PILLAI COLLEGE OF ENGINEERING

DEPARTMENT JOURNAL

Electronics & Telecommunication Engineering

IOT

DEC 2023

FROM PRINCIPAL'S DESK

I'm delighted to acknowledge the significant contribution of both the faculty and students in the Electronics and Telecommunication department for collaboratively creating a groundbreaking journal. This publication stands out as an impressive showcase of diverse technological advancements in electronics and telecommunication.

In today's rapidly evolving engineering landscape, continuous discovery and advancement are paramount, demanding the highest levels of imagination. To achieve meaningful goals, the current generation needs to find new and creative approaches to learning. I'm committed to providing an environment that supports both academic and creative learning opportunities for our students.

The journal has surpassed my expectations, reflecting the dedication and talent within the department. I extend my best wishes to the staff and students, hoping for continued success in their future endeavors.

Dr. Sandeep Joshi
Principal
Pillai College of Engineering

FROM HEAD OF THE DEPARTMENT'S DESK

Promoting a culture of continuous learning is a hallmark of Pillai College of Engineering. It fills me with great pride as the Electronics and Telecommunication department releases this latest issue of our department journal. The insightful content provided gives us a deep dive into the diverse interests within our department, showcasing the creative potential and originality of both our students and faculty.

I extend my heartfelt appreciation to the students for their exceptional dedication and outstanding work. Their ability to create remarkable projects while maintaining a focus on cost-effectiveness reflects a crucial aspect of sustainable initiatives.

The papers submitted to the journal serve as a testament to the students' dedication and efforts. I commend the journal committee for ensuring that the earnest work of our students is both noticeable and widely appreciated throughout the college through the publication of the journal. As our students embark on various paths in life, I hope they continue to discover innovative approaches.

Wishing all the students the very best in their future pursuits.

Dr. Avinash Vaidya
Head Of Department
Electronics and Telecommunication Engineering

FROM TEACHER'S DESK

The annual journal of the Electronics and Telecommunication department serves as a showcase for our students' proposals, providing a platform for their ideas to be presented to the entire campus. The papers written by students become a valuable repository of knowledge for others to explore. The Journal committee deserves immense appreciation for their tremendous efforts. Not only did they plan and organize the reports, but they also assisted students in the article-writing process. Their commendable punctuality in completing the work is noteworthy. The technical papers submitted this year reflect the creativity in our students' thinking, indicating a promising future.

I extend my best wishes to the committee and eagerly anticipate more outstanding issues of this journal in the future.

Prof.Jayashri Bhosale
Assistant Professor
Electronics and Telecommunication Engineering

VISION AND MISSION

INSTITUTE VISION :

Pillai College of Engineering (PCE) will admit, educate and train in technology, a diverse population of students who are academically prepared to benefit from the Institute's infrastructure and faculty experience, to become responsible professionals. It will further attract, develop and retain, dedicated, excellent teachers, scholars, scientists and professionals from diverse backgrounds whose work gives them visibility beyond the classroom and who are committed to making a significant impact in the lives of their students and the community.

INSTITUTE MISSION :

To develop professional engineers with respect for the environment and to make them responsible citizens, both from a local and global perspective. This objective is fulfilled through quality education, practical training, research, entrepreneurship and interaction with industries and social organizations.

DEPARTMENT VISION :

Strive towards producing world class engineers who will continuously innovate, upgrade telecommunication technology and provide advanced, hazard-free solutions to the mankind.

Inspire, educate and empower students to ensure green and sustainable society.

DEPARTMENT MISSION :

Benchmarking against technologically sound global telecommunication institutions with a view towards continuous improvement.

Continually exposing students to scenarios that demand structuring of complex problems and proposing solutions.

Educate students and promote values that can prevent further degradation of our planet.

Becoming responsible citizens genuinely concerned with and capable of contributing to a just and peaceful world.

INSTITUTAL OBJECTIVE

To evolve a teaching-learning process where by students have freedom of thought and thereby explore the various aspects of technological development.
To encourage the teaching faculty to pursue research in specialized and emerging areas of technology and develop their skills to impart that knowledge to students.
To provide the requisite infrastructure including workshops, Library and IT laboratories to create a learning environment.
To promote the interaction of students and faculty with the industry.
To collaborate with other leading institutions in India and overseas to gain improvement for the lives of all global citizens.

DEPARTMENT OBJECTIVE & OUTCOME

PROGRAM EDUCATIONAL OBJECTIVE :

Provide graduates with a strong foundation in mathematics, science and engineering fundamentals to enable them to analyze and solve challenging problems in Electronics and Telecommunication Engineering.
Impart analytic and thinking skills to develop innovative ideas in the field of Telecommunication Engineering.
To keep students up to date with the latest advancement in the field of Electronics and Telecommunication
Inculcate qualities of leadership skills, multi-disciplinary team work and an ability to adapt to evolving professional environment in the field of Engineering and Technology.
To create awareness among the students towards ethical, social and environmental issues in the professional career.

PROGRAM SPECIFIC OUTCOMES :

Able to understand the concept of Basic Electronics, Network and Circuit Analysis, Analog and Digital circuits, Signals and System, Electro magnetics and apply them in various areas like Microwave Engineering, Wireless Communication, Digital image processing, Advance Communication systems etc.
Able to use techniques, skills, software, equipments and modern engineering tools necessary for Electronics and Telecommunication Engineers to identify, formulate and solve problems in industries and research work.
Able to work in multi disciplinary environment to provide socially acceptable technical solutions for complex communication engineering problems.

INDEX:

IoT-Based Gas Leakage Detection and Alert System Using Rasberry pi 4

Siddhraj Sawant, Ganesh Waghmode, Jignesha Wavare, Prof. Suchitra Patil

Abstract: **The Gas Leakage Detection and Alert System is a vital safety and security solution designed to address the dangers associated with gas leaks in various environments, such as homes, industries, and commercial spaces. This system combines sophisticated technology with an array of sensors, including the MQ2 gas sensor, to monitor the presence ofhazardous gases like LPG, methane, and propane. Upon gas detection, the system activates a multi-tiered response mechanism, including visual and auditory alerts through LEDs and buzzers to immediately warn occupants of potential threats. In addition to local alerts, the system is integrated with IoT platforms and cloud-based services to enable remote monitoring and notifications. The system sends real-time updates to mobile devices through applications like Push bullet, enabling users to receive immediate notifications, even when away from the premises. Furthermore, an embedded GSM module allows the system to make phone calls and send text messages to predefined contacts, ensuring that occupants are promptly informed of gas leak incidents.**

I. INTRODUCTION

The Gas Leakage Detection and Alert System is an advanced security and safety solution designed to address the critical issue of gas leaks in various environments, including residential, commercial, and industrial spaces. Gas leaks, such as those involving liquefied petroleum gas (LPG), methane, and propane, pose significant threats to life, property, and the environment. Therefore, the development of a comprehensive detection and alert system is of paramount importance. This system leverages state-of-the- art technology, including gas sensors such as the MQ2 sensor, to continuously monitor the air for the presence of hazardous gases. When a gas leak is detected, the system triggers a sequence of alerts, which includes audible warnings through integrated buzzers and visual notifications using LEDs. Beyond local alerts, the Gas Leakage Detection and Alert System is equipped with the capability to connect to the Internet of Things (IoT) platforms and cloud services, allowing for remote monitoring and real-time notifications.

II. LITERATURE REVIEW

Subramanian M Athish developed a model to detectgas leakage with a push notification feature. The system uses a lighter that releases a gas we want to detect and for this, he is using an MQ2 sensor. As the gas is leaked the Buzzer light is turned on and a notification from the push bullet is sent to the user. According to the author of this paper, commonly used as a fuel in homes, companies, and automobiles. The United States Bureau of Mines investigated gas in 1910, initially developed by Dr. Walter Snelling, to see if there was any explanation why it dispersed so quickly, discovered that the vanishing gasses were propane, butane, and other light hydrocarbons. Both LPG and gaseous petrol are naturally friendly and may be easily distinguished. These gasses are usually stored in pressurized steel chambers in a fluid frame, where they dissolve at normal temperatures. LPG is heavier as a result of the air correlation; it flows down the floor and settles into cozy depression regions, making it difficult to disperse. According to Chaitali Bag we, GSM is an extension often internet notion. GSM refers to the use of the internet to connect multiple physical devices. Sensors are wired together in a physical device. The data collected was sent across the internet from one device to another. Using the GSM principle, the author created a novel gas alert system

III. METHODOLOGY

The system overview is presented in this Section. Gas leakage detection and alert system. when gas is detected through the sensor it will display on the LCD a buzzer and LED will start an Alert message and a Call will be sent to the defined phone number in the program.

A. System Architecture:

The methodology employed in the Gas Leakage Detection and Alert System centers around a comprehensive approach to effectively identify gas leaks and provide timely warnings. It involves several crucial steps, commencing with the strategic placement of gas sensors, such as the MQ2 gas sensor, in areas prone to gas leaks. These sensors continuously monitor the surroundings and are meticulously calibrated to detect specific types of gases commonly found in residential andindustrial settings The acquired data is then processed by a microcontroller unit (MCU) that meticulously analyzes it to detect irregularities or elevated gas levels indicative ofa potential leak. When a gas leak is identified, the system triggers a range of alert mechanisms, including visualsignals using LEDs, auditory alerts through a buzzer, and communication with an embedded GSM module. Furthermore, the system leverages IoT integration and cloud technology, enabling remote monitoring and real-time data access. Users are instantly notified via mobile applications like Pushbullet, which provide them with critical updatesabout gas leaks, whether they are on-site or not. The system also can send SMS messages and make phone calls to pre-defined contacts to deliver urgent gas leak alerts.

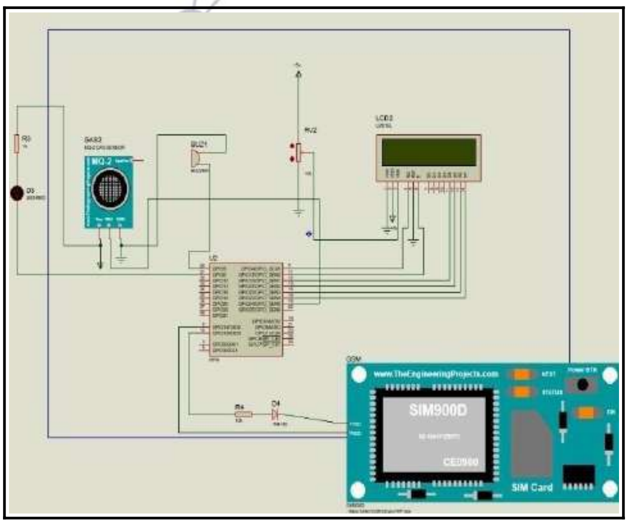


Fig.3.1: Proposed System architecture

A. Proposed System Architecture

The proposed system architecture for the Gas Leakage Detection and Alert System represents a significant advancement in enhancing gas safety measures for residential and industrial applications. At its core, the system incorporates state-of-the-art gas sensors, such as the MQ2 sensor, distributed strategically throughout the monitored area. These sensors collect real-time data on gas concentrations and transmit it to a central Raspberry Pi 4, serving as the system's processing and control unit. The Raspberry Pi 4, equipped with the necessary software, conducts continuous data analysis and gas leak detection. It interfaces with various output mechanisms, including LEDs and a buzzer, to provide immediate visual and auditory alerts in the event of a gas leak. The proposed architecture also integrates a GSM module, enabling the system to communicate remotely with usersand external services. Through the GSM module, the systemcan send SMS alerts to predefined contacts and initiate phone calls to deliver urgent notifications, ensuring that responsible individuals are alerted promptly. Additionally, the system leverages IoT connectivity to enable remote monitoring via cloud platforms. Users can access real-time data and receive alerts on their mobile devices through applications like Push bullet, providing them with criticalinformation even when they are away from the monitored location. This architecture highlights the adaptability of the system and scalability making it suitable for various settings from home to industries. By combining advanced gas sensing technology, rapid alert mechanisms and seamless data communication, the proposed system architecture aims to significantly enhance gas safety measures and minimize potential risks associated with gas leak incidents.

