their electrical properties, whether they behave as metals or semiconductors, depend on their chirality, which refers to the direction of the rolled graphite sheet. The size of a nanotube can be specified using a chiral vector, typically represented in the form of two integers (n, m). The bandgap of carbon nanotube is influenced directly by its diameter and chirality.

The relation between the chiral vector and DCNT of a particular CNT is given in Equation (1) as [7].

$$D_{CNT} = \frac{\sqrt{3}a_0}{\Pi}\sqrt{n^2+m^2+mn} \quad (1)$$

Where a0 is the carbon-carbon bonding length. Equation 2 gives the relation between the Vth and DCNT [8].

$$V_{th} = \frac{E_g}{2e} = \frac{aV_\Pi}{\sqrt{3}eD_{CNT}} = \frac{0.436}{D_{CNT}} \quad (2)$$

Where Eg is the band gap energy, V_π =3.303 eV is carbon π- π bond energy in the tight bonding model.

The Wg of the CNTFET is governed by the CNT number beneath the gate region in a CNTFET (n), DCNT, pitch, and Wmin as shown in Equation 3.

$$W_g = \text{Max}\,[W_{min}, (n-1)pitch + D_{CNT}] \quad (3)$$

The Wg and n is an important parameter as it determines the amount of current flowing through CNTFET. Increasing the value of Wg or n increases the current flow through the channel leading to faster switching or lower delays.

One carbon nanotube or a collection of them is used as channel material in a carbon nanotube field-effect transistor (CNTFET). CNT is used by CNTFET as the source, drain, and channel regions. The quantity of current passing via the drain and source terminals is controlled by the gate. A channel that permits the flow of current between the drain and source is created when the gate is opened. P-type and N-type transistors are complementary devices found in CNTFET, which are similar to CMOS technology. By changing the electron density in the channel, the voltage applied to the gate can be changed, providing control over the CNTFET's electrical conductance. Choosing the right diameter enables the CNFET to have a suitable threshold voltage. The reciprocal of the CNT diameter determines the CNFET's threshold voltage in a direct proportion [8]. In Figure 2, the internal structure of CNTFET is depicted. The CNTFETs offer higher transconductance, higher ON current, ballistic transport, same carrier mobility for devices of the p and n type, and lower leakage power. These features make CNTFETs a prolific choice for the implementation of low and reliable power circuits [9].

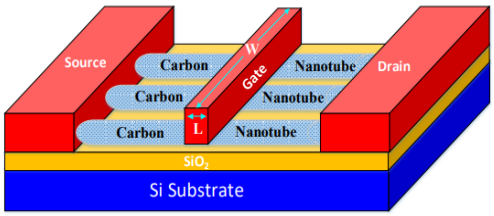

Fig. 2. Internal view of CNTFET [10]

III. Key performance parameters of SRAM

A. Write operation and write delay

It is assumed that node Q initially stores 0 and node QB stores 1, and that node Q must overwrite these bits during the write operation [11]. Now if we want to write a '1' on node Q we need to connect BL to VDD. The WL turns ON MAL which places the VDD on node Q. At the same time QB is discharged via MAR. In Figure 3, this behavior is displayed. The write delay is the period between 10% of WL rise and 90% of the node Q rise. The write delay of CNTFET-based 6T SRAM cell is 26.93ps.

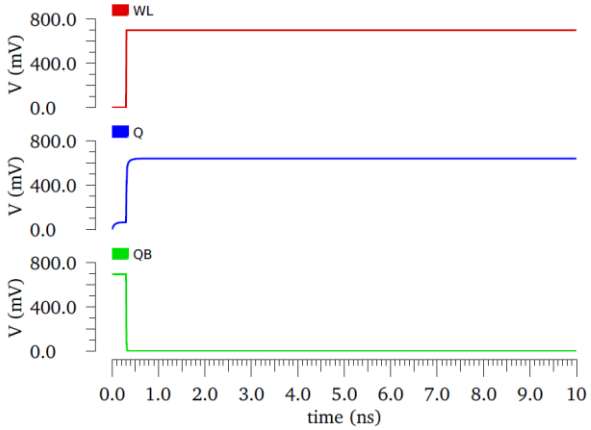

Fig. 3. Write-1 operation for 6T SRAM cell

B. Read operation and read delay

Read operation starts with pre-charging of two-bit lines to VDD. It has been stated that the stability of SRAM is lowest during the read operation [12]. To read the data at nodes QB and Q convert pre-charged BL and BLB to VDD. Assume that Q and QB store 1 and 0, indicating that MN2 is ON and MP2 is OFF. While the BL stays charged at the VDD because there isn't a path for discharge to the ground, BLB has a discharge path through MAR, MN2. The sense amplifier detects a voltage differential of 50 mV between the BLB and BL. The read-1 operation is now finished, as shown in Figure 4. The read delay has been calculated as the time elapsed in between the 50% of WL rise and VDD-50mV of the BL discharge. The CNTFET-based 6T SRAM's read delay is 46.89 ps.

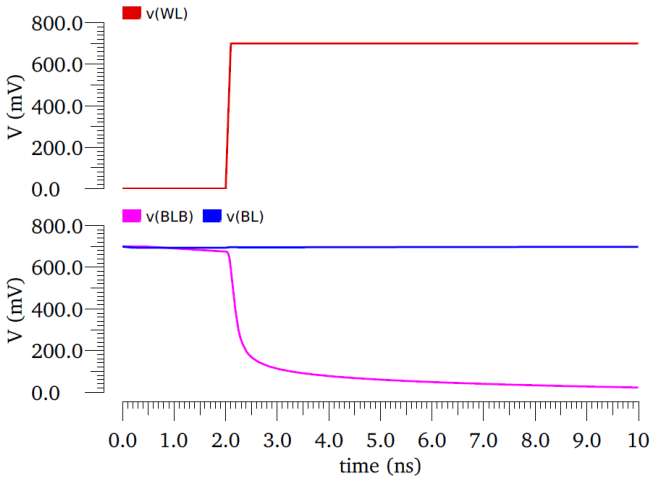

Fig. 4. Read-1 operation of the 6T SRAM cell

Maintaining BL, BLB at high values, and WL at low values hold the charge stored at both Q and QB nodes. The SNM provides a stability index for SRAM cells in static mode and is the amount of noise that can be added at node Q to flip its contents [13]. The SNM has been found by plotting the VTC and inverse VTC of the cross-coupled inverters and merging them to get the butterfly curve depicted in Figure 5. The side of the largest square in the smallest of the two butterfly lobes gives the value of SNM. The SNM of CNTFET-based 6T SRAM cell is 0.28V.

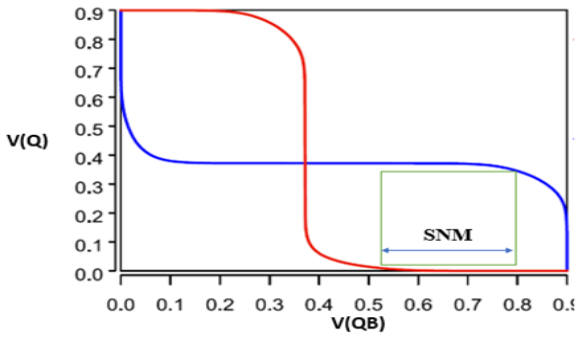

Fig. 5. Graphical representation of SNM of simulated 6T SRAM

D. Read Noise Margin

During the read operation, RNM assesses the cell's stability. High RNM values during read operations mean that there is less likelihood of data being flipped at the storage nodes [14]. In an SRAM cell, node QB does not stay exactly at ground potential when it is at logic high. Instead, read upset results from the voltage differential between the pull-down and access transistors, which pulls node QB to a non-zero potential. Reasonable values of RNM are crucial because the SRAM is more susceptible to read instability at lower supply voltages than it is to write or hold instability. If the ratio of RNM and VDD is larger than or equal to 0.25, an SRAM design is regarded as highly stable [15]. Fig. 6 shows a graphical representation of the RNM of simulated 6T SRAM. The RNM of CNTFET-based SRAM is 0.12V. The butterfly curve to find the RNM has been plotted by plotting the VTC while the cell is writing a logic '0' then plotting its inverse VTC and merging the two VTCs.

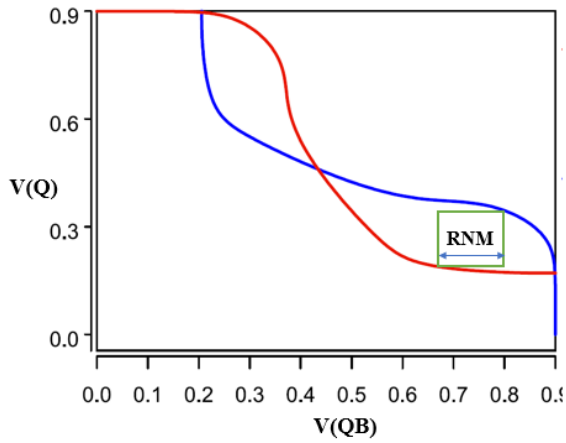

Fig. 6. Graphical representation of RNM of simulated 6T SRAM

E. Write Noise Margin

The WNM has been obtained by plotting the write VTC whereas logic '1' is stored on node Q, and then inverting the VTC. The second step is plotting the read VTC when node Q is storing logic '0' [16]. The last step is merging the two VTC and the longest square's side that fits within the merged VTC's gives the WNM. The WNM of the CNTFET-based 6T SRAM cell is 0.31V. Table 1 provides the comparison of key performance parameters of CNTFET-based 6T SRAM cell with that of CMOS-based 6T SRAM cell at 45nm node and a VDD of 0.9.

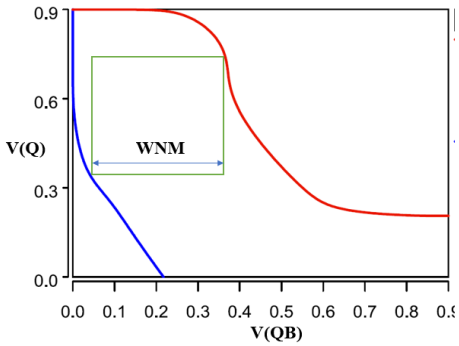

Fig. 7. Graphical representation of WNM of simulated 6T SRAM

Table 1: Comparative analysis of Key parameters of CNTFET and CMOS based 6T SRAM cell

Key parameters	Read power (W)	Write power (W)	Read delay (ps)	Write delay (ps)	SNM (V)	WNM (V)	RNM (V)
CMOS based	2.4μ	1.11μ	110.20	90.66	0.21	0.18	0.08
CNTFET based	320.8n	122.96n	46.89	26.93	0.28	0.31	0.12

IV. CONCLUSION

In this paper, we have studied the superiority of the CNTFET-based design over the MOSFET design by carrying the simulations on a 6T SRAM cell with a 0.9V supply voltage. We have derived some of the critical parameters of the SRAM cell which determine its figure of merit and stability. The write, read, hold operation along with the butterfly curves which determine the noise margins have been extracted which confirms the proper functionality of cell. Also, the critical parameters of the CMOS-based 6T SRAM cell have been derived under the same operating conditions. The CNTFET-based SRAM cell overshadows the performance of the SRAM cell in every aspect. The maximum power and maximum delay of the CNTFET-based cell is 86.66%, 57.45% comparatively lower than CMOS SRAM cell. Also, the SNM,

WNM, and RNM of CNTFET SRAM cell are 33.33%, 72.22%, and 50% higher than that of the CMOS-based SRAM cell.

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Arduino Based Snake Robot Controlled Using Android

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Abstract*—The "Arduino Based Snake Robot Controlled using Android" Nature inspires amazing inventions. Building a snake robot.Have you ever noticed how humans are fascinated by nature? We're constantly trying to mimic its wonders, and building a mechanical reptile is a perfect example! This project is a fun and educational way to explore how robots can move like real animals.We'll be using tiny motors called servos and an Arduino board to create a snake-like robot that slithers and navigates obstacles. This robot is bio-inspired, meaning it takes its design cues from living creatures.The size and shape of our robot are entirely up to you! This project focuses on building a medium-sized, 12-segment snake robot designed to avoid obstacles. By having multiple joints, the robot gains many "degrees of freedom." This flexibility allows it to bend, reach, and explore tight spaces with an almost endless range of movement. Imagine the possibilities for using this robot in hard-to-reach or dangerous environments.

The Secret to Snake-like Movement.Multiple Joints and App Control. The key to making our robot move like a real snake lies in its modular design. By including numerous joints, we give the robot many degrees of freedom.Think of these degrees of freedom as bendy points that allow the robot to twist, turn, and reach incredible places.This flexibility is what lets the robot navigate complex environments. Here's where things get even cooler: this project takes it a step further by making the robot controllable through an Android app. Imagine using your phone or tablet to steer your snake robot through tight spaces or dangerous areas!The app provides a user-friendly interface, allowing for real-time control and monitoring. This combination of sophisticated hardware (multiple joints) and user-friendly software (Android app) creates a truly unique robot with a wide range of potential applications.
This project makes learning robotics a breeze! It combines the power of Arduino, a beginner-friendly microcontroller platform, with the familiarity of Android, the operating system on most smartphones and tablets.The goal is to build a platform that lets students easily interact with robots they create themselves. Arduino makes building robots accessible, and the Android interface provides a comfortable environment for students to take their first steps in robotics.This platform uses Wi-Fi for communication, allowing students to control their robots wirelessly.

The Android interface itself is designed to be easy to use, guiding students through essential robotics concepts like:Reading sensor data: Robots use sensors to perceive their environment. The interface will help students understand how to interpret this data. Activating actuators: These are the parts that make the robot move or interact with the world. The interface will allow students to control these actuators.Closing the control loop: This is the heart of robotics - using sensor data to make decisions about how the robot should move. The interface will help students build these essential feedback systems.

I. INTRODUCTION

Snake-Inspired Robots squeezing through challenges. Nature's master of movement, the snake, inspires a whole new kind of robot - the reptile robot. These machines mimic the incredible flexibility of snakes, allowing them to navigate almost any terrain, from narrow crevices to open fields. Snakes can even climb and some can even "fly" by gliding through the air.This project takes a page from nature's playbook and creates a mechanical snake powered by Arduino and servo motors. Just like a real snake, the robot has multiple segments connected by joints, giving it the ability to bend, reach, and explore its surroundings in countless ways.Here's the exciting part: this robot can be controlled through a user-friendly Android app. Imagine using your phone or tablet to send your snake robot on missions in dangerous or hard-to-reach places! These robots, also known as slitherbots, have the potential to revolutionize how we approach tasks like search and rescue, firefighting, and maintenance in hazardous environments.

The secret to this innovation lies in the powerful combination of Arduino, a versatile microcontroller platform, and the intuitive interface of an Android app. This marriage of hardware and software creates a sophisticated yet easy-to-use system for controlling these amazing snake robots.proficiency in navigating through urban landscapes, suburban areas, and challenging terrains. The overarching goal is to create a system that not only excels in controlled environments but is also capable of seamlessly integrating into the complexities of the real world.

These snake robots, inspired by the incredible flexibility of real snakes, can navigate almost any terrain imaginable. From narrow pipes to open fields, these robots can handle it all. Some snakes can even climb and glide through the air.This project takes inspiration from these amazing creatures and creates a mechanical snake powered by Arduino and servo motors. Just like a real snake, the robot has multiple segments connected by joints. This design gives it the ability to bend, reach, and explore its surroundings in countless ways.But the real innovation lies in the control system.

This robot can be controlled through a user-friendly Android app. Imagine using your phone or tablet to send your snake robot on missions in dangerous or hard-to-reach places! These robots, also known as slither bots, have the potential to revolutionize how we approach tasks like search and rescue, firefighting, and maintenance in hazardous environments.

II. OBJECTIVE

Taking Snake Robot Control to the Next Level.Advanced Features We've already seen how this project creates a fantastic snake robot controlled by an Android app. But what if we could push it even further.Here are some exciting features that could take this snake robot to the next level.Advanced Control and Communication Reliable Wireless Connection: Seamless control is key. Bluetooth or Wi-Fi can be used to ensure a strong connection between the Arduino and your Android device.Intuitive App Interface: Imagine an app that lets you control the robot's movements, speed, and more with ease! A user-friendly interface is essential for a smooth experience.Smarter Movements Precise Motion Control: Sophisticated algorithms on the Arduino can translate your app commands into precise motor movements, making the robot respond accurately to your control.Sensor Integration: Adding sensors like accelerometers and gyroscopes can give the robot a sense of its surroundings. This allows for more adaptable and even autonomous behaviors.

Power Management: Who wants a robot that runs out of juice quickly. By optimizing energy use, the robot can operate for longer periods.Manoeuvring Master: Imagine the robot turning, slithering, and navigating obstacles with ease! Advanced control algorithms can make this possible.
Error Handling: Things can go wrong, but robust error handling can help the robot detect and address issues, keeping it stable and safe.Remote Monitoring: An app that lets you see what the robot "sees" through real-time feedback is pretty cool, right. This is called remote monitoring and telemetry.Expandable Design: This project can be a launchpad for future innovations! A modular design allows for easy integration of new sensors or features, making the robot even more capable.User-Friendly Resources: Clear documentation and user guides are essential for anyone who wants to build or use this robot. Providing these resources makes it accessible to a wider audience.By incorporating these features, this snake robot controller can become even more powerful, versatile, and user-friendly.

III. METHODOLOGY

This project focuses on building a snake robot controlled remotely for enhanced safety. The operator avoids risky environments while the robot explores and gathers information. The Control Unit is PC with Visual Basic 6.0 Application: This acts as the brain of the operation. A user-friendly interface displays directional arrows (left, right) for controlling the robot. RF Transceiver device sends the chosen direction signal wireless to the robot.

Commanding our Snake Robot. Android App in Charge app Starts Up Get ready to control your robot. The app launches, displaying a user-friendly interface with controls for movement (buttons, joysticks).User Takes Command: The user decides on a movement (forward, backward, left, right) and interacts with the app's controls.Sending the Orders.The app doesn't waste a beat. It transmits the chosen movement command to the Arduino using Bluetooth Arduino Takes Action Command Received by Arduino is on watch, and it receives the movement command signal sent by the Android app.Decoding the Message: The Arduino code acts like a translator, interpreting the received signal to understand the desired movement.Servo Motors on the Move.

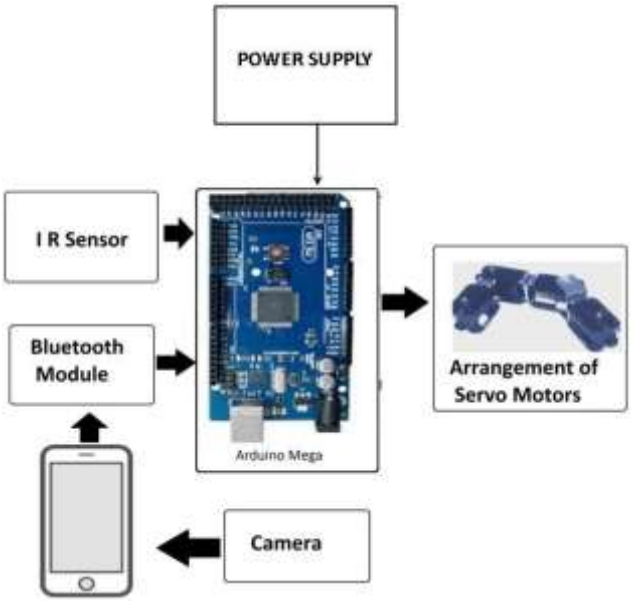

Figure 1: Block Diagram of Snake Robot Controlled by Android

Based on the interpreted command, the Arduino sends control signals to each servo motor in the snake robot's segments. These motors are what make the robot bend and slither.Servo libraries often come in handy for controlling these motors precisely.Always Listening: The process loops back to step. The Arduino continuously waits for new commands from the app, ready to respond and control the robot in real-time.

Extra Considerations:

Error Handling: Things don't always go according to plan. The code may include routines to handle situations like communication failures or unexpected signals.Sensors for Smarts If you've included sensors (like acceleromotor or gyroscopes), the Arduino code might also process sensor data. This data can influence how the robot moves or even be sent back to the app for feedback.

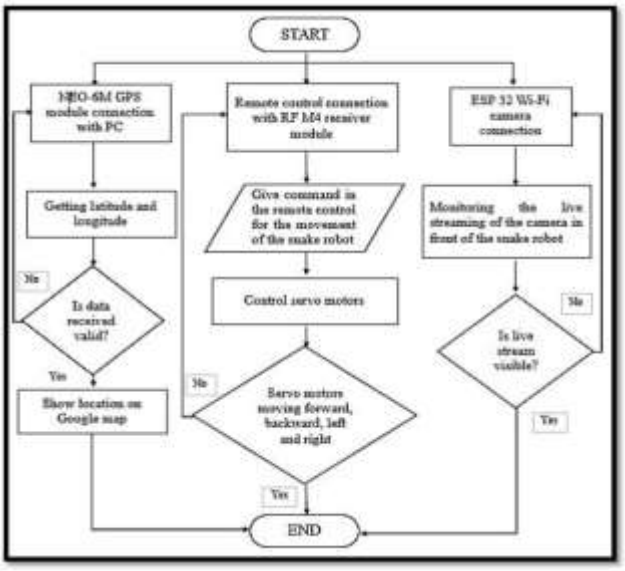

Figure 2: Flow chart of Snake Robot Controlled Using Android

IV. RESULTS

The "Arduino Based Snake Robot Controlled using Android" project successfully This initial robot will prioritize functionality over complex features. The goal is to demonstrate the snake robot mechanism system using limited resources.This device provides the images and videos to the android device through the app .Image Capture with a Wi-Fi Camera: A Wi-Fi camera mounted on the robot's head captures images of the surrounding area.The camera is smart It only turns on when the robot detects movement, saving battery life and capturing relevant data.Captured images are uploaded to the Thing Speak cloud platform. This allows for secure and remote storage of your data. Phone Access is provide no need to be tethered to the robot. You can access the stored images on our phone for analysis or further use. The "passive wheels" create anisotropic ground friction, allowing the robot to move smoothly forward on flat surfaces, mimicking a real snake's movement.

Figure 3 : Snake Robot

V. ADVANTAGES AND DISADVANTAGS

Advantages:

Search and Rescue: Disaster zones or collapsed buildings often have cramped spaces. Snake robots can navigate these areas, locate survivors, and even deliver supplies, saving valuable time in critical situations.

Inspection and Monitoring: Pipelines, machinery, and infrastructure often have hard-to-reach nooks and crannies. Snake robots can perform visual inspections, identify potential issues, and prevent costly breakdowns.