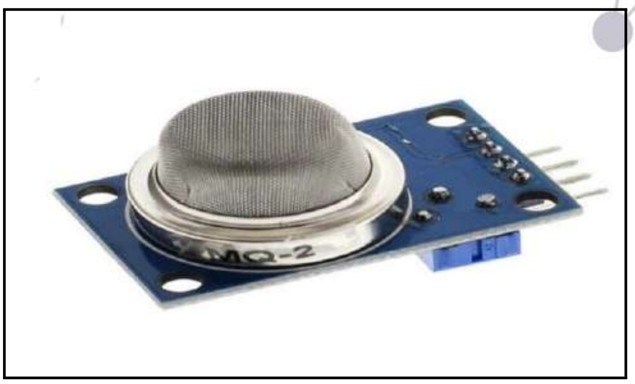


Fig.3.2: MQ2 Sensor

The following shows the diagram for the network we created:

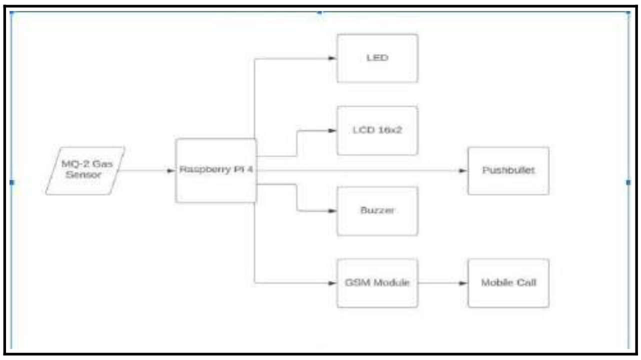
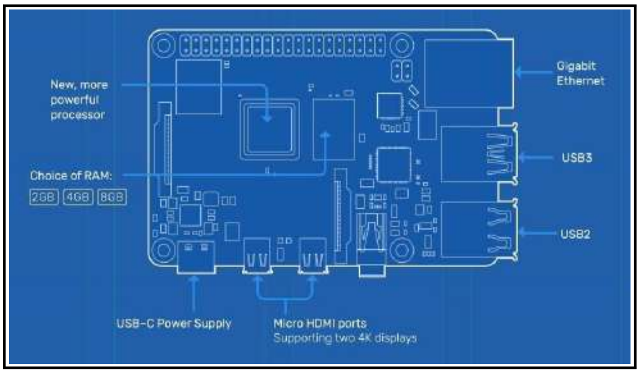


Fig 3.3 Basic block diagram

The above diagram shows:
1) Five MQ-2 gas sensors are connected to Raspberry Pi 4 which can detect LPG gas. The MQ2 gas sensor operates on 5V DC and consumes approximately 800mW. It can detect LPG, Smoke, Alcohol, Propane, Hydrogen, Methane, and Carbon Monoxide concentrations ranging from 200 to 10000 ppm.2)LCD 16x2. 3)Buzzer. 4)GSM Module.

B. Hardware and Software Specifications:
The experiment setup is carried out on a computer system that has different hardware and software specifications as given in Fig 3.4 and Fig 3.5 respectively.



Raspberry Pi 4B: The Raspberry Pi is a single-board, low-cost, high-performance computer that enables endless possibilities for physical computing and exploring the Internet of Things (IoT). It can be used for various purposes like programming, gaming, media center, home automation, etc. It has several models, including the Pi 4, Pi 3, Pi Zero and Pi Compute Module, each with different specifications and capabilities suited for various applications. LCD Display: A display is used to show the status of the device, the remaining quantity of pills in the box, and the time for the next dose. A typical display is a 128 x 64 OLED display. Buzzer: A buzzer is used to generate an alarm or alert sound when it is time for the patient to take their medication. Gas Sensor: A gas sensor is required to detect gas leakage. There are various types of gas sensors available in the market, such as MQ-2, MQ-5, MQ-6, etc. You can choose the one which suits your requirements. GSM Module: A GSM module is required to send an alert message to the user's phone in case of gas leakage or fire detection. Power Supply: A power supply is required to power the gas and fire sensors, microcontroller, and GSM module. You can use a 9V battery or a 12V DC adapter for this purpose.

IV. CONCLUSION

In conclusion, the Gas Leakage Detection and Alert System represents a crucial innovation in ensuring safety and mitigating the risks associated with gas leaks. The system's capability to detect gas leaks in real-time and provide immediate alerts through a combination of visual, auditory, and mobile notifications can save lives and prevent property damage. By integrating advanced gas sensors, a RaspberryPi 4, GSM communication, and IoT connectivity, the system offers a comprehensive and flexible solution suitable forboth residential and industrial applications.

RESULTS

MQ-2 gas sensor detection results are shown below which shows the Gas is detected and an Alert message and call will be sent on a specific phone number:

Fig. 4.1: Notification and call Alert

REFERENCES

[1] Subramanian, M Athish; Selvam, Naveen; Rajkumar; Mahalakshmi, Ram Prabhakar, (2020). [IEEE 2020 Fourth International Conference on Inventive Systems and (ICISC) - Coimbatore, India (2020.1.8- 2020.1.10)] 2020 Fourth International Conference on Inventive Systems and Control (ICISC) - Gas Leakage Detection System using IoT with integrated notifications using Push bullet- 359–362. doi:10.1109/ICISC47916.2020.9171093.

[2] Mallik, Avijit, et al. "IoT Utilized Gas-Leakage Monitoring System with Adaptive Controls Applicable to Dual Fuel Powered Naval Vessels/Ships: Development & Implementation." Cybernetics and Information Technologies 20.1 (2020): 138-155.

Smart Circuit and Fire Prediction System

Viraj Rane, Suyash Shinde, Aniket Nawale, Sai Mulik, Prof. Sweta Waghmare

Abstract: The Smart Circuit and Fire Prediction System is an innovative project that harnesses the power of advanced Machine Learning techniques and state-of-the-art sensor technology to predict and prevent circuit faults and fire incidents in real-time. By deploying a diverse array of sensors and continuously monitoring electrical parameters, this system proactively identifies fault patterns, enabling early detection and intervention. The integration of Machine Learning not only enhances the system's efficiency but also ensures scalability, making it a groundbreaking solution for enhancing safety and reliability in electrical systems, especially in high-risk fire-prone environments. This project represents a significant milestone in the domain of circuit fault and fire detection, offering real-time, data-driven insights and proactive measures to safeguard lives and property.

I. INTRODUCTION

The Smart Circuit and Fire Prediction System is a groundbreaking initiative, focusing on strengthening the safety and reliability of electrical power transmission networks. By combining real-time data monitoring and machine learning analysis, it not only identifies short-circuit faults and fire hazards in advance but also classifies them for more precise intervention. This proactive approach ensures uninterrupted power supply, significantly reducing downtime and operational disruptions. Moreover, the system's capacity to precisely pinpoint fault locations allows for swift and efficient maintenance, further enhancing system reliability. By prioritizing safety and optimizing operational efficiency, this project not only benefits operators but also end-users who can rely on a consistently reliable power supply, even in the face of potential electrical hazards. This project marks a significant leap forward in the domain of electrical power transmission safety and efficiency.

II. LITERATURE REVIEW

In the first set of papers, Mr. Abdare Mahesh Ishwar, Mr. Borase Mayur Santosh, Mr. Patil Vaibhav Champalal, and Prof. Rokade J.R. introduced a microcontroller-based electronic circuit breaker with three Current Transformers (CTs) for precise load management. This innovation enhances safety but requires technical expertise and may pose cost constraints for some projects.

[2]Mengjiao Wang, Xinlao Wei, and Zhihang Zhao also employed a similar electronic circuit breaker with three CTs for load identification and safety improvement. However, like the previous paper, it demands technical expertise and potential budget considerations.

Simon W. Pallam, Rilwan Usman, David W. Michael, and Matthew K. Luka introduced an electronic distribution board with a PIC16F877A microcontroller and Solid State Relays to address traditional circuit breaker shortcomings. Nonetheless, their paper lacks comparative performance analysis and benchmarking data, making it challenging to assess the system's reliability.

[2][5]Qian Chen, Guogang Zhang, Jingcun Liu, Yingsan Geng, and Jianhua Wang presented a novel early fault detection method using the Wavelet Transform and zero prediction via recursive least square (RLS). Although their approach promises rapid detection, the paper also lacks comparative analysis and benchmarking, limiting the assessment of its practical effectiveness.

III. METHODOLOGY

Additionally, the Smart Circuit and Fire Prediction System will incorporate machine learning algorithms to continuously analyse sensor data trends, allowing for the early detection of potential circuit faults or fire hazards. It will also provide users with actionable insights to prevent accidents and ensure electrical system safety. The system's versatility will make it suitable for both residential and industrial applications, offering a proactive and reliable approach to electrical system monitoring.

A. System Architecture

The methodology underpinning the Smart Circuit and Fire Prediction System is a structured, multi-step process dedicated to enhancing electrical circuit safety and mitigating fire risks. It commences with the deployment of a network of high-precision sensors that actively gather real-time data, encompassing crucial electrical performance metrics and environmental conditions. Subsequently, meticulous data preprocessing and feature extraction procedures are executed to ensure data quality, laying the foundation for the development of advanced machine learning models.

The heart of the system lies in the machine learning models, which are trained on historical data and real-world scenarios to identify patterns and anomalies associated with potential short circuits and fire risks. Real-time monitoring and alerting capabilities integrated into the system continually

assess circuit health, triggering alerts when significant deviations or potential threats are detected. The system is designed to adapt and learn from new data, ensuring it remains effective in changing conditions. Field testing in diverse environments and real-world usage scenarios is pivotal in assessing the system's performance and provides invaluable insights for fine-tuning accuracy. User training and meticulous deployment preparations are vital for ensuring successful operation. Furthermore, a proactive maintenance and upgrade strategy is in place to uphold the system's reliability and its adaptability to changing conditions. In summary, this methodology offers a holistic approach to elevate safety, minimize risks, and usher in a new era of circuit monitoring.

B. Proposed System Architecture

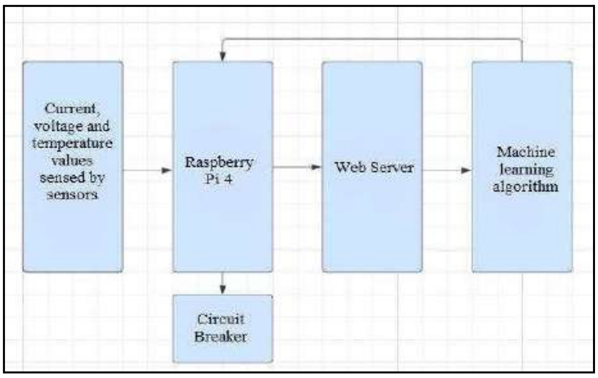


Fig 3.1 Proposed System Architecture

The Smart Circuit Prediction System is a pioneering solution for short circuit prediction in circuit breakers. It relies on advanced machine learning techniques to automate the monitoring and predictive processes, eliminating the need for human intervention. Equipped with high-precision sensors, this system continuously gathers real-time data on circuit performance, which machine learning algorithms analyse to identify patterns and foresee potential short circuits. What sets this system apart is its automatic detection capabilities, swiftly responding to deviations from expected behaviour. Moreover, its adaptive nature enables it to continuously learn and improve over time, further enhancing its accuracy and reliability. By enabling early and precise short circuit predictions, it reduces the risk of equipment failure and costly downtime, offering the potential to transform how circuit breakers are managed.