Exploration and Research: From exploring volcanic vents to studying underwater ecosystems, snake robots can venture into remote or dangerous locations, gathering valuable data for scientific research.

Imagine controlling a snake robot through a familiar Android app! This user-friendly interface makes the technology accessible even to those without extensive robotics experience.

Wireless Freedom: No more tethered operation! Control the robot remotely using Bluetooth or Wi-Fi, allowing for safer navigation in hazardous environments.

Disadvantages:

The robot's operational range is limited by Bluetooth or Wi-Fi. This can be a constraint in large or complex environments, keeping your robot tethered to a shorter leash.

Larger or more powerful robots can quickly drain batteries. Careful selection of motors and efficient control strategies are key to extended operation.

Basic Arduino code might limit the robot's movement repertoire. Fancy maneuvers like climbing walls or avoiding obstacles might require more sophisticated control systems..

Adding sensors like accelerometers or gyroscopes increases the complexity of the project. You'll need additional code to interpret the data and make the robot react accordingly.

These robots are built for navigating tight spaces, not hauling heavy loads. Their size and motor limitations might restrict the types of payloads they can carry for specificapplications.

Programming complex snake behaviors can be streamlined by designing the robot with modular segments. This allows for easier integration of additional components like sensors or even upgrading the controller for more advanced functionalities later.

Multiple servos can be power-hungry. To extend runtime, explore techniques like efficient servo control libraries or using a separate power supply for the servos. A lightweight design can also help reduce the overall power consumption.

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SMART CAP FOR VISUALLY IMPAIRED PERSONS BASED ON IOT

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Abstract: **The fusion of Deep Learning (DL) and Internet of Things (IoT) has birthed a groundbreaking solution tailored for the visually impaired—a visually impaired assistant powered by sophisticated algorithms and practical sensor technology. At its core lies YOLO (You Only Look Once), an algorithm renowned for real-time object detection, enabling the system to swiftly identify and classify objects within the user's surroundings, providing a comprehensive understanding in mere seconds. Complementing YOLO is the integration of Convolutional Neural Networks (CNNs) for face recognition. Leveraging CNNs' proficiency in image recognition tasks, the assistant can identify and memorize faces, enhancing social interactions and fostering a sense of inclusivity for the user.**

To ensure safety and mobility, ultrasonic sensors are seamlessly integrated into the system for obstacle detection. Serving as the "eyes" for the visually impaired, these sensors offer real-time alerts about potential obstacles, empowering users to navigate their environment confidently. In case of obstacle detection, a buzzer provides immediate feedback to the user, further enhancing their situational awareness.

In the realm of data acquisition, Python emerges as a versatile tool for automating the retrieval of new articles. Through techniques like web scraping, Python facilitates the extraction of content from online sources. Leveraging modules such as requests and BeautifulSoup, users can fetch and parse HTML code, extracting specific information like article titles and text. Moreover, Python's capability to handle structured formats like JSON allows for seamless retrieval of data from websites offering structured content.

This transformative assistive technology, housed within the compact Raspberry Pi, envisions a future where the visually impaired can navigate the world with unprecedented independence and ease. By harnessing the power of DL algorithms, IoT sensor technology, and Python's automation capabilities, this solution embodies a paradigm shift in accessibility, promising a more inclusive and empowering future for individuals with visual impairments.

Keywords- *YOLO, CNN, Ultrasonic sensors, Raspberry Pi, Buzzer feedback.*

I. INTRODUCTION

In an age where technological innovation is reshaping the landscape of accessibility, the convergence of Deep Learning (DL) and Internet of Things (IoT) has birthed a groundbreaking solution—a visually impaired assistant tailored for the blind. At the heart of this transformative initiative lies the fusion of sophisticated algorithms, such as YOLO (You Only Look Once) for object detection, CNN (Convolutional Neural Network) for face recognition, and the practicality of ultrasonic sensors for obstacle detection. This assistive technology, housed within the compact Raspberry Pi, envisions a future where the visually impaired can navigate the world with unprecedented independence and ease.0

Central to the functionality of this visually impaired assistant is the YOLO algorithm, renowned for its prowess in real-time object detection. By leveraging YOLO, the system can swiftly identify and classify objects within the user's environment, creating a comprehensive understanding of surroundings in a fraction of a second. Convolutional Neural Networks (CNNs) algorithm is used for face recognition. CNNs, designed to excel in image recognition tasks, are harnessed to enable the assistant

to identify and memorize faces. This functionality not only enhances the user's social interactions by allowing them to recognize acquaintances but also contributes significantly to their overall sense of inclusivity. *D.*

In the pursuit of creating a safer and more secure environment, ultrasonic sensors are integrated into the system for obstacle detection. These sensors act as the eyes of the visually impaired, offering real-time alerts about potential obstacles in their path. Buzzer is used to alert the user in case of obstacle detection. Acquiring new articles
with Python involves extracting information from websites or online sources. Python offers tools and modules that make this process relatively straightforward. By utilizing methods like web scraping, you can extract content directly
from web pages. Python's requests module is handy for fetching the web page's HTML code, and then tools like BeautifulSoup help in parsing and extracting specific information, like article titles and text. Alternatively, some websites provide data through structured formats, like JSON, which can be obtained using Python's built-in capabilities. This way, Python acts as a versatile tool for automating the retrieval of new articles, allowing you to easily stay updated with the latest content available on the web.

II. LITERATURE SURVEY

A. Enhance Spatial Awareness

Implement YOLO-based object detection to recognize and announce the names of objects in the user's environment.
Provide real-time auditory feedback to enhance the user's spatial awareness and facilitate better interaction with their surroundings.

B. Ensure Safety through Obstacle Detection

Utilize ultrasonic sensors to detect obstacles in the user's path.Activate a buzzer to alert the user in case of detected obstacles, preventing collisions and ensuring a safe navigation experience.

C. Promote Accessibility

Design the system to be user-friendly and accessible to individuals with visual impairments. Prioritize simplicity and intuitive interactions to ensure that users can easily understand and operate the blind assistant system.

D. Enable Information Access:

Implement a feature to fetch and read aloud real-time news articles from online sources. Empower users with access to current information, fostering a more connected and informed experience.

E. Utilize Cost-effective Hardware:

Leverage the capabilities of the Raspberry Pi, an affordable and widely accessible single-board computer, to make the system cost-effective and accessible to a broader user base.

III. SYSTEM DESIGN

A. Raspberry Pi (Central Processing Unit)

The central component of the system is a **Raspberry Pi**. It serves as the brain of the system, coordinating various input and output devices.

B. Input Device

Camera: Captures visual data.
Ultrasonic Sensor: Measures distances using sound waves.
Push Buttons: Allow manual input.
Website: Sends data related to “Fetch News” to the Raspberry Pi.

C. Output Devices

Buzzer: Produces audible alerts or notifications.
Audio Output Device: Likely connected to speakers for sound playback.
Speaker: Used for audio output.

D. Functionality

The Raspberry Pi fetches news from a website (indicated by an arrow labeled “Fetch News”).It receives input from the camera, ultrasonic sensor, and push buttons.The system provides output through the buzzer, audio output, and speaker.The Raspberry Pi is connected to the internet via WiFi.

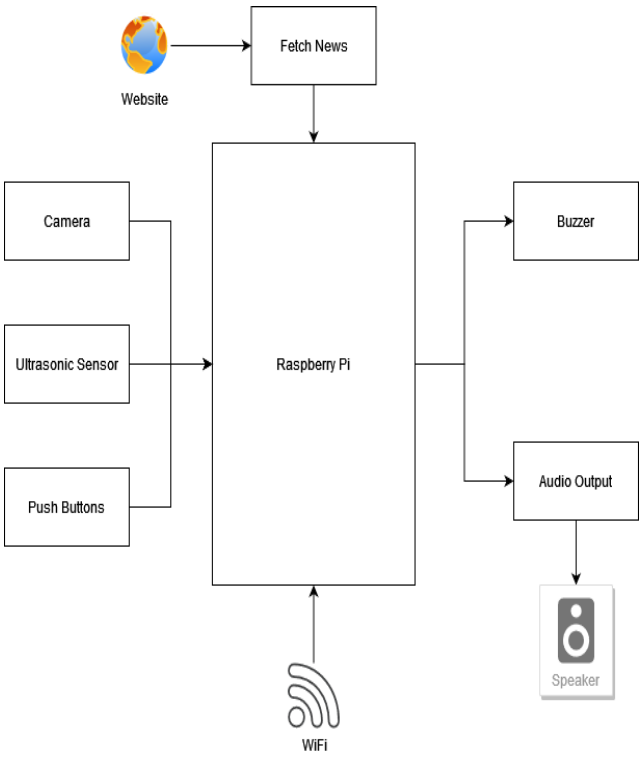

Fig 1: Block Diagram

IV. IMPLEMENTATION

The methodology for developing the proposed project revolves around a systematic and iterative process. The project begins with a thorough understanding of the user's needs through consultations and feedback from visually impaired individuals. The hardware components, notably the Raspberry Pi, ultrasonic sensors, and speaker, are selected for their affordability, accessibility, and reliability.

The YOLO-based object detection model is implemented and trained on a diverse dataset to ensure accurate and efficient recognition of various objects. The ultrasonic sensors are integrated to detect obstacles in real-time, triggering a buzzer for immediate user alerts. The system's software is designed with user-friendliness in mind, incorporating intuitive interfaces and customizable settings. Throughout development, rigorous testing and user feedback sessions are conducted to refine and enhance the system's performance, responsiveness, and overall user experience.

The methodology embraces an open-source approach, fostering collaboration and allowing for continuous improvements and adaptations by the community. This iterative process ensures that the Blind Assistant System remains at the forefront of assistive technology, addressing the evolving needs of visually impaired individuals.

V. HARDWARE AND SOFTWARE REQUIREMENTS

A. Hardware

1. Raspberry Pi

Figure: raspberry-pi 4

Raspberry-pi is single board computer(SBC), raspberry-pi developed by raspberry-pi foundation. Raspberry-pi is used in many fields such as industries, robotic automation, education sector, home automation and much more. It is specifically designed for the student to encourage them computer science with electronics. As the name suggests raspberry-pi bc consists of processor, memory and numerous input/output. The raspberry-pi supports only linux at the moment and different types of linux distro are available which can be chosen based on the user preference. The officially supported operating system for raspberry-pi single board computer is raspberry-pi OS (formerly known as Raspbian).

Advantages of raspberry-pi is the availability of multiple GPIO pins. These gpio pins to interface multiple components to raspberry-pi single board computer. Which allows to interface external devices such as sensors, actuators, relays and much more. Which helps to interface with the real world. Since raspberry-pi is single board computer it can be as a standalone desktop and it also multiple at a time thanks to its multi core processor. Performs web browsing, watching media content, word *processing and much more. A media center to stream* media from the raspberry-pi.The raspberry-pi is for education, where to teach the students the basics in computer science electronics and low cost of the single board computer. Many enthusiasts to make diy projects and automation. The advantage of raspberry-pi the vast amount of interfacing options such as raspberry-pi has 2x USB 3.0 ports and 2x USB 2.0 ports, ethernet, HDMI, microphone and headphone jack. Which

allows the user to interface any kind of USB devices such as keyboard, mouse, storage devices. It supports Gigabit Mbps ethernet connectivity. Interconnect Tv or monitor with HDMI port, microphone and headphone interfaced with the raspberry-pi.

2. Raspberry-pi power supply

Supply type used for raspberry-pi Ac to Dc converter. Power supply converts the AC signal to DC signal. Power supply used everywhere where the DC current is required. Power supply used aspberry-pi is 230V Ac to 5V DC 3A. The ac/dc power supply consists of multiple stages. In the input stage, it consists of a cord or plug which is used to connect to the wall outlet, in addition to this it consists of a protection circuit such as fuse and such which protects against power surges or voltage fluctuations.

In the second stage, it consists of power rectification. In power rectification the circuit uses a bridge rectifier which converts the AC voltage which comes from the wall outlet. The AC voltage may change between 110V and 220V depending upon the region. The rectification circuit converts the AC source to DC source. This rectification performs at 50 times or 60 times a second based on the region's frequency. The s=next stage is filtering. The output voltage from the rectifier contains pulsating dc voltage, this type of pulsating voltage is not suitable for devices as it may destroy due to pulsating waveform. To fix this issue, the system consists of filtering circuits, which smooths out the dc voltages and removes any pulsating waveform in the dc voltage. For the filtering, the system uses capacitors such as electrolytic and ceramic capacitors. Electrolytic capacitor is used to remove low frequency and ceramic capacitor is used to remove high frequency from the dc voltage.

The next step is voltage regulation, in this step, the system performs regulation of the voltage provided by the filtering system. The voltage regulation module uses switchmode technology or linear regulators to maintain the constant voltage set by the manufacturer. This module ensures that the voltage remains constant even in the event of load fluctuation. The final stage consists of protection circuits. The protection circuit prevents the malfunction of the device due to human error or manufacturing defects. The protection circuit consists of over-voltage protection (OVP) or over-current protection (OCP) to protect the connected device from voltage spikes or high current.

3. Ultrasonic sensor

This sensor is a very popular sensor used in many applications where measuring distance or sensing objects are required. The module has two eyes like projects in the front which forms the Ultrasonic transmitter and Receiver. The sensor works with the simple high school formula that

Distance = Speed × Time

The Ultrasonic transmitter transmits an ultrasonic wave, this wave travels in air and when it gets objected by any material it gets reflected back toward the sensor this reflected wave is observed by the Ultrasonic receiver module

Now, to calculate the distance using the above formulae, we should know the Speed and time. Since we are using the Ultrasonic wave we know the universal speed of US wave at room conditions which is 330m/s. The circuitry inbuilt on the module will calculate the time taken for the US wave to come back and turns on the echo pin high for that same particular amount of time, this way we can also know the time taken. Now simply calculate the distance using a microcontroller or microprocessor..

HC-SR04 Sensor Features

Operating voltage: +5V
Theoretical Measuring Distance: 2cm to 450cm
Practical Measuring Distance: 2cm to 80cm
Accuracy: 3mm
Measuring angle covered: <15°
Operating Current: <15mA

Operating Frequency: 40Hz

4. Web camera

A webcam is a video camera which is designed to record or stream to a computer or computer network. They are primarily used in video telephony, live streaming and social media, and security. Webcams can be built-in computer hardware or peripheral devices, and are commonly connected to a device using USB or wireless protocols.

5. Buzzer

A buzzer or beeper is an audio signaling device which may be mechanical, electromechanical, or piezoelectric (piezo for short). Typical uses of buzzers and beepers include alarm devices, timers, train and confirmation of user input such as a mouse click or keystroke.

6. Speaker

A loudspeaker (commonly referred to as a speaker or speaker driver) is an electroacoustic transducer[1] that converts an electrical audio signal into a corresponding sound.[2] A speaker system, also often simply referred to as a speaker or loudspeaker, comprises one or more such speaker drivers, an enclosure, and electrical connections possibly including a crossover network. The speaker driver can be viewed as a linear motor attached to a diaphragm which couples that motor's movement to motion of air, that is, sound. An audio signal, typically from a microphone, recording, or radio broadcast, is amplified electronically to a power level capable of driving that motor in order to reproduce the sound corresponding to the original unamplified electronic signal.

7. Push buttons

Push Buttons are normally-open tactile switches. Push buttons allow us to power the circuit or make any particular connection only when we press the button. Simply, it makes the circuit connected when pressed and breaks when released. A push button is also used for triggering of the SCR by gate terminal.

Push Button Features

Prevent flux rise by the insert-molded terminal
Snap-in mount terminal
Contact Bounce: MAX 5mS
Crisp clicking by tactile feedback
Dielectric Withstanding Voltage 250V AC for 1 minute.

Technical Specifications

Mode of Operation: Tactile feedback
Power Rating: MAX 50mA 24V DC
Insulation Resistance: 100Mohm at 100v
Operating Force: 2.55±0.69 N
Contact Resistance: MAX 100mOhm
Operating Temperature Range: -20 to +70 ℃
Storage Temperature Range: -20 to +70 ℃

B. Software

1. Raspberry-pi OS

An operating system (OS) is a critical software component that serves as the bridge between computer hardware and user applications, ensuring smooth and efficient functioning of the device. Among the plethora of operating systems available, one particularly noteworthy and widely embraced OS is raspberry-pi OS. Designed explicitly for the raspberry-pi single-board computer, this OS has garnered immense popularity in the tech community due to its remarkable versatility and user-friendly features. raspberry-pi OS, formerly known as Raspbian, is based on the Debian Linux distribution, providing a stable and robust foundation for various projects. One of its key strengths lies in its support for an extensive range of programming languages and development tools, making it an ideal choice for educational purposes and hobbyist ventures alike. Additionally, the OS is equipped with a well-rounded collection of pre-installed software, simplifying the initial setup process and enhancing the overall user experience. Its adaptability extends to serving as a media center, a retro gaming console, a home automation hub, or even as a web server, showcasing its adaptability and multifaceted utility. Whether you are a seasoned developer or an enthusiastic beginner, raspberry-pi OS stands as an accessible platform, fostering creativity and innovation in the ever-evolving world of technology.

2. Thonny IDE

A robust software application that facilitates streamlined software development by offering a cohesive set of tools within a single platform. One of the most prominent IDEs, Thonny, has garnered considerable attention in the coding community for its user-friendly interface and powerful functionalities. Thonny IDE caters predominantly to Python developers, providing an accessible space for beginners and seasoned programmers alike. Its intuitive design enables programmers to effortlessly write, edit, and debug Python code, thereby boosting productivity and reducing the learning curve. The IDE features autocompletion, and indentation assistance, simplifying code composition. Thonny also boasts an interactive debugger, enabling developers to identify and rectify errors efficiently. For those new to Python, Thonny offers a simplified mode where they can focus on the essentials without overwhelming distractions. Has features such as variable exploration and module management. Furthermore, Thonny IDE allows easy integration with microcontrollers, like the popular MicroPython devices, expanding its versatility. Overall, Thonny's versatility, user-friendliness, and robust functionality make it an outstanding choice for Python developers at all levels, contributing significantly to the growth of Python's thriving community.

VI. RESULT AND DISCUSSIONS

A. Object Detection and Recognition

The integration of IoT sensors and deep learning algorithms enables real-time object detection and recognition, allowing visually impaired users to perceive their surroundings effectively. The cap's ability to detect objects and provide auditory or haptic feedback enhances the user's situational awareness and aids in navigation.

B. Obstacle Detection and Avoidance

Utilizing ultrasonic sensors, the smart cap can detect obstacles in the user's path and provide timely alerts. This functionality enhances the user's safety and mobility, allowing them to navigate environments with greater confidence and independence.

C. Face Recognition

The incorporation of convolutional neural networks (CNNs) for face recognition enhances social interactions for visually impaired users. By memorizing and recognizing faces, the smart cap facilitates smoother communication and fosters a sense of inclusivity for the user.

D. Python-based Data Acquisition

The use of Python for data acquisition, particularly through web scraping techniques, enables the retrieval of relevant information from online sources. This feature allows users to access news, updates, or other pertinent data, further enriching their experience and providing valuable information in real-time.

E. Compact and Portable Design

Housed within a Raspberry Pi, the smart cap is designed to be compact and portable, ensuring ease of use and accessibility for the user. Its lightweight and wearable design make it suitable for everyday use, both indoors and outdoors.

F. Affordability and Scalability

The use of cost-effective IoT sensors and the Raspberry Pi platform makes the smart cap an affordable solution for visually impaired individuals. Moreover, its scalability allows for potential enhancements and modifications to cater to different user needs or technological advancements in the future.

G.. Paradigm Shift in Accessibility

Overall, the smart cap represents a paradigm shift in accessibility for visually impaired individuals. By harnessing the power of IoT, deep learning, and Python automation, it offers a comprehensive solution that empowers users to navigate the world with unprecedented independence and ease, promising a more inclusive future for individuals with visual impairments.

VII. CONCLUSION

In conclusion, the development of a visually impaired assistant leveraging the fusion of Deep Learning (DL) algorithms and Internet of Things (IoT) sensor technology represents a significant advancement in accessibility and inclusivity. By incorporating sophisticated algorithms like YOLO for object detection and Convolutional Neural Networks (CNNs) for face recognition, coupled with practical ultrasonic sensors for obstacle detection, this innovative solution addresses key challenges faced by the visually impaired community. Through real-time feedback mechanisms and customizable settings, users can navigate their surroundings with increased independence and confidence.

Furthermore, the compact design and affordability of the system ensure widespread accessibility, empowering individuals with visual impairments to lead more fulfilling lives. The seamless integration with assistive technologies and adherence to non-functional requirements such as accuracy, reliability, and privacy underscores the commitment to enhancing the user experience while prioritizing safety and security.

Overall, this visually impaired assistant embodies a paradigm shift in assistive technology, promising a future where individuals with visual impairments can navigate the world with unprecedented ease, autonomy, and inclusivity. It stands as a testament to the transformative potential of technology in improving the quality of life for diverse populations.

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Machine Intelligence for Crime Analysis

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Abstract-Machine Intelligence for Crime Analysis presents a cutting-edge approach to crime detection and prevention by leveraging the power of machine learning algorithms. By utilizing vast data sets comprising of historical crime data, geographical information and socio economic factors, machine learning models are trained to identify patterns and trends indicative of criminal activity. The application of predictive analytics facilitates proactive decision making enabling law enforcement agencies to allocate resources effectively and anticipate emerging threats. The integration of machine intelligence into crime analysis represents a transformative approach towards proactive law enforcement strategies in modern society.

Keywords: crime analysis, Crime prediction, Machine learning, Ethical Considerations.

I.INTRODUCTION

This paper serves as a comprehensive exploration of the intersection between machine learning and crime analysis, focusing on the application of various techniques to predict and analyze criminal behavior. We delve into the diverse sources of crime data, ranging from reported incidents and arrests to calls for service and citizen reports, each presenting unique challenges and opportunities for analysis. Moreover, we discuss the critical preprocessing steps required to cleanse and prepare raw crime data for modeling, including data cleaning, normalization, and handling missing values. Public safety and security are fundamental aspects of any thriving society, and effective crime analysis and prediction play pivotal roles in maintaining these pillars. Traditional approaches to crime analysis have long relied on historical data and the expertise of law enforcement professional. However, these methods often suffer from limitations in accuracy, scalability, and adaptability to evolving crime patterns. With the exponential growth of data availability and advancements in machine learning techniques, therehas been a paradigm shift in the way crime analysis and prediction are approached. The emergence of machine learning has revolutionized various domains, and its exception. Machine learning techniques offer the promise of uncovering hidden patterns, identifying trends, and making accurate predictions based on large volumes of heterogeneous data. By leveraging algorithms that can learn from data, crime analysts and law enforcement agencies can gain deeper insights into crime dynamics and enhance their ability to prevent and respond to criminal activities effectively.In addition to discussing technical aspects, this paper also addresses the ethical considerations and challenges associated with deploying machine learning models for crime analysis. We emphasize the importance of fairness, transparency, and accountability in the development and deployment of predictive policing systems, striving to mitigate potential biases and uphold the principles of justice and equity. Furthermore, we provide an in-depth review of various machine learning algorithms employed in crime prediction tasks, ranging from traditional supervised learning methods to more advanced techniques like deep learning and ensemble methods. By comparing the performance and suitability of these algorithms for different types ofcrime prediction tasks, we aim to guide practitioners in selecting the most appropriate models for their specific needs.