Central to this system's innovation is its utilization of advanced machine learning techniques to revolutionize short circuit prediction. High-precision sensors play a critical role by monitoring voltage, current, temperature, and other parameters, delivering a wealth of data for machine learning algorithms to process. A key advantage of the system is its automatic short circuit detection, triggered when significant deviations are detected, allowing for swift protective measures without human intervention. Furthermore, the system's adaptability ensures it remains effective in the face of changing conditions and evolving parameters, making it a dynamic and responsive solution for circuit monitoring and maintenance.

In conclusion, the Smart Circuit Prediction System represents a major leap forward in predicting short circuits within circuit breakers. Its integration of high-precision sensors and advanced machine learning allows for automated and highly accurate predictions, significantly enhancing safety and minimizing the risks associated with electrical circuits. This system has the potential to revolutionize circuit breaker monitoring by offering an efficient, cost-effective, and reliable approach to maintaining and operating these critical electrical components.

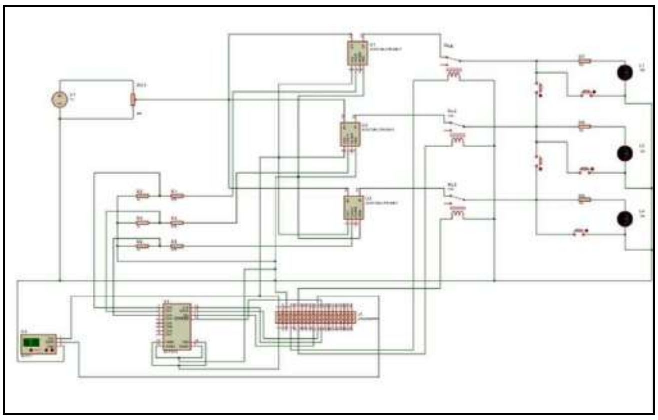


Fig.3.2: Implementation Diagram

The Raspberry Pi serves as the central control unit in this setup, while the ACS712 current sensor plays a crucial role in measuring current. The ACS712 sensor has three pins: VCC for power, OUT for output, and GND for ground. The connections on the breadboard facilitate the exchange of data and power between the Raspberry Pi and the ACS712 sensor, enabling the Raspberry Pi to gather real-time current information and make informed decisions based on that data. Additionally, the relay is integrated into the system, allowing the Raspberry Pi to control external devices such as switches or appliances, creating a versatile and responsive electronic system.

C. Hardware and Software Specifications

The experiment setup is carried out on a computer system which has the different hardware and software specifications as given in Fig 3.3 respectively.

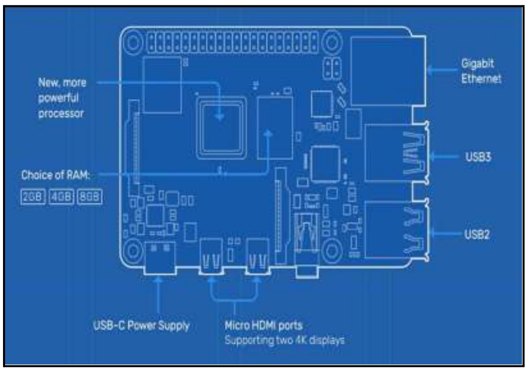


Fig. 3.3: Hardware details (Raspberry Pi 4)

Broadcom BCM2711, Quad core Cortex-A72 (ARM v8) 64bit SoC @ 1.5GHz.1GB, 2GB, 4GB or 8GB LPDDR4-3200 SDRAM (depending on model). 2.4 GHz and 5.0 GHz IEEE 802.11ac wireless, Bluetooth 5.0, BLE.Gigabit Ethernet. 2 USB 3.0 ports; 2 USB 2.0 ports. Raspberry Pi standard 40 pin GPIO header (fully backwards compatible with previous boards). 2 × micro-HDMI ports (up to 4kp60 supported). 2lane MIPI DSI display port. 2-lane MIPI CSI camera port. 4pole stereo audio and composite video port. H.265 (4kp60 decode), H264(1080p60 decode, 1080p30 encode). OpenGL ES3.1, Vulkan 1.0. Micro-SD card slot for loading operating system.

IV. RESULTS

The incorporation of machine learning techniques into our detection system has yielded compelling results, surpassing the conventional method of using fixed threshold values for fault detection. Through our comprehensive analysis, we have conclusively demonstrated that machine learning significantly enhances the system's versatility and accuracy in predicting and identifying faults within the electrical circuit. Unlike traditional fixed threshold approaches, machine learning allows for a more dynamic and adaptable system, capable of continuously learning from diverse data patterns. This adaptability results in a far more accurate and versatile detection model, enabling proactive identification of faults, particularly in complex and evolving scenarios. Our findings underscore the pivotal role of machine learning in advancing fault detection systems, promising a more robust and responsive approach to ensuring electrical circuit safety and reliability.

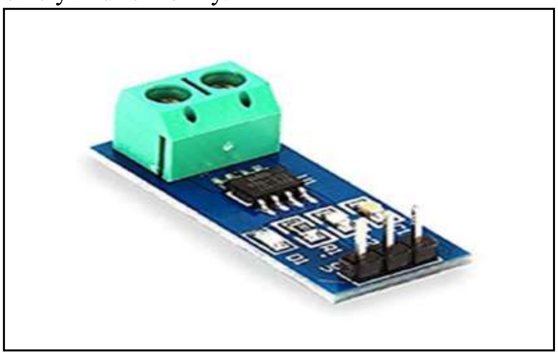


Fig. 3.4: ACS712 Sensor

The ACS712 current sensor is a Hall effect-based device designed to measure both AC and DC current. It comes in various models with different sensitivity ratings, typically ranging from 5A to 30A. The sensor offers a linear analog output voltage that varies proportionally with the current being measured. Additionally, it is available in both unidirectional and bidirectional versions, allowing for flexibility in different applications.

Software Used: -

Thonny IDE is an integrated development environment designed to simplify the process of writing and managing code for microcontrollers and embedded systems. It provides a user-friendly interface that allows developers to write, edit, and test their code efficiently. Thonny is particularly valuable for beginners as it streamlines the setup process for microcontrollers like the Raspberry Pi Pico W. With features like code highlighting, code completion, and an integrated Python interpreter, Thonny aids in the development of the project's code, making it easier for developers to work with the microcontroller and sensors. Thonny simplifies the programming workflow, enabling developers to focus on the project's functionality.

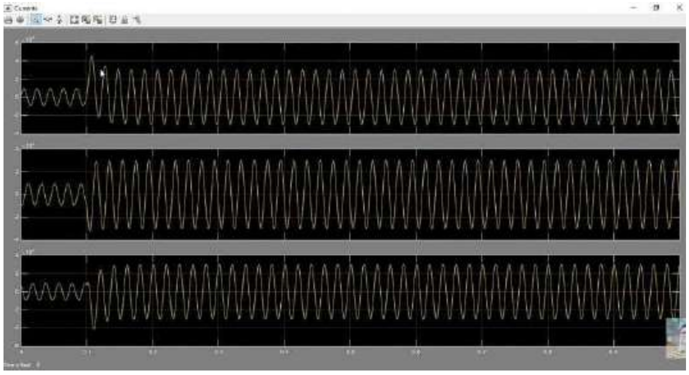
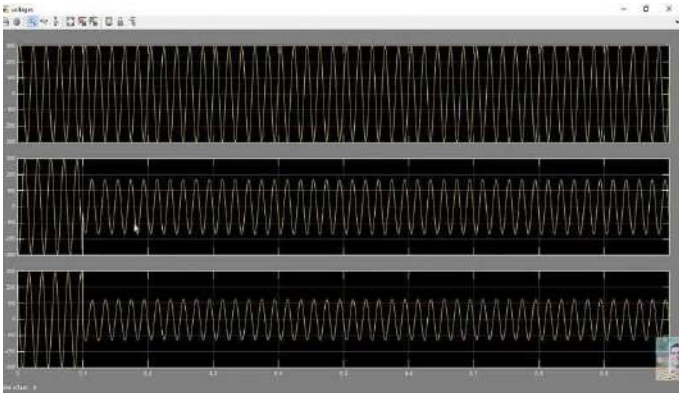


Fig. 3.5: Current Fluctuation During Short Circuit

Fig. 3.6: Voltage Fluctuation During Short Circuit



```
Predicted values:
[[1. 0. 0. 1.]
 [0. 1. 1. 0.]
 [0. 0. 0. 0.]
 ...
 [1. 0. 1. 1.]
 [1. 1. 1. 1.]
 [0. 1. 1. 1.]]
Cross-checking - Actual vs. Predicted for a few samples:
Sample 239:
Actual: [1 0 1 1]
Predicted: [1. 0. 1. 1.]
==============================
Sample 1950:
Actual: [1 1 1 1]
Predicted: [0. 1. 1. 1.]
==============================
Sample 2083:
Actual: [0 0 0 0]
Predicted: [0. 0. 0. 0.]
==============================
Sample 460:
Actual: [0 0 0 0]
Predicted: [0. 0. 0. 0.]
==============================
Sample 1273:
Actual: [0 0 0 0]
Predicted: [0. 0. 0. 0.]
==============================
Model Accuracy Score : 86.05 %
```

Fig. 3.7: Machine learning Model Training

V. CONCLUSION

The Smart Circuit and Fire Prediction System represents a significant milestone in the field of circuit fault and fire detection. Its innovative approach combining advanced sensor technology and Machine Learning not only enhances the efficiency of electrical system monitoring but also brings about a paradigm shift in how we approach safety in high-risk environments. This project underscores the importance of preventive measures in safeguarding lives and property. By identifying potential issues at an early stage, it reduces the risk of fire incidents and their associated devastating consequences. Moreover, the scalability of the system means it can be implemented across a wide range of applications and industries. In conclusion, the Smart Circuit and Fire Prediction System is a groundbreaking solution that offers real-time, data-driven insights and proactive measures to enhance safety and reliability in electrical systems. It is poised to make a lasting impact in minimizing the risks associated with circuit faults and fire incidents, ultimately contributing to the protection of lives and property

.REFERENCES

[1] Lou, Y.; Zha, Z.; Li, Z.; Wan, L. Delayed Current Zero Crossing Characteristics for Circuit Breaker Interrupting Short-Circuit Current Following Permanent Single-phase Ground Fault on Short 1000 kV AC Lines. In Proceedings of the 2019 IEEE Asia Power and Energy Engineering Conference (APEEC), Chengdu, China, 29–31 March 2019; pp. 49–54

[2] Wang, H.; Xu, F.; Jiao, D.; Hu, K.; Yu, L.; Zhang, Y. Analysis on the problems of three-phase short circuit current over-limited of 500 kV bus when UHV connected to Beijing power grid. In Proceedings of the 2016 IEEE PES Asia-Pacific Power and Energy Engineering Conference (APPEEC), Xi'an, China, 25–28 October 2016; pp. 581–585.

[3] Ye, L.; Lin, L.Z.; Juengst, K.-P. Application studies of superconducting fault current limiters in electric power systems. IEEE. Trans. Appl. Supercond. 2022, 12, 900–903.

[4] Chae, W.; Lee, J.H.; Kim, W.H.; Hwang, S.; Kim, J.O.; Kim, J.E. Adaptive Protection Coordination Method Design of Remote Microgrid for ThreePhase Short Circuit Fault. Energies 2021, 14, 7754.