II.DESIGN AND DEVELOPMENT

Data Collection and preprocessing:

Gather diverse sources of crime data including reports of accidents, arrests, call for service and citizen reports, from relevant law enforcement agencies and other authoritative sources. Perform data cleaning to remove inconsistencies, errors, and outliers, ensuring the quality and reliability of the dataset. Normalize the data and handle missing values using appropriate techniques such as imputation or deletion. Conduct exploratory data analysis (EDA) to gain insights into the characteristics and distributions of the crime data.

Feature Engineering:

Extract relevant features from the preprocessed crime data, including spatial and temporal attributes, as well as contextual factors such as weather conditions, demographic information, and urban infrastructure. Develop innovative feature engineering techniques tailored to crime data such as creating hotspot maps, calculating crime density metrics, and encoding temporal patterns.

Model Selection and Training:

Evaluate a variety of machine learning algorithms for crime prediction tasks, including supervised unsupervised, and hybrid methods. Split the preprocessed data into training, validation and testing sets to assess the performance of the models.

To experiment with different algorithm configurations, hyper parameters, and feature combinations to optimize model performance.

Model Evaluation:

Assess the performance of the trained models using appropriate evaluation metrics such as accuracy,

precision, recall, F1-score, and area under the ROC curve. Conduct cross-validation to ensure the generalizability of the models across different datasets and scenarios. Analyze the strengths and weaknesses of each model, identifying areas for improvement and refinement.

Ethical Considerations:

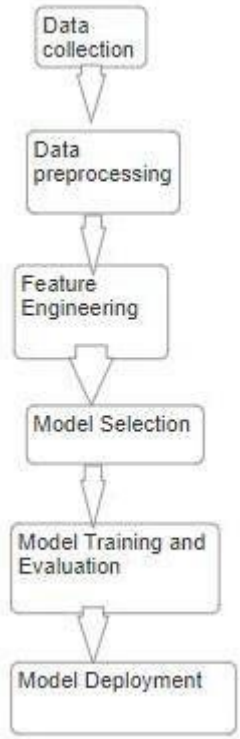
Address ethical concerns related to algorithmic bias privacy infringement, and potential misuse of predictive policing systems. Incorporate fairness-aware techniques to mitigate biases and promote equity in the deployment of machine learning models for crime analysis. Implement transparency and accountability measures to ensure the responsible use of predictive analytics in law enforcement practices.

Model Deployment and Integration:

Deploy the trained models into production environments, integrating them into existing crime analysis workflows and decision support systems.Provide user-friendly interfaces and visualization tools to facilitate the interpretation and utilization of model predictions by law enforcement personnel and other stakeholders.

Continuously monitor and evaluate the performance of the deployed models, incorporating feedback and making iterative improvements as needed

IV. FLOW MODEL:



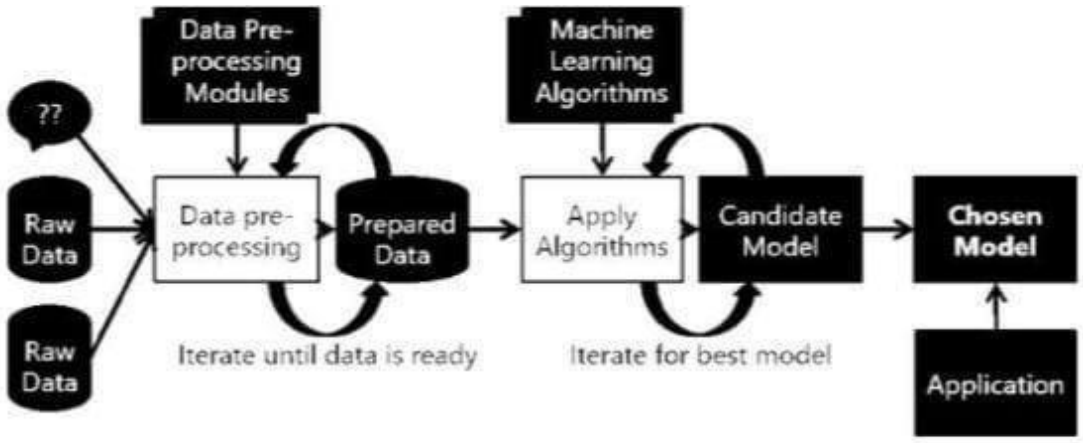


Fig 4.2 System Architecture

III. LITERATURE SURVEY:

1. "Predictive Policing: The Role of Crime Forecasting in Law Enforcement" by Mohler et al. (2015) This paper explores the concept of predictive policing, emphasizing the importance of crime forecasting in law enforcement. It discusses various machine learning algorithms used for crime prediction, such as random forests and neural networks, highlighting their effectiveness in identifying crime patterns and hotspots.
2. "Crime Prediction using Data Mining Techniques: A Comprehensive Review" by Malathi and Geetha (2016) This review paper provides a comprehensive overview of data mining techniques applied to crime prediction. It discusses the use of algorithms like decision trees, support vector machines, and clustering methods in analyzing crime data. The paper also examines the challenges and limitations associated with crime prediction models.
3. "A Survey of Crime Prediction using Data Mining Techniques" by Alwakeel et al. (2018) This survey paper presents an overview of recent advancements in crime prediction using data mining techniques. It discusses the integration of geographical information systems (GIS) with machine learning algorithms for spatial analysis of crime data. The paper also examines the ethical implications and privacy concerns associated with predictive policing technologies.

4. "Crime Prediction using Machine Learning Techniques: A Survey" by Bhatt et al. (2020) This survey paper reviews the application of machine learning techniques in crime prediction. It discusses the use of supervised, unsupervised, and hybrid learning approaches for analyzing crime data. The paper also explores the role of feature selection and dimensionality reduction techniques in improving the accuracy of predictive models.
5. "Deep Learning Techniques for Crime Prediction: A Comprehensive Survey" by Tripathi et al. (2021) This comprehensive survey focuses on the application of deep learning techniques for crime prediction. It discusses the use of convolutional neural networks (CNNs), recurrent neural networks (RNNs), and hybrid architectures for analyzing spatiotemporal crime data. The paper also examines the challenges and future directions in deep learning-based crime pre

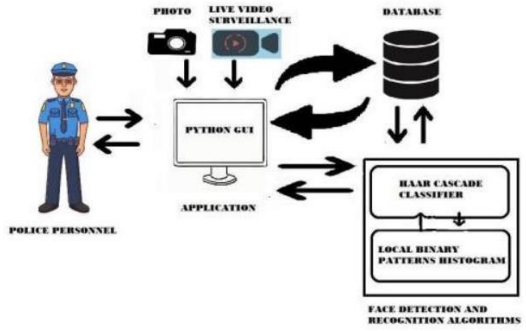
IV. METHODOLOGY:

System development method is a process through which a product will get completed or a product gets rid from any problem. Software development process is described as a number of phases, procedures and steps that gives the complete software. It follows series of steps which is used for product progress. The development method followed in this project is waterfall model.

Model phases Requirement Analysis: This phase is concerned about collection of requirement of the system. This process involves generating document and requirement review. System Design: Keeping the requirements in mind the system specifications are translated in to a software representation. In this phase the designer emphasizes on: -algorithm, data structure, software architecture etc.

Coding: In this phase programmer starts his coding in order to give a full sketch of product. In other words, system specifications are only converted in to machine readable compute code. Implementation: The implementation phase involves the actual coding or programming of the software. The output of this phase is typically the library, executables, user manuals and additional software documentation Testing: In this phase all programs (models) are integrated and tested to ensure that the complete system meets the software requirements. The testing is concerned with verification and validation. Maintenance: The maintenance phase is the longest phase in which the software is updated to fulfill the changing customer need, adapt to accommodate change in the external environment, correct errors and oversights previously undetected in the testing phase, enhance the efficiency of the software.

System architecture:



The system architecture for crime analysis and prediction using machine learning is a comprehensive framework designed to process, analyze, and predict criminal activities based on historical data and relevant factors. At its core, the architecture consists of several interconnected layers, each serving a distinct purpose in the overall workflow. The process begins with the Data Collection Layer, where data from diverse sources such as crime reports, demographics, socioeconomic indicators, and environmental data are gathered. This layer ensures the availability of a rich and comprehensive dataset for analysis. Subsequently, the Data Preprocessing Layer takes charge, where collected data undergoes cleaning, transformation, and normalization to ensure consistency and reliability. Missing values are handled, outliers are removed, and categorical

variables are encoded to prepare the data for further analysis.

V. RESULTS:

Table 1.

Req_Id	Tkt_Id	Req_Description	Actual_o/p	Expected_o/p	Tkt_status
1.	101	During registration of criminal, 5 criminal photos must be uploaded with faces in it.	Registration successfull	Registration successful	PASS
	102	If NO faces found in images.	NO faces found error message	NO faces found error message	PASS
	103	If less than 5 images are selected	Alert message Please select 5 images	Alert message Please select 5 images	PASS
	104	If above 5 HD images are selected then.	Memory Limit exceeded	Memory Limit exceeded	PASS

Fig : Test Case of Criminal Registration

Req_Id	Tkt_Id	Req_Description	Actual_o/p	Expected_o/p	Tkt_status
2.	201	Upload image from pictures and if criminal is found.	Criminal details will be displayed	Criminal details will be displayed	PASS
	202	Upload image from pictures and if criminal is not found.	No criminal recognized message	No criminal recognized message	PASS

Table 2: Test case for detecting criminals

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IOT BASED FOREST FIRE PREVENTION SYSTEM WITH ANTI-SMUGGLING IDENTIFICATION

*Note: Sub-titles are not captured in Xplore and should not be used

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***Abstract*— Our study introduces an IOT-driven solution for forest fire prevention, coupled with anti-smuggling identification. By deploying IOT sensors to monitor environmental conditions and employing advanced algorithms, our system can swiftly detect signs of forest fires and identify suspicious activities. Real-time alerts enable rapid response, helping authorities to intervene promptly. This integrated approach aims to safeguard forests from both natural and human-induced threats, promoting sustainable conservation efforts.

Keywords— IoT, Forest fire prevention, Anti-smuggling, Identification, Environmental monitoring, Real-time alerts

I. INTRODUCTION

Protecting our forests from the destructive effects of wildfires has become a top priority in light of the growing environmental issues. The Real-Time Forest Fire Detection and Suppression System with Tree Cutting and Trespassing Detection is an inventive solution that was developed as a result of new avenues for tackling these difficulties created by the integration of advanced technologies. The ESP32 microcontroller, smoke sensor, water pump, relay, GPS module, DHT11 sensor, vibration sensor, flame sensor, microwave body radar motion sensor, and an OLED display are just a few of the many parts that this innovative system uses.