[5] Zhang, X.H.; Sheng, S.Q.; Li, F.Q.; Hu, Y.O.; Zhang, W.C.; Pan, Y. Analysis of Limiting Measures of Three-phase Short-circuit Current of 500kV

Air Quality Detection and Purification

Pranav Pillai, Pranav Gavas, Rohan Ramesh, Yogesh Sakore, Dr. Suman P. Wadkar

Abstract: The importance of air quality in the modern world cannot be overstated, with rising concerns about its impact on health and well-being. Poor air quality, characterized by high pollutant levels, can lead to respiratory issues, allergies, and even more severe health problems. Regular monitoring allows for early detection of harmful conditions, enabling timely interventions to protect public health. In this context, our report focuses on a comprehensive system that combines air quality detection and purification, centered around Raspberry Pi 4 and supported by the MQ-9 and MQ-135 gas sensors, GP2Y1010AU0F Dust Sensor, and MCP3008 ADC. The integration of these components, along with the utilization of the Blynk App, forms the backbone of our study. The core of our report revolves around the Raspberry Pi's role in processing this data, calculating air quality indices, and delivering these results to users through the Blynk App. In addition, we address the purification aspect by integrating a HEPA filter. Using the above system various harmful gases like carbon dioxide and carbon monoxide can be detected. The system also helps to detect other air quality indices. The Blynk app allows for access of real-time air quality data, enhancing user convenience and accessibility. Furthermore the data from the Blynk App can be extracted as a CSV file and be used in machine learning algorithms to predict future air quality.

I. INTRODUCTION

The fundamental concept behind the project is to create a state-of-the-art air purifier system employing advanced sensors and technologies to enhance indoor air quality. Key components include the GP2Y1010AU0F Optical Dust Sensor, MQ-9 carbon monoxide sensor, MQ-135 air quality sensor, MCP3008 10-bit ADC, Raspberry Pi 4, HEPA filter, and centrifugal fan. These elements work together to create an efficient air purifier capable of detecting and mitigating pollutants like carbon monoxide, nitrogen oxides, benzene, and ammonia, as well as dust and allergens. The Raspberry Pi 4 processes sensor data, adjusting the fan speed to improve air quality. The project aims to provide a user friendly, practical solution for cleaner indoor air. It will also offer continuous air quality monitoring and recording, allowing remote control via a Blynk-based mobile application. This project's scope encompasses various applications, from enhancing indoor air quality for homes and offices to industrial safety and educational purposes, making it a comprehensive solution for diverse environments

II. LITERATURE REVIEW

A. This paper presents a low-cost system built on theESP8266 NodeMCU board that connects to multiple sensors to measure temperature, humidity, carbon monoxide (CO) concentration, ozone-gas (O3) concentration, and PM2.5 concentration. The air quality data is displayed through Node-RED, which also manages data and sends notifications to users through LINE Notify service. However, the drawback is that the Air Quality Index (AQI) is not calculated from real-time data but relies on average gas concentration values.

B. In this paper, a system is developed using an MQ-2 sensor for carbon monoxide detection. The sensor is calibrated to ensure accurate readings. Data collected in real time is uploaded to a web server via USB, and if the CO concentration exceeds a threshold, a buzzer, LED, and GSM module are triggered to alert the user.

C. This paper focuses on a remote monitoring system usingMQ-7 Carbon Monoxide (CO) and MQ-135 air quality sensors. The system calculates CO2 and CO values in ppm units, displaying them on a device. A buzzer alerts when gas levels reach safety limits.

D. In this study, a single semiconductor metal oxide (MOX) sensor is demonstrated to detect multiple gases effectively at varying concentrations. Adaptive algorithms, including artificial neural networks, improve accuracy in gas identification. The paper also showcases the successful identification of a binary gas mixture of CO and H2, even under humid conditions.

E. This discusses the measurement of air quality usingMQ135 and MQ7 sensors. It emphasizes the importance of measuring air quality for environmental awareness and highlights government initiatives to reduce pollution. The system uses IoT platforms like Thingspeak and Cayenne to create awareness and provides corrected PPM values. Overall, these papers showcase diverse approaches to air quality monitoring and detection, addressing environmental concerns and promoting healthier living conditions.

III. METHODOLOGY

The system overview is presented in this Section.

The methodology of the above system involves the integration of cutting-edge sensors and technologies, data analysis using Raspberry Pi, real-time monitoring through the Blynk App, and air purification mechanisms to comprehensively address air quality concerns.

A. Proposed System Block Diagram

The proposed system architecture offers several advantages over the existing system. It excels in comprehensive air quality monitoring by integrating both the MQ-135 and MQ-9 sensors, providing a nuanced understanding of air quality by measuring volatile organic compounds (VOCs) and carbon monoxide. The inclusion of the Raspberry Pi and the Blynk App enables remote monitoring and control, enhancing convenience and accessibility for users. The Raspberry Pi's processing power facilitates data analysis and storage, allowing for historical data retention and trend analysis. Additionally, the system's air purification capabilities, with a HEPA filter and centrifugal fan, actively remove pollutants when detected. Its versatility extends to various applications, from indoor air quality improvement to environmental monitoring, industrial safety, and smart city integration. The user-friendly Blynk App interface ensures a seamless interaction between users and the system, offering a superior experience compared to simpler systems.

In summary, the "Air Quality Detection and Purification" system's strengths lie in its comprehensive monitoring capabilities, remote accessibility, data analysis, air purification, versatility, and user-friendly interface, making it a robust solution for a range of applications where advanced air quality monitoring and purification are essential.

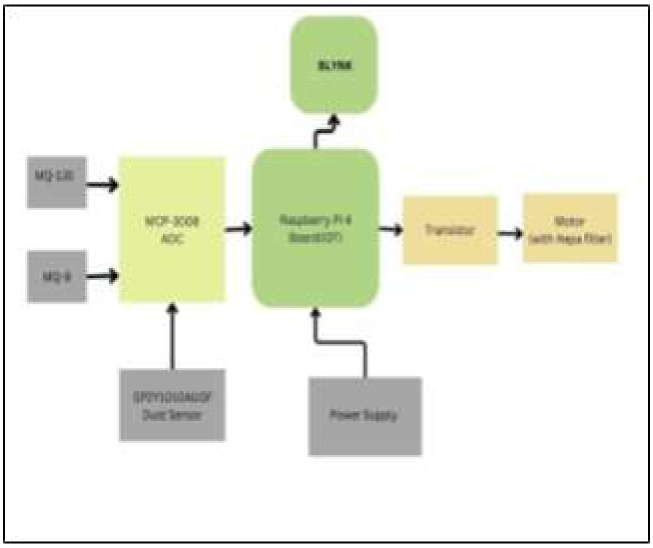


Fig.3.1: Proposed System Block Diagram

B. Circuit Diagram

The circuit diagram presented here embodies a comprehensive gas sensing system that combines the robust capabilities of the Raspberry Pi 4 with the precision and versatility of the MQ-9 and MQ-135 gas sensors. The aim of this setup is to facilitate accurate monitoring of gas concentrations, making it an invaluable tool for various applications, including air quality assessment and environmental monitoring.

The system interfaces two distinct MQ-series gas sensors: the MQ-9 for detecting carbon monoxide (CO) and the MQ135 for the identification of various gases, such as ammonia (NH3), methane (CH4), and carbon dioxide (CO2). These sensors are renowned for their sensitivity and reliability in detecting and quantifying specific gases, and when used in tandem with the Raspberry Pi, they offer real-time monitoring and data analysis capabilities. The analogue output from the MQ-9 and MQ-135 sensors is efficiently converted into digital data through the MCP3008 10-bit Analogue-to-Digital Converter (ADC), ensuring that the signals are suitable for processing by the Raspberry Pi. The MCP3008 connects to the Raspberry Pi via the Serial Peripheral Interface (SPI), streamlining data acquisition and transmission.

The circuit also features a low-pass filter incorporating a resistor and capacitor for the GP2Y1010AU0F dust sensor's LED control. This filter enhances signal stability by minimizing noise, optimizing the quality of the data retrieved from the dust sensor.

Together, these components form a sophisticated, yet practical gas monitoring system. The Raspberry Pi serves as the control unit and data hub, enabling remote data logging, analysis, and visualization. The comprehensive integration of these elements facilitates the systematic measurement and assessment of gas concentrations, making this setup an ideal tool for environmental monitoring and safety applications.

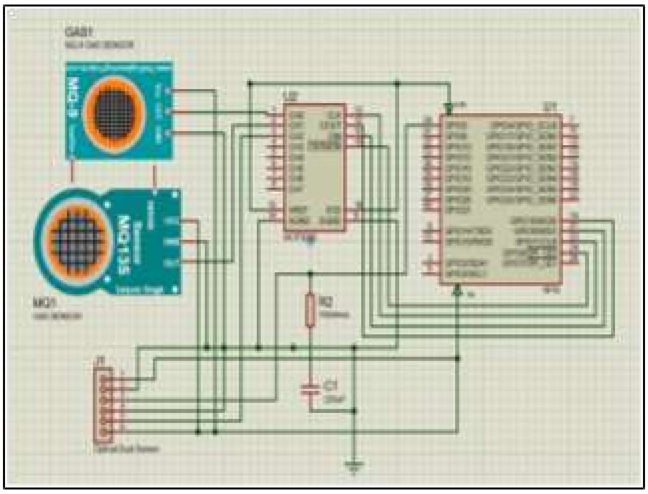


Fig.3.2: Circuit Diagram

C. Hardware and Software Specifications

The major sensors used in the project are mentioned below.

1) Optical Dust Sensor GP2Y1010AU0F

Fig 3.3 Optical Dust Sensor

The Sharp GP2Y1010AU0F is an optical dust sensor renowned for its ability to detect fine airborne particles within the 0.8 to 2.5 micrometer range. Operating on a standard 5V supply voltage, it operates on the principle of light scattering, wherein an integrated infrared LED emits light and a photodetector measures the intensity of light scattered by particles in the air. The sensor provides an analog output voltage that corresponds to the concentration of dust or particles in the environment. This makes it well suited for applications such as air quality monitoring, air purifiers, HVAC systems, and various industrial contexts where real-time particle detection is vital. The sensor's quick response time is advantageous for capturing immediate changes in particle concentration.

2) MQ-9 sensor

Fig 3.4 MQ-9 sensor

The MQ-9 sensor is a type of gas sensor that is commonly used to detect carbon monoxide, methane, and other gases in the atmosphere. It is often used in industrial settings and can also be used in homes for gas leak detection. The sensor works by measuring the electrical resistance of a sensing element when it comes into contact with the target gas. The MQ-9 sensor is typically made up of a ceramic substrate with a metal oxide layer and a heater element. When the target gas comes into contact with the metal oxide layer, it causes a change in the electrical resistance of the sensing element, which is then measured by the sensor's circuitry. The sensor can be connected to a microcontroller or other electronics to provide real-time gas concentration readings.

3) MQ-135 sensor

Fig 3.5 MQ-135 sensor

The MQ-135 sensor is another type of gas sensor that is commonly used to detect a range of gases including ammonia, nitrogen oxides, and a range of other organic and inorganic gases. Like the MQ-9 sensor, it works by measuring the electrical resistance of a sensing element when it comes into contact with the target gas. The MQ-135 sensor typically consists of a ceramic substrate with a metal oxide layer and a heater element. When the target gas comes into contact with the metal oxide layer, it causes a change in the electrical resistance of the sensing element, which is then measured by the sensor's circuitry. The MQ-135 sensor is often used in air quality monitoring systems and can be connected to microcontrollers or other electronics to provide real-time gas concentration readings. It can be used in a range of applications such as detecting gas leaks, monitoring indoor air quality, and monitoring pollution levels outdoors.

IV. RESULTS

The value of CO and CO2 in ppm obtained on the Blynk App is shown below. The dust concentration in air in ppm is also shown.