This integrated system forms a strong network by integrating multiple sensors and actuators to continuously monitor forest conditions, with the goal of achieving effective forest management and early wildfire detection. The central processing unit, or ESP32 microcontroller, is responsible for coordinating the data gathered from various sensors to offer real-time insights and prompt reactions to possible threats. In addition to identifying forest fires and initiating rapid suppression actions, this system has other features including monitoring for trespassing and detecting tree cutting.

Often called the "lungs of our planet," the world's forests are essential to preserving ecological balance and sustaining a variety of habitats. But because of human activity and shifting climatic patterns, wildfires are becoming a more serious danger to these priceless resources. It is therefore essential to improve forest protection and conservation activities in response to these difficulties by developing novel technology.

Using cutting-edge parts and clever data processing, the Real-Time Forest Fire Detection and Suppression System with Tree Cutting and Trespassing Detection is a ground-breaking solution. The purpose of this integrated system is to promptly detect incidences of trespassing, illegal tree cutting, and forest fires, allowing for quick response and mitigating measures. The integration of an extensive array of sensors and actuators provides a holistic approach to forest monitoring and management through this system.

II. LITERATURE SURVEY

Forests are seriously threatened by forest fires and illicit activities like smuggling, which calls for efficient monitoring and preventative actions. The integration of forest fire monitoring systems with anti-smuggling identification technologies through the use of IoT (Internet of Things) and related approaches is the subject of this review of the literature.

A. "IoT-Based Forest Fire Detection Systems: A Comprehensive Survey"

An overview of IoT-based forest fire warning systems is given in this survey article, which also covers sensor technology, data analytics approaches, and real-time monitoring strategies. Although it is mainly concerned with fire detection, it recognizes that anti-smuggling identifying elements might be added to these devices to improve overall forest protection.

B. "Combating Illegal Activities in Forests Using IoT: A Review"

This research examines the usefulness of IoT technology in preventing illicit activities in forests, primarily focusing on smuggling and illegal logging. It talks about using GPS tracking devices, sensor networks, and security cameras to find and stop illegal invasions. For complete protection, the

assessment also emphasizes how crucial it is to incorporate anti-smuggling measures into forest monitoring systems.

C. "Machine Learning Approaches for Anomaly Detection in Environmental Monitoring: A Review"

This review discusses machine learning techniques for anomaly detection in environmental monitoring systems. While not specifically focused on forests, it explores the applicability of anomaly detection algorithms for identifying unusual patterns indicative of both forest fires and illicit activities like smuggling. The review emphasizes the potential for leveraging machine learning to enhance the capabilities of integrated forest monitoring systems.

D. "Advances in Remote Sensing Technologies for Forest Monitoring: A Literature Review"

This review of the literature looks at developments in aerial drones and satellite imaging as well as remote sensing technology for monitoring forests. It covers the possibility of employing remote sensing data to identify and monitor forest fires and illicit activities, even if its main focus is on mapping land cover and assessing the health of forests. The review emphasizes how crucial it is to combine IoT systems based on the ground with remote sensing technologies to provide thorough forest monitoring.

Finally, To improve forest conservation efforts, extant literature emphasizes the significance of combining anti-smuggling identification technologies with forest fire warning systems. The development of integrated IoT-based systems that can identify, stop, and lessen risks to forests from both natural and man-made sources should be the main emphasis of future research. Promoting sustainable forest management and conservation techniques requires the use of such integrated approaches.

III. METHODOLOGY

The Real-Time Forest Fire Detection and Suppression System with Tree Cutting and Trespassing Detection is a system that combines hardware, sensors, data processing, and communication protocols in a well-organized architecture to provide a complete forest protection solution.

The ESP32 microcontroller, which was selected for the system's core due to its wireless and computational capabilities, is the central component. This central processing unit is the brain that directs and coordinates the activities of the entire system. Numerous sensors, such as the DHT11 sensor, vibration sensor, smoke sensor, flame sensor, and microwave body radar motion sensor, connect with the microcontroller. These sensors keep an eye out for trespassing activity, unapproved tree cutting, temperature changes, humidity, and evidence of fire or smoke in the forest environment. Their data is fed into the module for data processing, which does real-time analysis.

Data from the numerous sensors is received, interpreted, and analyzed by the data processing module. The decision logic module's algorithms analyze this data and choose the best course of action for various scenarios. The technology uses a relay to activate the water pump in the event of a fire or smoke detection, starting the fire suppression process right away. When someone chops down a tree without permission or trespasses, the system sends out email warnings with the exact GPS coordinates of the occurrence.

The user interface is an OLED display that gives personnel on-site visual feedback in real-time. They may see alerts, keep an eye on the system's status, and assess general operating conditions thanks to this display. The smooth interchange of information both inside the system and with external stakeholders is guaranteed by the communication module. It makes it easier to create email alerts that include incident details and coordinates, swiftly alerting the appropriate authorities to respond quickly.

The GPS module makes sure that incidents are identified accurately and provides geographic coordinates so that emergency services can locate the incidents. Email alert creation, formatting, and delivery are managed by the alert management module.

IV. BLOCK DIAGRAM

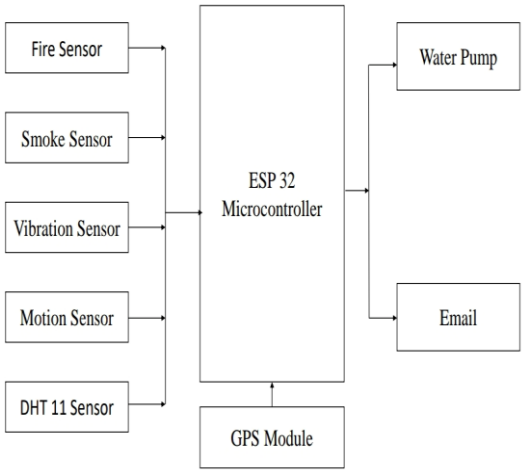

Fig 3.1 Block Diagram

V. HARDWARE AND SOFTWARE REQUIREMENTS

Hardware Requirements:

1. ESP32 Microcontroller
2. Fire Sensor
3. Water pump
4. Vibration Sensor
5. Motion Sensor
6. GPS Module
7. DHT 11 Sensor
8. Smoke Sensor

Software Requirements:

1. Arduino IDE

VI. APPLICATIONS

Many uses exist for the Deforestation, Fire, Smoke, and Wildlife Monitoring and Anti-Smuggling System for Trees in Forest with Fire Suppression System and Deforestation, including:

1. Conservation of Forests: The system contributes to the protection and preservation of forests by keeping an eye on and stopping illicit logging, tree smuggling, and deforestation, which protects important ecosystems and biodiversity.
2. Wildlife Protection: It contributes to the conservation of wildlife by spotting and addressing risks such habitat degradation and poaching, protecting the security and welfare of threatened and endangered species.

VII. RESULT

The Real-Time Forest Fire Detection and Suppression System with Tree Cutting and Trespassing Detection represents a pivotal advancement in the realm of forest protection, management, and ecological conservation. By seamlessly integrating cutting-edge technology, sophisticated sensors, and intelligent algorithms, this system offers a comprehensive solution to address the complex challenges posed by forest fires, unauthorized activities, and the preservation of valuable natural resources.

Through a meticulously designed architecture, the system demonstrates its ability to swiftly detect incidents such as fires, smoke, unauthorized tree cutting, and trespassing activities. Its proactive approach, triggered by real-time data analysis and decision-making, ensures rapid response and efficient management of such events. The integration of sensors like the smoke sensor, flame sensor, vibration sensor, and microwave body radar motion sensor, coupled with the power of the ESP32 microcontroller, forms the backbone of its success.

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A Prosthetic Hand with Gesture Control Features

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Abstract: **In this study, a three-dimensional (3D) printed soft robotic hand with embedded soft sensors, intended for prosthetic applications is designed and developed to efficiently operate withnew-generation myoelectric control systems, e.g., pattern recognition control and simultaneous proportional control. The mechanical structure of the whole hand is fabricated as a monolithic structure using a low-cost and open-source 3D printer. It minimizes the post-processing required for the addition of the embedded sensors in the hand. These are significant benefits for the robotic hand that features low cost, low weight (313 grams), and anthropomorphic appearance. With the soft position sensors added to the fingers, the fingers' positions can be monitored to avoid self-collision of the hand. Besides, it allows a robotic prosthetic hand to eliminate the conventional way of returning to the neutral fully open position whenswitching from one type of gesture to another. This makes the transition between the hand gestures much faster, more efficient, and more intuitive as well. Further, initial contact detection of each finger is achieved for the reshaping of multi-finger grasps, e.g., tripod grip and power grasps, to improve the stability and quality of the grasps. Combinations of different gestures allow the hand to perform multi- stage grasps to seize and carry multiple objects simultaneously. It can potentially augment the hand's dexterity and grasping diversity. Providing direct transition between the hand gestures and improved grasping quality and diversity are the primary contributions of this study.**

Index Terms—Soft robotics, prosthetic hand, soft sensors, finger position tracking, direct gesture transition, reshaping, multi-stagegrasps

Introduction:

Significant endeavors have been dedicated to the enhancement of upper limb functionality for individuals grappling with upper limb deficiencies. Positioned as a synthetic adjunct to the human anatomy, the prosthetic hand aspires to emulate myriad facets of its biological counterpart, encompassing aesthetic, postural, and gripping functionalities.

Amidst the panoply of options, a self-contained anthropomorphic robotic hand, characterized by the integration ofactuators within its structure, emerges as a premier contender. Propelled by the meteoric advancements in robotics technology, robotic prosthetic hands have transcended their rudimentary origins, metamorphosing from rudimentary apparatuses reliant on a singular electric motor facilitating limited degree of freedom (DOF) movements, to formidable bionic contrivances endowed with an array of dexterous grasping capabilities, facilitated by an ensemble of miniature electric motors [1]. Such a sophisticated robotic appendage typically interfaces with users through the utilization of surface electromyogram (sEMG) electrodes, which capture the myoelectric activities emanating from the residual arm musculature, thereby facilitating the embodiment of the so-called myoelectric hand.

Within the realm of commercial myoelectric hands, the prevalent user-hand interface modality encompasses direct control or 2- myosites sequential control, heralded for its efficacy within clinical milieus. However, a salient drawback ensues from this control interface paradigm, namely, the user's inability to seamlessly transition the hand to a desired gesture prior to its activation. Traditionally, the toggling between disparate gestures necessitates manual intervention or the orchestration of muscle co-contractions across two myo-sites. In a bid to optimize cost and weight considerations, the design of a robotic prosthetic hand invariably mirrors the capabilities of the user-hand interface. With direct control mechanisms in place, wherein only one gesture remains active at anygiven moment, all hand movements pertinent to each gesture are preordained.

Facilitating the transition to a distinct gesture mandates the hand's regression from its previous gesture to a neutral stance, typically characterized by complete hand extension. Within the confines of this neutral posture, the hand commences its traversal from a known initial position towards a predetermined target location specific to the desired gesture, thereby enabling the antecedent trajectories to be meticulously pre-determined. Strikingly, this operational framework operates devoid of any position feedback mechanism, with the majority of commercial prosthetic hands embracing an open-loop control architecture devoid of onboard position sensors. Despite its seemingly simplistic guise, this pragmatic approach effectively achieves its intended objectives while ensuring economic viability within the domain of direct control paradigms.