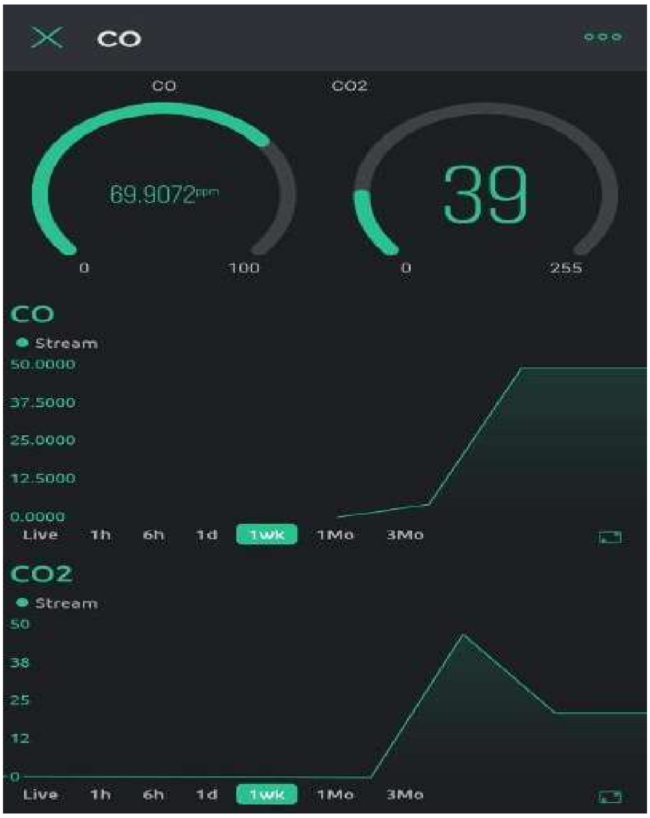


Fig 4.1 CO and CO2 concentration (ppm)

Fig 4.2 Dust concentration (ppm)

CONCLUSION

In conclusion, the "Air Quality Detection and Purification" system represents a significant advancement in the realm of air quality monitoring and purification. The integration of cutting-edge technologies, including the Raspberry Pi, Dust Sensor, MQ-135 and MQ-9 sensors, the HEPA filter, and the Blynk App, empowers this system to provide a holistic solution for enhancing indoor air quality. The Raspberry Pi's processing power enables real-time data analysis and historical data retention. The system's active air purification capabilities, combined with remote monitoring and control through the user-friendly Blynk App, make it a versatile solution with applications in diverse settings, from homes and offices to industrial environments and smart city infrastructure. As environmental concerns continue to grow, this system stands at the forefront of technology-driven solutions, offering a user-friendly, and adaptable approach to air quality improvement, poised to play a pivotal role in ensuring cleaner, safer, and more accessible air quality management in the era of smart and sustainable living.

REFERENCES

[1] S. Chanthakit and C. Rattanapoka, "MQTT Based Air Quality Monitoring System using Node MCU and Node-RED," 2018 Seventh ICT International Student Project Conference (ICT-ISPC), Nakhonpathom, Thailand, 2018, pp. 1-5, doi: 10.1109/ICT-ISPC.2018.8523891.

[2] Singh, Harveet & Abdulla, Raed & Kumar Selvaperumal, Assoc. Prof. Dr. Sathish. (2021). Carbon monoxide detection using IoT. 5. 7-12. Journal of Applied Technology and Innovation (e -ISSN: 2600-7304) vol. 5, no. 3, (2021)

[3] A. A. Ibrahim, "Carbon Dioxide and Carbon Monoxide Level Detector," 2018 21st International Conference of Computer and Information Technology (ICCIT), Dhaka, Bangladesh, 2018, pp. 1-5, doi: 10.1109/ICCITECHN.2018.8631933.

[4] Krivetskiy, Valeriy & Efitorov, Alexander & Arkhipenko, A. & Vladimirova, Svetlana & Rumyantseva, Marina & Dolenko, Sergey & Gaskov, Alexander. (2017). Selective detection of individual gases and CO/H 2 mixture at low concentrations in air by single semiconductor metal oxide sensors working in dynamic temperature mode. Sensors and Actuators B: Chemical. 254. 10.1016/j.snb.2017.07.100.

[5] Rawal, Ramik. (2019). Air Quality Monitoring System. 10.13140/RG.2.2.20471.37282

Safe Ride: An Intelligent Bike Crash Detection System

Shetty Shivani Harish, Jadhav Yash Bhalchandra Patil , Vighnesh Abha , Wairkar Vedant Rajan

***Abstract*—Motorbike accidents are a prevalent concern on roadways, often resulting in severe consequences. Detecting such accidents early is crucial to mitigate their impact. This research paper presents the design and implementation of a motorbike crash detection system aimed at identifying accident severity promptly. The system comprises three key components: sensors for accident detection, a Raspberry Pi Pico for sensor data processing, and a wireless module for user notification. Utilizing accelerometers and gyroscopes, the system monitors the motorbike's orientation, identifying dangerous positions such as oblique angles or upside-down states. In the event of a precarious situation, the Raspberry Pi Pico sends alert messages to the user, potentially via a smartphone app, and notifies emergency services in the case of an accident. Beyond accident detection, the system can monitor driving behavior, offering insights into acceleration, braking, and turning patterns. It is lightweight, portable, long lasting, and minimally disruptive to the bike's operation, ensuring rider safety and accountability.**

***Index Terms*—Real-time Crash Detection, Sensor Technology, Machine Learning Algorithms, Alert Mechanism, Location Information, Monitoring Driving Behavior.**

I. INTRODUCTION

A bike crash detection system stands as a testament to the amalgamation of cutting-edge sensor technology and machine learning algorithms, orchestrated with a singular purpose: to enhance the safety of motorbike riders by swiftly detecting and responding to crash events in real-time. This system epitomizes a paradigm shift in motorbike safety, aligning closely with the ever-evolving landscape of technology-driven solutions. Within this framework, our research paper embarks on an exploration of the intricate components and processes that constitute this groundbreaking technology.

Sensor Setup, where the foundation of the system is laid with the integration of accelerometers and gyroscopes, serves as the first layer of defense, continually collecting data about the bike's orientation and acceleration. The heart of the system resides in the Real-time Monitoring and Machine Learning Algorithms that collectively decipher this sensor data. These algorithms are meticulously trained on an extensive dataset encompassing both normal biking behavior and crash events, empowering them to differentiate between the two with exceptional accuracy through pattern recognition.

Upon detection of a precarious situation, the system promptly activates an Alert Mechanism, capable of sounding alarms, vibrating for rider alertness, or notifying pre designated emergency contacts. Significantly, this notification incorporates precise Location Information, aiding in an expe dited emergency response. Yet, the functionality of this system transcends crash detection, it also encompasses Monitoring Driving Behavior and providing feedback to riders on their actions.

Characterized by its battery-powered, lightweight, and non interfering design, this technology assures users of its seamless integration into their biking experience. This paper encapsulates the essence of this innovative system, highlighting its real-time crash detection, reliability, advanced sensor technology, machine learning algorithms, integration with existing safety features, and user-friendly interface. In doing so, it illuminates the path to a safer, technology-enhanced future for motorbike riders.

II. LITERATURE SURVEY

Jussi Parviainen et al. [1] Proposed a system with three different inertial measurement units which were attached to head, torso of the motorist and to the rear of the motor cycle which could detect the crash and send an automated emergency call and the position of the motorist.

Prathmesh Jadhav et al. [2] system introduced would cut off in the carburetor with the help of electrical system and send the information of over speeding or the accident to the emergency number provided via call or SMS.

Akash Singh et al. [3] proposed application is connected to the hardware system through Bluetooth. the system detects the change in vibrations via vibration sensor, sudden change in the tilt of the vehicle. By verifying these changes along with our developed algorithm, it will decide whether an accident has occurred or not. In case of a confirmed accident the system sends alert messages to the nearest medical teams and also the nearest police stations..

P.Manikandan et al. [4] proposed a e-NOTIFY system that allows immediate detection of traffic accidents and alerting the authorities of the emergency services which would improve the assistance to the injured passengers by reducing the response time of emergency services with the help of relevant combinations of V2V and V2I safety regulations and standards.

A. User Training and Education:

Educate riders on system operation and importance. Instruct on how to respond to alerts.

B. Maintenance and Updates:
Implement a maintenance plan. Perform software updates for system performance and issue resolution.

C.Conclusion:
A well-coordinated implementation process ensures enhanced rider safety and reduced severity of injuries in motorbike crashes. This flowchart outlines the systematic process for implementing a motorbike crash detection system, from data collection to maintenance and updates, with a strong focus on safety and user education.

IV. METHODOLOGY

The methodology employed in the development and implementation of the Motorbike Crash Detection System is underpinned by a carefully orchestrated integration of hardware components and sensors, facilitating swift accident identification and response. In Fig.2, we outline the systematic approach that has been adopted to create this innovative safety technology.

a). Sensor Integration (MPU-6050 Gyroscope + Accelerometer):
The core of the system begins with the integration of MPU-6050 gyroscope and accelerometer sensors. These sensors serve as the vigilant ”eyes and ears” of the system, continually monitoring the motorbike’s orientation and movements. They provide real-time data regarding the bike’s position, detecting any sudden changes, such as tilts or accelerations, which are pivotal in identifying hazardous situations and potential crashes.

b). Data Processing (Raspberry Pi Pico):
The Raspberry Pi Pico, acting as the central processing unit, receives data from the integrated sensors. This microcontroller plays a pivotal role in real-time data analysis. It processes the incoming sensor data to detect unusual patterns or events that may pose risks to the rider, allowing for swift accident detection.

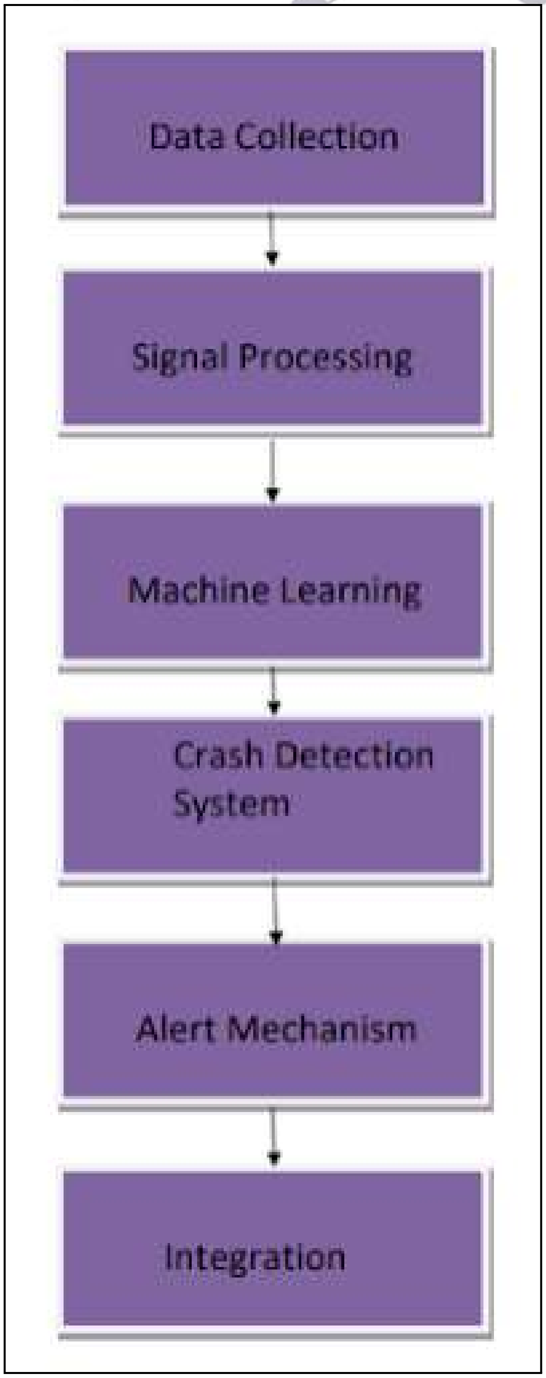


Fig. 1. Implementation Flowchart

c). Wireless Connectivity (HC-05 Bluetooth Module):
The HC-05 Bluetooth module establishes a wireless connection with the rider’s smartphone. This connection serves as a vital link for seamless communication between the motorbike system and the user’s smartphone. It enables the transmission of critical data and real-time