The advent of pattern recognition (PR) based user-hand interfaces heralds a transformative shift aimed at enhancing the intuitive nature of myoelectric control [2]–[5]. Diverging from the conventional paradigm of direct control, PRcontrol harnesses the power of machine learning algorithms to discern an array of upper limb intentions exhibited by the user, thereby enabling the direct command of each gesture through distinct muscle contractions. Notably, this paradigm obviates the need for manual gesture activation, as all pre-selected gestures are deemed inherently 'active', rendering the hand poised to execute any gesture at the user's behest. garnered tractionwithin clinical spheres.

With pattern recognition (PR) control at the helm, the anticipated trajectory for a robotic prosthetic hand entails more intuitive gesture transitions, potentially occurring with heightened frequency, courtesy of theelimination of cumbersome manual switching protocols. However, should the hand be mandated to revert to a neutral position preceding each gesture initiation, the operational paradigm manifests as conspicuously non-intuitive and inefficacious. PR control's capacity to furnish multi-degree- of-freedom (DOF) commands imbues the hand with the capability to seamlessly navigate gesture transitions, irrespective of its spatial orientation. Nevertheless, the abolition of the neutral position to facilitate seamlesstransitions precipitates a conundrum: the robotic hand embarks on its trajectory from an indeterminate starting point, engendering a scenario wherein preordained movements become fraught with risk

elimination of cumbersome manual switching protocols. However, should the hand be mandated to revert to a neutral position preceding each gesture initiation, the operational paradigm manifests as conspicuously non-intuitive and inefficacious. PR control's capacity to furnish multi-degree- of-freedom (DOF) commands imbues the hand with the capability to seamlessly navigate gesture transitions, irrespective of its spatial orientation. Nevertheless, the abolition of the neutral position to facilitate seamless transitions precipitates a conundrum: the robotic hand embarks on its trajectory from an indeterminate starting point, engendering a scenario wherein preordained movements become fraught with risk, as the hand's digits maneuver sans real-time position tracking, predisposing the hand to potential self- collision, thereby precipitating operational malfunction or even permanent damage. Given that hand grasp epitomizes a concerted endeavor involving all digits, the attainment of a superlative grasp quality becomes a Herculean task sans access to real-time digit positions in the absence of pre-programmed movements. Ergo, to realize the vision of seamless transitions between gestures, the imperative to modernize extant robotic prosthetic hands emerges as an exigency of paramount importance.

This study endeavors to introduce and develop a pioneering soft robotic hand tailored specifically for prosthetic utility, boasting superior control and grasping efficacy relative to extant commercial counterparts. Distinguished by its three-dimensional (3D) printed monolithic construction, this innovative hand integrates embedded soft position and touch sensors within each of its four fingers and thumb. Leveraging real-time tracking of each joint, the hand attains precise control over its movements, facilitating the execution of diverse gestures with seamless transitions directly between any two of them.

This study represents a pivotal advancement towards the realization of intuitive gesturetransitions and the augmentation of grasp quality within the realm of soft robotic hands tailored for prosthetic applications. By bridging the gap between conventional prosthetic functionality and the revolutionary potential ofpattern recognition (PR) based user-hand interfaces, this research endeavors to align the maneuverability of the prosthetic hand with the inherent capabilities of its biological counterpart. In doing so, it heralds a paradigm shift, bringing the operational functionality of hand prostheses one step closer to emulating the natural dexterity and fluidity exhibited by human hands.

OBJECTIVES

A user-hand interface that allows the control of individual fingers is ideal for prosthetic hand users. However, there is no indication that anymyography-based (i.e., either non-invasive or invasive) interface can achieve this goal in the short term. As a practical approach with current technology, a PR system detects and outputs the user's intention as different hand gestures, which are the synergies of all the fingers and thumb. Therefore, the very first objective for any robotic prosthetic hand is to determine the desired grasps and gestures. To achieve an intuitive transition between any two grasps, the hand needs to be able to start the requested grasp from the PR system straightaway without returning to its neutral position. Therefore, the second objective of this work is to provide the hand with the capability of online position tracking of all the joints and motion planning based on the acquired position information. This can make sure self-collision of the hand is avoided and the switching of gestures/grasps is smooth andfrom the pressure change in the bending chamber. For simplicity, the thumb is also designed to have two 1-DOF joints only. The lower joint enables the thumb's palmar abduction/adduction while the upper joint supports its flexion/extension. Similar to the fingers, pneumatic bending sensing chambers

seamless. Another main objective is to improvegrasp quality by enabling the hand to perform form closure when grasping an object, which is realized by preshaping the hand to envelop the object geometrically. Through the detection of each finger's initial contact with the object, an external wrench (i.e., force and moment) can be achieved to avoid the object's movement before being grasped securely. This can greatly improve the stability of the power grasp for a robotic prosthetic hand, especially when four fingers cannot reach the object at the same time. This situation is often encountered with ahand with a PR system since its power grasp does not necessarily start from its fully opened position anymore. Some common benefits of soft robots are also targeted for this hand, including fabrication by 3D printing for easy customization, and realization of a lightweightand affordable (i.e., low-cost) robotic prosthetic hand.

MATERIALS AND METHODS

A. Design, Modeling, and Fabrication:

The computer-aided design (CAD) model of thesoft robotic hand is shown in Fig. 1. The hand has an anthropomorphic appearance as this is one of the key factors for the acceptance of prosthetic hands [15], [16]. Four fingers are designed based on our previous work, which reported on a 3D printed soft robotic finger with embedded bending and touch sensors for closed-loop position and force control [17], [18]. Two joints in the form of 1-DOF flexure hinges are employed for each finger in which one pneumatic bending sensing chamber is embedded in each. The rotational displacement of each joint can be detected

are integrated for detecting the thumb's position. Also, a pneumatic chamber is embedded inside the fingertip of each of the four fingers and the thumb as a force sensing chamber. These touch sensors can also be potentially used for tactile sensory feedback. More details about the touch sensors can be

found in our previous work [17]. It is important to note that the intrinsic elasticity of the joints is responsible for the fingers' extension.

Fig. 1. Soft robotic prosthetic hand computer-aided design(CAD) model.

The hand is modeled in Autodesk Fusion 360 (Autodesk Inc.). The thumb which is newly designed in this study is simulated using finite element modeling (FEM) to find the relationship between the bending angle and the internal volume for each of its pneumatic chamber (i.e., upper and lower joints). The FEM results show the relationship between the bending angle and a chamber's internal pressure since PV = Constant with the assumption of no temperature change according to the ideal gas law (P: Pressure, V: Volume) [17]. For ease of calibration and mapping the bending angle to the pressure change, a linear relationship is desired. The topologies of the thumb's two joints are optimized to achieve linearity and to minimize the bending stiffness as well. The joints' models are meshed using higher-order tetrahedral elements. The FEM results, shown in Fig. 2, indicate that a linear relationship exists between the bending angle of the internal volume for the upper and lower jointsof the thumb, respectively.

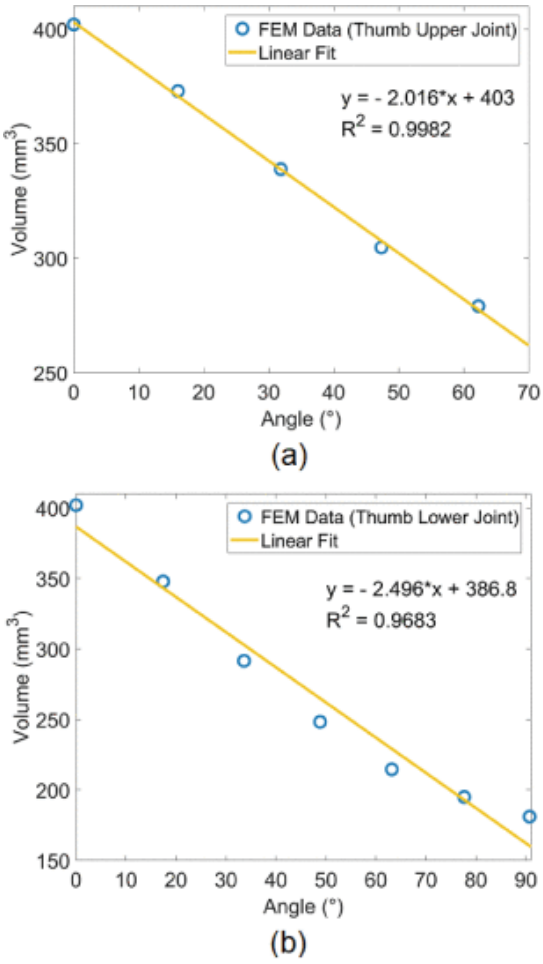

Fig. 2. FEM results showing the relationship between thebending angle and the internal volume for (a) the upper joint and (b) the lower joint of the thumb, respectively.

The optimized CAD model of the hand is sliced using a commercial software (Simplifiy3D, LLC, OH) where the 3D printing parameters were optimized to obtain airtight soft chambers (i.e., position and touch chambers) and soft fingers with high quality exteriors [19]–[21]. The soft monolithic fingers and thumb and the palm are 3D printed using a commercially available Polylactic Acid (PLA) due to the desired structure stability and minimum deformation caused by some internal or external loads. The pressure in each pneumatic chamber is measured by a solid air pressure sensor (ABPDANT015PGAA5, 0–15psi Gauge, 0.25% Accuracy, Honeywell International Inc.). A microcontroller board (Arduino Mega 2560, Arduino) is used to acquire all the pressure

measurements and send them to a computer for processing.

The hand is self-contained with all the actuators in it with a total mass of 313 grams. For the sake of being lightweight and simple, tendon-driven underactuation is employed for all the fingers and the thumb to enhance the mechanical compliance of grasps. All the tendons are made of abrasive-resistant braided polyethylene fibers with a diameter of
0.48 mm and a rated tensile load of 445 N (Manufacturer: SYUTSUJIN, Type: GRAND PE JIGMAN WX8).

Full actuation is employed for the thumb since it is critical to the hand's grasping and dexterity as it is responsible for up to 40% of a hand grasps [22]. Initially, five tendon-driven mechanisms were designed, two for the thumb, one for the index finger, one for the middle finger, and one for the ring and little fingers together. The motor for the flexion/extension of the thumb was initially designed to sit inside the thumb's phalange to save space inside the palm, which was a usual strategy in robotic hand design [1], [23]. The other four motors were designed to be housed inside the palm. Ideally, DC motors with small strong pulleys (i.e., 2.5 mm in diameter in [24]) can provide better performance in terms of pulling strength and speed. However, it usually requires a more complicated control circuit. As the main aim of this work is to develop and test the concept of seamless transition between gestures, simple hardware is employed for the sake of rapid prototyping. Servo motors (Dynamixel XL-320) with 3D-printed plastic pulleys (10 mm in diameter) are used. Since the relatively large pulleys are used and the torque output is constant, the pulling force from each motor is weakened. Therefore, the number of motors is increased from five to six motors so that each finger can be pulled by an individual motor. Besides, as the servo motors used are not cylindrical, they cannot be placed inside the thumb's phalange. Therefore, the initial design is altered and the final motor configuration is shown in Fig. 3. An open- source motor controller (OpenCM9.04) is employed to provide communication between the computer and the motors.