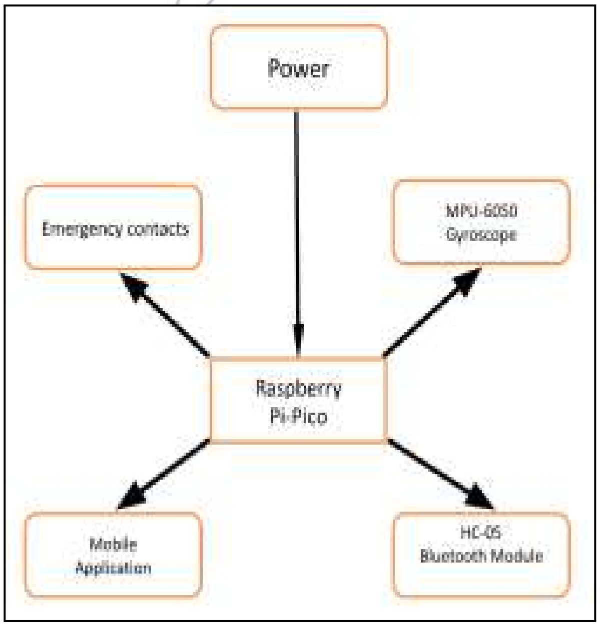


Fig. 2. Proposed Architecture

alerts, ensuring that the rider is promptly informed of potential dangers.

d). Alert Mechanism:
In response to the detection of potential crashes or hazardous situations, the system activates a comprehensive alert mechanism. This mechanism encompasses two primary functions: alerting the rider via their smartphone through the Bluetooth module and notifying nearby emergency services for rapid assistance.

e). Data Logging and Analysis:
The system is equipped with the capability to log crash data for detailed analysis. This data serves multiple purposes, including insights into accident patterns, contributing to safety research, and informing potential system improvements. This feature holds the potential to enhance motorbike safety on a broader scale.

f). Rider Behavior Monitoring:
Beyond crash detection, the system continuously monitors and provides feedback on the rider's behavior. It promptly alerts the rider to any risky behaviors or patterns, such as excessive speed or abrupt braking, thereby encouraging safer and more responsible motorbike riding.

g). User Interface:
The user primarily interacts with the system through a dedicated smartphone app. This app offers a real-time dashboard with critical information, including the bike's current status, alerts, warnings, and feedback on riding behavior. serves as a user-friendly, accessible interface to keep riders informed and safe while on the road.

In summary, the methodology employed in the development of the Motorbike Crash Detection System is a harmonious integration of hardware components, data analysis, and real-time communication. This systematic approach not only enhances rider safety but also encourages responsible riding practices, demonstrating the impactful role that technology can play in fostering safer and more responsible motorbike riding.

V. RESULTS & ANALYSIS

The Fig.3 provides a comprehensive view of the hardware implementation of the motorbike crash detection system. Ensuring continuous functionality, the system is connected to a power bank for a reliable power source and establishes a real time connection with a mobile application via a Bluetooth module, facilitating prompt data transmission in the event of a crash. At the system's core, a gyroscopic sensor continuously monitors the motorbike's angle, enabling the early detection of any significant changes and serving as a crucial safety measure to prevent potential crashes or imbalances. This holistic approach combines power supply, Bluetooth connectivity, and gyroscope technology to create an effective and sophisticated motorbike crash detection and prevention system.

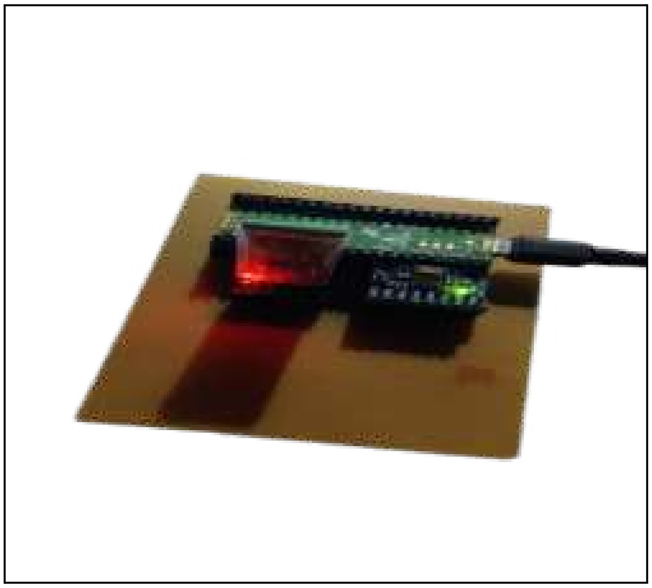


Fig. 3. Hardware implementation prototype

The software application includes a registration page that mandates users to furnish vital information, encompassing their name, phone number, blood group, and emergency contact number. Upon successful registration, users gain the ability to sync their mobile phone with the crash detection system via Bluetooth while riding a motorbike. The system's core function lies in its capability to autonomously identify when the motorbike tilts beyond a predefined angle limit, triggering an immediate warning message on the user's screen. To acknowledge their safety, the user must click the "I'm okay" button within a15-second window of the warning's appearance.

Should this time frame elapse without a response, the user's mobile phone will activate a blaring alarm to alert individuals in the vicinity of the potential accident, concurrently dispatching an SMS to the predetermined emergency contact number, complete with the user's location. This alarm screen also displays the user's registered details, such as their blood group and name, to aid anyone nearby in providing assistance in the event of an emergency.

VI. CONCLUSION

The Motorbike Crash Detection System, featuring the Raspberry Pi Pico, HC-05 Bluetooth module, and MPU-6050 gyroscope and accelerometer, marks a remarkable milestone in motorbike safety technology. With a keen focus on swift and accurate accident detection, it promises to play a pivotal role in mitigating the risks associated with motorbike accidents, potentially saving lives by reducing the severity of accidents. What sets this system apart is its seamless coordination with emergency services, ensuring rapid assistance during critical situations, further enhancing rider safety. Moreover, its role as a vigilant riding companion, promoting responsible riding practices through continuous monitoring and feedback, makes it a versatile tool for road safety enhancement. The user-centric design, emphasizing portability, lightweight construction, and non-disruptive integration with the motorbike's stability, ensures its practicality and reliability. Operating on battery power extends its usability without frequent recharging, making it an unobtrusive and dependable companion for motorbike journeys. This innovative technology represents a significant leap forward in motorbike safety, combining accident prevention with rider awareness, with the ultimate goal of transforming the landscape of motorbike safety and creating a safer environment for riders.

REFERENCES

[1] Parviainen, J., Colliri, J., Pihlstrom, T., Takala, J., Hanski, K., Lumiaho, A. (2014). Automatic crash detection for motorcycles. IECON 2014 - 40th Annual Conference of the IEEE Industrial Electronics Society. doi:10.1109/iecon.2014.7049003

[2] "Speed Control and Accident Alert System For Bikes." By "Mr.Prathmesh Jadhav et al" At National conference on Changing Technology and Rural Development.

[3] Singh, Akash Rajkumar, Rajasekaran. (2019). TWO-WHEELER ACCIDENT DETECTION AND ALERT SYSTEM WITH ANTI-THEFT CONTROL. International Journal of Science and Research (IJSR).

[4] "Bike Crash Detetcion." By "P.Manikandan et al" (2019) At REVA University,Yelahank,Bangalore,(INDIA)

Smart Electricity Meter with Energy Monitoring and Theft Detection

Aaditya Andhale, Anirudh Shylajan, Bhushan Meshram, Pragati Gaikwad Prof.Ameet Mehta.

Abstract-The design of an electricity smart meter depends on the technical requirements of the utility company as well as the customer, meanwhile assisting in facing electricity management and distribution of several challenges. One of those major challenges is electricity theft. Other than typical transmission power losses, considerable extra losses are due to the theft of supplied electricity at the customer premises. Power utilities are looking for means to detect theft and prevent it from occurring. In this paper, smart energy meter system specifications are presented, as a typical model is configured and designed. The system's ability to smart measurement under normal conditions and various theft circumstances is verified via detailed simulation analysis. Several theft techniques have been implemented and the smart energy system detection facility and protection capability are presented and detailed.

Keywords: Meters, Microcontrollers, Monitoring, Internet of Things

I. INTRODUCTION

An IoT based Raspberry Pi Smart Energy Meter is a system designed to monitor and control energy consumption in homes or small businesses using Raspberry Pi as the central processing unit. The system is capable of measuring and analysing the energy usage of different appliances and devices, and providing real-time data to the user through a web-based interface. The smart energy meter utilizes various sensors and modules to monitor the electrical parameters of the energy grid, such as voltage, current, and power. The system collects this data and processes it through an IoT platform, allowing for remote monitoring and control of energy consumption. The IoT based smart energy meter typically consists of sensors that measure the energy consumption of appliances and devices, a Raspberry Pi board to process and transmit the data, and a cloud-based platform to store and analyse the data. The system also consists of theft detection mode. If there is an unusual spike in energy consumption then the system sends messages to the user device. The data can be accessed through a web-based interface or a mobile app, allowing consumers to monitor their energy usage and adjust their habits accordingly.

II. LITERATURE SURVEY

The Internet of Things (IoT) has been a growing trend in recent years, with the ability to connect everyday devices to the internet for remote monitoring and control. The Raspberry Pi is a popular platform for IoT projects due to its low cost and flexibility. The IoT based smart energy meter typically consists of sensors that measure the energy consumption of appliances and devices, a Raspberry Pi board to process and transmit the data, and a cloud-based platform to store and analyse the data. The data can be accessed through a web-based interface or a mobile app, allowing consumers to monitor their energy usage and adjust their habits accordingly. Overall, an IoT based Raspberry Pi smart energy meter is an innovative solution that can help households and businesses become more energy-efficient, reduce their carbon footprint, and save money on their energy bills. Internet of Things (IoT) is a technology that enables devices to communicate and interact with each other over the internet. One popular device for implementing IoT projects is the Raspberry Pi, a low-cost, credit-card sized computer that can run various operating systems and is equipped with various interfaces and connectors to connect sensors, actuators, and other electronic components.

III. EXISTING AND PROPOSED SYSTEM

A. Existing System

The software architecture of a smart electricity meter with energy monitoring and theft detection
typically consists of several components that work together to provide its functionalities. These components may include:

1. Metering Module: This module is responsible for accurately measuring and recording electricity consumption data, such as voltage, current, and power factor. It may also include features such as time-of-use (TOU) metering, which captures data based on different time intervals, and data logging capabilities for storing historical consumption data.

2. Communication Module: This module enables the smart meter to communicate with external systems, such as utility servers or consumer devices, using various communication protocols such as wired (e.g., Ethernet, RS-485) or wireless (e.g., Zigbee, LoRaWAN, cellular) communication. It facilitates data transfer and remote management of the meter.

3. Energy Monitoring Module: This module analyses the consumption data collected by the metering module to provide real-time energy monitoring features, such as visualizing consumption data in graphical charts or providing consumption breakdown by appliance or time period. It may also include features such as load profiling, demand response, and energy usage forecasting.

4. Theft Detection Module: This module uses advanced algorithms and techniques to detect irregularities in electricity usage patterns that may indicate energy theft or tampering. It may analyse data from multiple sources, such as metering data, load profiles, and historical consumption data, to identify anomalies and raise alerts to relevant authorities or utility companies for further investigation.

5. Data Management and Security Module: This module is responsible for securely storing and managing the metering data, consumption data, and other relevant information collected by the smart meter. It may include features such as data encryption, data validation, and access control to ensure the confidentiality, integrity, and availability of the data.

6. User Interface Module: This module provides a user-friendly interface for consumers to access and interact with the features of the smart meter, such as viewing real-time consumption data, setting up energy consumption goals, receiving alerts, and managing energy usage. It may be accessible through web-based portals, mobile apps, or other consumer devices.

B. Proposed System

The proposed system architecture for an IoT-based Raspberry Pi smart energy monitor using Adafruit.IO would involve the following components: 1. Raspberry Pi board: This would serve as the main processing unit and would be responsible for reading data from the energy meter and sending it to the Adafruit.IO cloud platform.

2. Energy meter: This would be connected to the Raspberry Pi board and would provide real-time data on energy consumption.

3. Wi-Fi module: This would enable the Raspberry Pi board to connect to the internet and send data to the Adafruit.IO cloud platform.

4. Adafruit.IO cloud platform: This would serve as the central hub for the energy consumption data and would provide a user-friendly interface for users to view and analyse the data.

5. User interface: This would be a web-based interface that would allow users to view their energy consumption data and analyse it to identify energy saving opportunities.

The flow of data in this system would be as follows:

1. The Raspberry Pi board would read data from the energy meter and send it to the Adafruit.IO cloud platform using the Wi-Fi module.
2. The Adafruit.IO cloud platform would receive the data and store it in a database.
3. Users would access the data through a web-based user interface, which would display the data in an easy-to-understand format.
4. Users could analyse the data to identify energy saving opportunities and take steps to reduce their energy consumption.

Overall, the proposed system architecture for an IoT based Raspberry Pi smart energy monitor using Adafruit.IO is simple, yet effective, and would enable users to track and manage their energy consumption in real-time.

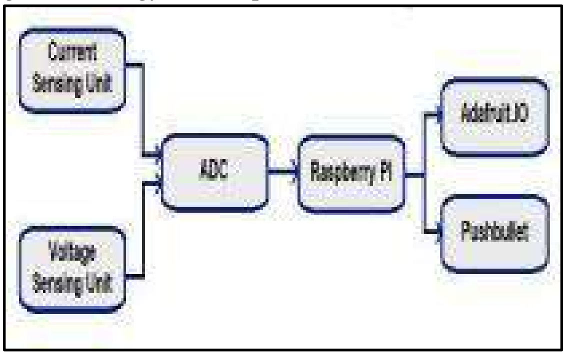


Fig.3. B.1: Proposed System Block Diagram

IV. HARDWARE SPECIFICATION

The major sensors used in the project are mentioned below.

1. SCT-013-030 Non-invasive AC Current Clamp Sensor

Fig.4.1: SCT-013-030 Current Sensor

This is SCT-013-030 Non-invasive AC Current Sensor

Clamp Sensor 30A. SCT-013-000 is a Non-Invasive AC current sensor i.e. it is a current transformer that can be used to measure AC current up to 100 amperes.
This Non-invasive AC Current Sensor clamped around the supply line can measure a load up to 30 Amps, and allow you to calculate how much current pass through it. It can be useful for building your own energy monitor or for building an over-current protection device for an AC load. This current clamp can be used to detect a current of up to 30A. Simply clip it around the current source that you wish to measure and it will produce a (very) small AC voltage proportional to the current. The cable is terminated on one end with a standard 3.5mm jack (like a headphone jack).

2. ZMPT101B voltage sensor

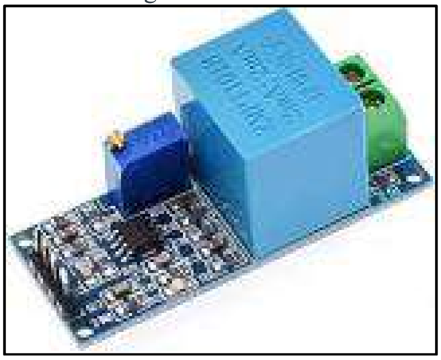


Fig.4.2: ZMPT101B voltage sensor

The ZMPT101B is a voltage sensor module commonly used in electronic projects. It is designed to measure AC voltage in the range of 0 to 250V. The sensor employs a transformer-based design to provide galvanic isolation between the measured circuit and the sensor circuit, enhancing safety. It outputs a low voltage proportional to the input AC voltage, making it suitable for interfacing with microcontrollers and other electronic devices. The ZMPT101B is widely utilized for applications such as voltage monitoring, power quality analysis, and automation systems.

3. ADS1115 ADC 16-bit

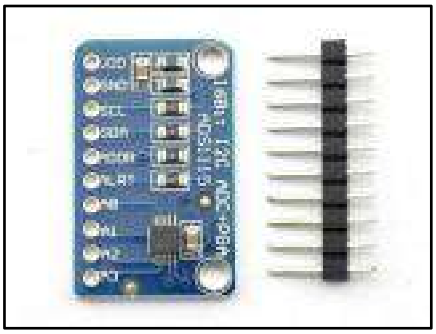


Fig.4.3: ADS1115 ADC 16-bit

The ADS1115 is a 16-bit analogy-to-digital converter (ADC) manufactured by Texas Instruments. It is commonly used to convert analogy signals, such as voltage levels, into digital data for microcontrollers or other digital systems. The 16-bit resolution allows for high precision, meaning it can distinguish small changes in the input voltage. The ADS1115 features four input channels, making it versatile for measuring multiple analogy signals simultaneously. It communicates with microcontrollers through I2C, simplifying integration into various electronic systems.

V. RESULT AND DISCUSSION

A. Result:

1. Energy Monitoring: Present the collected data on energy consumption, including graphs, statistics, and visualizations, demonstrating the effectiveness of the system.

2. Theft Detection: Showcase the results of theft detection, including instances of theft detected during the testing phase, and how Raspberry Pi contributed to these detections.

3. User Interface: If applicable, present the user interface developed for consumers to access and interpret their electricity consumption data. Explain how Raspberry Pi supports this interface.

B. Discussion:

1. Energy Conservation: Discuss the potential benefits of energy monitoring, emphasizing Raspberry Pi's role in data analysis and its impact on energy conservation.

2. Theft Prevention: Explain how the Raspberry Pi based theft detection feature enhances security and prevents electricity theft, saving costs for utility providers and consumers.

3. Challenges and Limitations: Address any challenges faced during the project, specifically related to the use of Raspberry Pi, and discuss the limitations of the smart meter system.

VI. FUTURE SCOPE

Suggest areas for future improvements, enhancements, or additional features that can be added to the smart meter system, considering the potential for further Raspberry Pi integration and advanced capabilities.
Energy Forecasting: Develop predictive models that forecast future energy consumption patterns based on historical data and external factors, such as weather forecasts and user behaviour. This can help users optimize their energy usage. Mobile Applications: Create mobile apps that allow consumers to monitor and control their electricity consumption in real-time, usage alerts, and receive notifications about anomalies or potential theft. User-Friendly Interface: Enhance user interfaces and dashboards to make energy consumption data more accessible and understandable for consumers. Consider incorporating data visualization techniques to improve data interpretation. Cross-Platform Compatibility: Ensure that

the system is compatible with various hardware platforms and communication protocols to facilitate integration with different electricity grids and systems.

VII. CONCLUSION

From the literature review, it is evident that the combination of Raspberry Pi and Adafruit.IO platform provides a flexible and cost-effective solution for the development of IoT-based smart energy meters. The studies reviewed above demonstrate the potential of these technologies for monitoring and controlling energy consumption in homes and other settings. The development of mobile and web apps for real-time monitoring of energy consumption further enhances the usefulness of these systems. Future research could focus on improving the accuracy of energy metering and exploring additional applications of IoT-based energy monitoring systems.

VIII. ACKNOWLEDGEMENT

We would like to express our sincere gratitude to our project guide, Prof. Ameet Mehta, whose unwavering support, valuable guidance, and insightful feedback played a pivotal role in shaping this project. Their expertise and mentorship were invaluable throughout the entire process, and we are truly thankful for their dedication and encouragement. We extend our heartfelt appreciation to the Head of the Department, Dr. Avinash Vaidya, for providing the necessary resources and a conducive academic environment. Their leadership and support have been instrumental in the successful completion of this project, and we are grateful for their trust in our capabilities. We would also like to thank our Principal, Dr. Sandeep Joshi, for fostering an institution that encourages innovation and practical learning. Their vision and commitment to academic excellence have motivated me to embark on this project, and we are appreciative of their continuous support.

IX. REFERENCE

[1] B. K. Sahani, T. Ravi, A. Tamboli, and R. Pisal, "IoT Based Smart Energy Meter", International Research Journal of Engineering and Technology (IRJET), Vol. 04, No. 04, 2017, pp. 96 – 102.

[2] Rashmi M. N., and U. B. Mahadevaswamy, "IOT based Energy Meter Monitoring using ARM Cortex M4 with Android Application", International Journal of Computer Applications, Vol. 150, No.1, 2016, pp. 22 – 27.

COLOR SORTER

Akanksha Rakshe, Priti Patil, Gitanjali Pandey, Simran Thakur Prof. Sweta Waghmare

Abstract- ***In this digital world, color processing in different industries gives us more leverage to solve the consistency problem of continuous manual sorting. This document will be a new approach to continuously detect and classify objects and keep them in a specific place. Color processing attracts a lot of attention since the help of modern technology leads to the possibility of expanding the scope of its application in various areas. The Arduino Uno micro-controller, TCS3200 colour sensor, servo motor, and other electronic components are used to study, develop, and build a colour sorter. This work involves sensors that detect the color of the object and send the signal to the Arduino. The micro- controller sends a signal to the circuitry that drives the various motors to activate the object and place it in the specified location. Based on the detection, everything moves to the specified position releases the object, and returns to the original position. The system is able to quickly classify the object based on its color at the respective color station.***

Keywords- Arduino Uno, Servo Motor.

I. Introduction

In this digital world, continuous manual sorting is a difficult and time consuming process, color sorter processing gives us opportunity to solve this issue in different industries. Machines can perform highly repetitive tasks better than humans. Automating many of the tasks in the industries may help to improve the efficiency of the manufacturing system. The purpose of this model is to design and implement a system which automatically separates products based on their color. To reduce human efforts on mechanical manoeuvring, different types of sorting machines are being developed. A common requirement in the field of color sorting is that of color sensing and identification. The system has the ability to sort the object according to their colors into respective colored cups in minimum time.

II. Block diagram

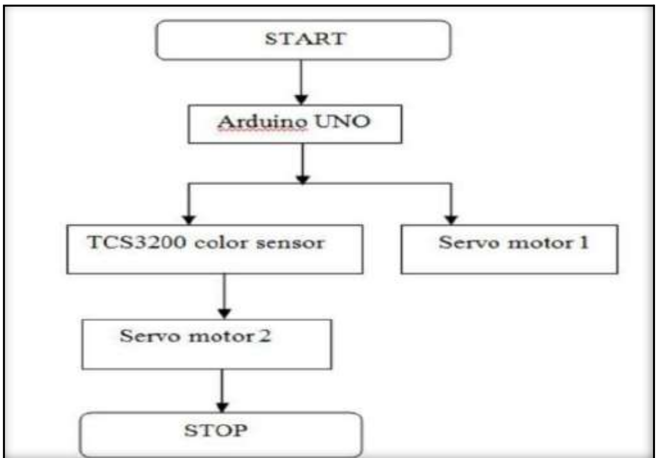


Fig. 2.1 Block Diagram

III. Circuit diagram

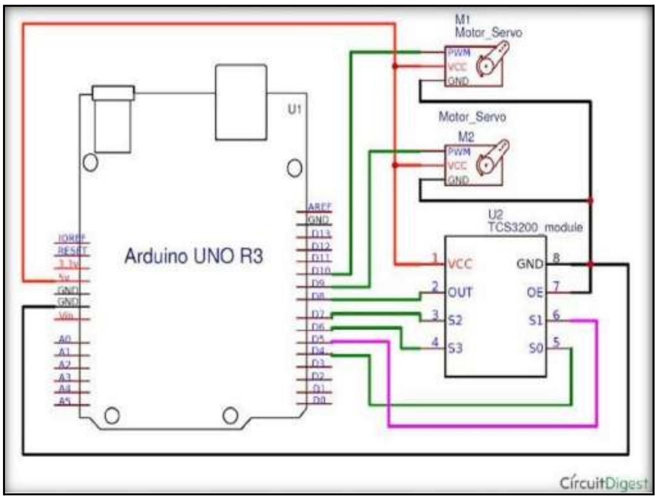


Fig. 3.1 Circuit Diagram

IV. Component description

Hardware:-

Arduino Uno –

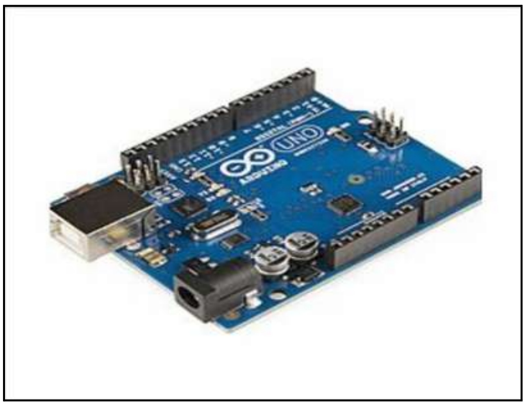


Fig. 4.1 Arduino Uno

Arduino is an open-source platforms used for building electronics projects. Arduino consist of both a physical programmable circuit board (often referred to as a micro-controller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.