The total length of the fabricated prototype is 203 mm, which can be potentially reduced to 179 mm (i.e., from the middle finger's tip to the palm's base) if the motor-pulley system is optimized by using good-quality DC motors (e.g., Faulhaber 1024M006SR+10/1 64:1) and smaller pulleys (e.g., machined stainless steel) as well as a corresponding advanced control circuit. The major width of the palm is 92 mm. The hand's total mass is 313 grams, including the mass of the mechanical structure, six electric motors, and fifteen solid pressure sensors. This hand is much lighter compared to the commercial myoelectric hands (i.e., typically over 500 grams). The details of the design and fabrication can be found in our previous work [25].

B. Targeted Hand Grasps/Gestures

Three hand grasps, including power grasp, pinch grip (i.e., index finger and thumb), and lateral grasp (i.e., key grip) are usually identified as the most useful hand grasps [26], [27]. They are all enabled for the hand. Tripod grip is also selected as a popular supplementary precision grasp for pinch grip. Index pointing is included for clicking purposes and postural use. Thumb-up is selected as the releasing-type gesture corresponding to lateral grasp (i.e., key grip). Besides, it can be used as a hook for lifting and it is a common gesture as well. Lastly, the hand gesture of the full opening is a must as it can release all the other hand grasps/gestures. It can also work as a 'platform' gesture with all fingers fully extended and the hand's front facing upwards to support an object. Overall, seven commonly used hand grasps/gestures are selected for people's activities of daily living (ADL), listed below:

- hand fully opening
- hand fully closing (i.e., power grasp)
- pinch grip with index finger and thumb

- tripod grip with index and middle fingers, and thumb
- lateral (i.e., key) grip
- index pointing
- thumb-up/hook

C. Determining Final Positions of All the Hand Digits for Each Hand Gesture

Each hand gesture has special features that differentiates it from other gestures. For fully opening, fully closing (i.e., power grasp), and thumb-up, the final positions of the hand digits are unanimous. However, for the other hand gestures, there is flexibility in this regard. As long as its key feature are made, the requested hand gesture is considered to be achieved (i.e., successful gesture). For example, the key feature of pinch grip is the thumb touching the index finger while the other three fingers' positions are usually not important. A similar situation occurs to tripod grip, in which the ring and little fingers' positions do not affect people's perception of whether tripod grip is formed or not. The final positions of the hand digits are determined for each hand gesture, as shown in Table I. In Table I, a cell is left blank if a digit's movement is considered unnecessary for a corresponding hand gesture, in which all the unnecessary movements are removed for the sake of power and energy saving.

D. Direct Transition Between Hand Grasps

To realize a direct and seamless transition between hand grasps, the neutral position must be eliminated. The key is to provide the hand with online position tracking capability using the embedded soft sensors. Based such online position information, a motion control system can calculate the optimized trajectories for all the hand digits so that the transition can be conducted smoothly and efficiently withoutself-collision.

The avoidance of self-collision is achieved through three main steps. In Step 1, four fingers are designed to bend/extend within the parallel planes so that they never collide with each other in space. The range of motion (ROM) for the thumb's abduction is limited so that the thumb can only reach the middle finger for the tripod grip. In this way, the risk of self-collision can be reduced, which is likely to happen to the thumb and the index/middle finger only. For Step 2, some rules are set, namely:

i. When abduction/adduction and flexion are both involved for the thumb, the former is set to move before the latter.

ii. When abduction/adduction and extension are both involved for the thumb, the latter is set to move beforethe former.

iii. When the thumb is at the non- opposed position and only flexion is involved (i.e., key grip), the thumb is set to stop at 50% flexion and wait until the finger(s) at the final targeted position(s) and then go for its full flexion.

iv. When the thumb is within the index or middle finger's plane of movement (POM), the fingers are set not start to move until the thumb reaches its final position.

Based on Step 1 and Step 2, self-collision should not take place in a normal operation. However, in case an abnormal operation happens (i.e., motor failure), a fail-safe procedure is designed as Step 3 to detect self- collision as fast as possible so that damages can be minimized. Once self-collision is detected, the hand is set to a full stop, and only a fully opening position can be performed. To activate this fail-safe procedure, two conditions need to be met at the same time:

- The thumb's tip is within the POM of the index/middle finger. The position

of the thumb's tip is monitored online by using forward kinematics.

- As shown in Fig. 1, the distal phalange of the thumb is defined as one line- segment (aa') while the two phalanges of the index finger and two phalanges of the middle finger are defined as four line-segments, respectively. The closest distance between aa' and each of the other four line-segments is calculated online. If it is below a certain value (i.e., based on the diameters of the hand digits), the thumb is considered to collide with the index/middle finger.

When the hand is not at risk of self-collision, all the digits are designed to move simultaneously as much as possible, which saves time to form the desired hand gesture and allow the robotic hand to behave more like a biological one.

E. Preshaping of the Hand for Improved Quality of Grasps

It is essential for a stable grasp to have more contact points (i.e., area) evenly distributed on the surface of a grasped object. These contact points can improve the balancing of the forces applied on the object by the fingers and the thumb. As the hand does not start from a fully opening position for a grasp, the time required by each finger to make contact with the object varies when performing multi-finger grasps, which leads to the reduction in the number of contact points when the hand starts to firmly grip the object. This may cause a force imbalance on the object and consequently lead to an unstable grasp (i.e., failed grasp). Even when a power grasp is performed by starting from the hand fully opening position, this situation might also arise when grasping an object with a non-uniform perimeter or irregular outer geometry (i.e., shape). To alleviate this problem, preshaping the hand is implemented to allow all the fingers to touch the object first and envelop it geometrically before large forces are applied in order to grasp the object securely. Detecting the initial contact for each finger is a significant step for preshaping a grasp that requires multiple fingers, e.g., tripod grip or power grasp. In the literature, fingertip sensors or motor current sensing are usually used for initial contact detection. However, the former does not work if the proximal phalange of a finger rather than its tip makes contact with the object first. For the latter, such sensing method is still not accurate and reliable. In this work a practical approach is employed which considers that the finger gets in touch with an object once any of its two joints stop rotating or bending.

F. Multi-Stage Grasps

As the direct transition between grasps is available, the hand does not have to release a grasp before performing another one. Instead, different grasps can be combined to provide users with multi-stage grasps to hold more than one object at the same time, which is a feature of a biological hand. For example, the hand can perform a pinch grip to hold a small- sized object such as a coin and then perform a power grasp, by which the other remaining three fingers bend to hold a second object against the palm. Another example is that the hand can perform a thumb-up/hook to hold a cylindrical object first and then perform a key grip to hold a second object such as a key. Users can create different combinations of grasps depending on their needs. Multi-stage grasps can potentially improve the flexibility and dexterity of the hand grasps, making the robotic hand's operation one step closer to their biological counterparts.

There are no fixed operation steps or operation routines to combine different grasps. Once the users are trained to be skilled in PR control, they are expected to confidently activate any gesture from their own pre- selected list of gestures whenever they want. Then, the users may find some commonly used combinations of gestures, or multi-stage grasps, to suit their own needs in life. Subject to different needs, the multi-stage grasps can be quite individual to each user. Since they are commonly used, the users get to operate or practice their own multi-stage grasps frequently, helping to improve the proficiency.

Discussion

A. Preshaping

Overall, the inclusion of preshaping can alleviate the instability and unbalancing effect for multi-finger grasps due to the different timing of the fingers' contact to the grasped object, especially for those low-weight objects. This is a special demand, particularly for robotic prosthetic hands. For robot hands, their fingers can be individually controlled to adapt to the profile of an object by regulating the speed of each finger. However, this approach is impractical for prosthetic hands since they are all gesture-based controlled robotic hands. Although an additional vision system can be added to detect the object's profile and regulate each finger's movement (i.e., like a robot hand) it brings extra complexity and computational burden to the overall system, in addition to contradicting some basic rules for designing a prosthetic hand, i.e., low weight and low cost. Also, there is another approach to possibly alleviating such an issue. A user can adjust each finger's position by performing some prior gestures and accordingly adjusting the whole hand's orientation so that the pre-grasp position of the hand can perfectly fit the profile of the object. Apparently, finding an optimal pre- grasp position for each object can greatly increase the cognitive load for a prosthetic hand user. Together with excessive training, it can significantly discourage them to use robotic prosthetic hands with PR control. Moreover, the amount of improvement by training is not guaranteed since the ADLs involve a much uncontrollable environment compared with training classes or laboratory environment.

Therefore, the preshaping capability demonstrated in this work is a simple and effective way to improve the tolerance for maintaining the stability and quality of the multi-finger grasps (i.e., pinch, power grasp), especially with a prosthetic hand operated using a PR control system in real life.

B. Multi-Stage Grasps

There are potentially many more combinations of grasps that allow different multi-stage grasps in addition to the ones demonstrated this work. Besides, not only two-stage but also three-stage grasps are possible to suit the specific needs of each prosthetic hand user, which can greatly augment the dexterity and capability of the hand in terms of grasping diversity.

The use of multi-stage grasps is expected to be a personal choice based on the preferences of a user since each user has individual needs in practice. The number of needs can affect the amount of practice required and consequently affect the proficiency when it comes to operating multi-stage grasps.

C. Besides, proficiency

in using PR control for separate gestures is a pre-skill for a user, which can greatly affect their confidence and aspiration to achieve multi-stage grasps. As the relevant techniques advance, PR control is expected to become more popular in clinical settings with more efficient training procedures developed by joint efforts among all the stakeholders such as users, therapists, prosthetists, medical doctors, researchers, and engineers. This will significantly help users to comfortably learn and master PR control.

CONCLUSION

In this work, a 3D printed soft robotic hand with embedded soft sensors, intended for prosthetic applications, is developed to efficiently operate with pattern recognition based myoelectric control systems. Pneumatic chambers are designed to be embedded within the fingers and thumb, working as flexure hinges for the joints and soft position sensors simultaneously. The whole hand can be 3D printed monolithically and require minimal post-processing for the addition of its embedded sensors. These characteristics are significant a bionic for a bionic device that is required to be lightweight and anthropomorphic. The mechanical structure of the hand was fabricated by using a low-cost and open-source 3D printer.

With the addition of position sensors, self- collision can be avoided and therefore the neutral fully-opening position can be eliminated for switching between different gestures. This makes the transition between hand gestures much faster, more efficient, and more intuitive as well. Besides, initial contact detection of each finger/thumb is enabled to achieve preshaping of multi-finger grasps (i.e., tripod grip and power grasp). This can considerably alleviate the issue of grasp instability due to a grip force imbalance which is the result of the fingers of the hand reaching the hand at different times. The inclusion of preshaping allows the hand to achieve form closure of a grasped object readily, which greatly improves the stability and quality of the hand grasps.

References

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Last but not least, the free transition between gestures allows the hand to perform multi-stage grasps by combing different grasp types sequentially so that the hand is not limited to carrying or holding one object at a time, which improves the hand's dexterity and grasping diversity, rendering this soft robotic hand one step closer to its biological counterpart.

Future work aims to optimize the soft robotic hand in terms of grip strength, grip speed, and lifespan. Also, the motor-pulley system will be upgraded and the self-collision avoidance routine will be repeatedly tested to ensure that the hand's grip time does not exceed the response time of the fail-safe procedure. The real-time internal processing of data will be optimized to make sure it is compatible with specific PR control systems. To translate the hand for prosthetic use in practice, its reliability and robustness will be investigated through an interactive design process to be guided by clinical trials.

ABOUT THE EVENT

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ABOUT THE DEPARTMENT

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