Color sensor-

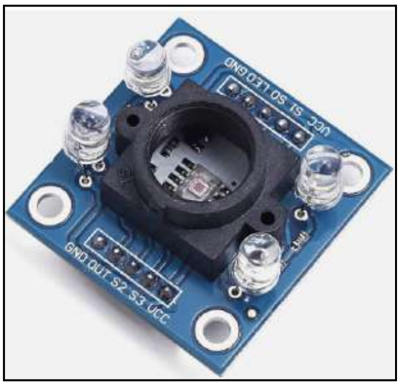


Fig. 4.2 Color Sensor

TCS3200 color sensor is a complete color detector, including a TAOS TCS3200 RGB sensor chip and a 4 white LEDs. The TCS3200 can detect and measure a nearly limitless range of visible colors. Applications include test strip reading, calibration, and color matching, to name just few.

Servo motor-

Fig. 4.3 Servo Motor

A Servo Motor is a type of motor that can rotate with great precision. Normally this type of motor consists of a control circuit that provides feedback on the current position of the motor. Shaft, this feedback allows the servo motor to rotate with great precision. If you want to rotate an object at some specific angles or distance, then you use a servo motor. It just made up of simple motor which runs through a servo mechanism. If motor is powered by a DC power supply, then it is called DC servo motor. If motor is powered by AC power supply then it is called AC servo motor.

Software :-

Arduino IDE –

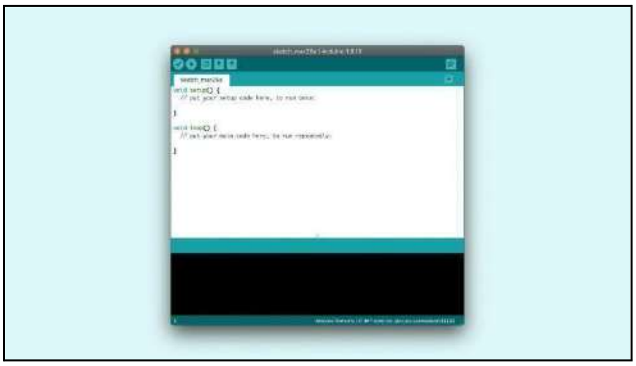


Fig.4.4 Arduino IDE

The Arduino Integrated Development Environment - or Arduino Software (IDE) contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them.

V. Hardware implementation

Connect the Color Sensor Module to Arduino. VCC and GND: Connect the VCC pin on the color sensor module to the 5V output on the Arduino. Connect GND to Arduino's ground (GND) pin.S0, S1, S2, S3 (if applicable): These pins are used for setting the frequency scaling of the sensor. Connect them according to your requirements (e.g., connecting S0 and S1 to set the sensor to 100% scaling). OUT: Connect the OUT pin from the color sensor module to one of the digital pins on the Arduino, e.g., digital pin 2. OE (optional): If your color sensor module has an OE (Output Enable) pin, you can connect it to a digital pin on the Arduino (e.g., digital pin 3) to control when the sensor output is enabled. Connect OE to GND to enable the sensor and VCC to disable it. LED (optional): If you want to add an LED for status indication, connect an LED through a current-limiting resistor (e.g., 220-470 Ohms) between an Arduino digital pin (e.g., digital pin 4) and GND. Power Supply: Connect the power source to the Arduino. This can be a USB connection from your computer or a separate power supply, depending on your project requirements.

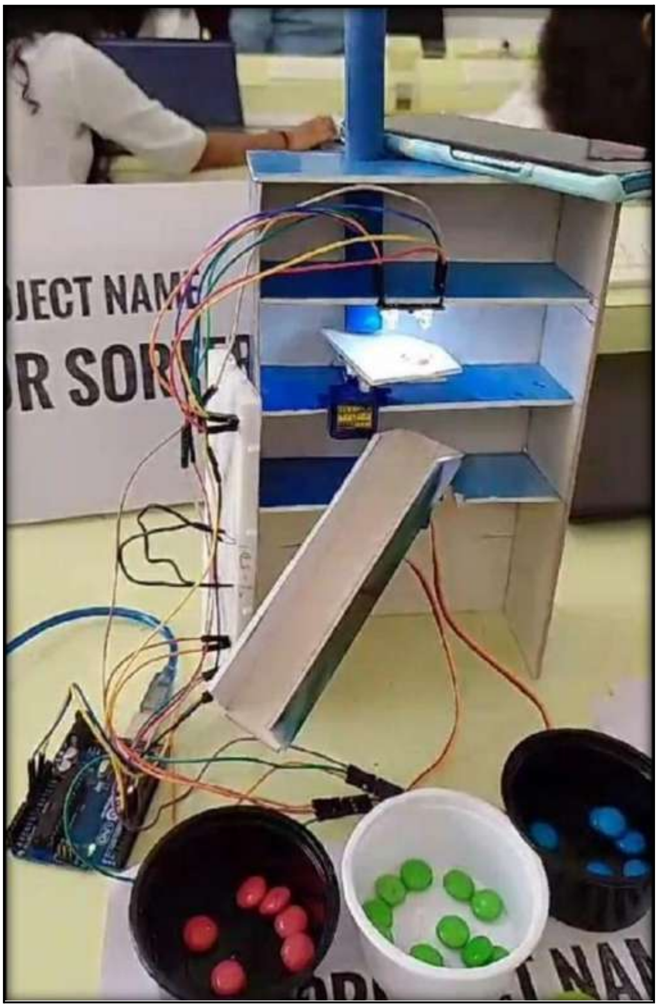


Fig 5.1 Hardware implementation

VI. Result and discussion

Color Recognition - The color sorting system successfully recognized and distinguished between a set of predefined colors. Through the integration of color sensors and image processing algorithm, the Arduino Uno accurately identified objects based on their color.

Sorting Efficiency – The system demonstrated efficient sorting performance, achieving a high throughput of sorted objects per minute.

Flexibility – The system proved adaptable to sorting various objects with different colors, size and shape.

Data collection – The implement data logging mechanism captured and sorted information about sorted the object, including color and quality.

VII. Future scope

In the contemporary industrial landscape, there is an escalating need for products with high accuracy and performance. Among the various parameters crucial for achieving this, color stands out as a particularly effective criterion for sorting different objects at an industrial level. The principles of color sorting, exemplified in applications such as paper sorting, not only provide insights into efficient sorting mechanisms but also alleviate the burden on human efforts. The versatility of color sorting machines is evident in their application in agriculture, where they streamline the sorting of grains, rice, and fruits. Furthermore, these machines find utility in diverse industrial settings, such as plastics, facilitating the efficient sorting of toys, nuts, and bolts based on their colors. Looking ahead, the future of color sorting machines appears promising, with a potential scope that extends well beyond their initial applications, offering valuable contributions to a wide array of industries.

VIII. Conclusion

To summarize, our paper examines different types of research on color sorting machines, focusing on comparative technologies and utilizing the TCS3200 color sensor with Arduino Uno for our project. The literature review highlights the crucial role of color sorting technology in diverse industries, emphasizing its transformative impact on sorting processes. The findings underscore the need for ongoing research and development to enhance color sorting methods. Color sorter machines, exemplified by our project, have already revolutionized industries by boosting efficiency and precision. Looking ahead, continued integration with cutting-edge technologies is expected to solidify their essential role. The success of our color sorter project demonstrates the innovative application of technology in enhancing object sorting based on color criteria.

Acknowledgement

We extend our heartfelt appreciation to Prof. Sweta Waghmare, whose invaluable guidance and unwavering support significantly enriched our project. Prof. Waghmare's extensive knowledge and encouragement played a pivotal role in shaping the trajectory of our work, offering insights that were instrumental in achieving our goals. Additionally, we would like to express our gratitude to Dr. Avinash Vaidya, the Professor and Head of the Department of Electronics and Telecommunication Engineering. Dr. Vaidya's provision of essential facilities proved instrumental in the successful completion of our project. His support and commitment to fostering a conducive learning environment were integral to the realization of our endeavors, and we are sincerely thankful for the opportunities provided under his leadership.

References

The URL is:

[1] https://en.wikipedia.org/wiki/Colour_sorter

[2] https://en.wikipedia.org/wiki/Optical_sorting

IoT based Monitoring and Control of Electricity Consumption

Om Sutar, Raj Patil, Payal Mane, Prabhavati R.

Abstract - In an era of increasing energy consumption and sustainability concerns, efficient energy management has become a critical necessity. This paper presents an innovative IoT-based energy monitoring system designed to predict electricity bills by continuously monitoring the power consumed by electronic devices. The system utilizes the ZMPT101B voltage sensor and ACS712 current sensor to accurately measure and record voltage and current data in real-time.

This research introduces an innovative IoT-based energy monitoring system designed to predict electricity consumption and optimize billing processes. The system's user interface is accessible through web or mobile applications and provides a user-friendly platform for consumers to monitor their energy consumption in real-time. Additionally, the system calculates and displays an estimated electricity bill based on the observed power consumption trends. This feature not only enhances consumer awareness but also assists utility providers in streamlining billing processes.

I. INTRODUCTION

the current flow within the electrical circuit. Data is then displayed in a user-friendly manner on an OLED (Organic Light Emitting Diode) display, showing important information like voltage, current, and power consumption. This data is also transmitted to the cloud and displayed using the Blynk IoT platform, which provides a user interface for remote monitoring and control of the system.

ZMPT101B Voltage Sensor for measuring AC voltage, ACS712 Current Sensor for monitoring electricity consumption, an OLED Display for visualizing real-time data, and the Blynk IoT platform for cloud-based data storage, visualization, and remote control. The utilization of Micro Python for programming the Raspberry Pi Pico W ensures efficient communication with the sensors and seamless data transmission to the cloud, resulting in a comprehensive and effective IoT-based solution for electricity consumption monitoring and control.

II. PROPOSED SYSTEM

The system consists of an ESP32 microcontroller, an app. To monitor the electricity consumption, ZMPT101B energy monitoring circuit, a cloud server, and a mobile voltage sensor and ACS712 current sensor is used. The energy monitoring circuit includes a current The ZMPT101B voltage sensor to measure the AC sensor and a voltage sensor, which are used to measure voltage, and the ACS712 current sensor to measure the energy consumption of different devices. The microcontroller reads the data from the energy monitoring circuit and sends it to the cloud server through Wi-Fi. The cloud server stores the energy consumption data and makes it accessible through the mobile app. The mobile app displays the energy consumption data in real time and allows users to remotely control their devices. The power supply unit is used to provide the necessary voltage and current to power the system. The ESP32 microcontroller is the main control unit of the system, and it interfaces with the energy monitoring circuit, the cloud server, and the mobile app. The energy monitoring circuit is connected to the microcontroller through analog inputs, and it provides accurate and real-time energy consumption data for different devices. The cloud server is used to store the energy consumption data and make it accessible to the mobile app. It can be hosted on a public or private cloud platform. The mobile app is the user interface of the system, and it allows users to view their energy consumption data and remotely control their devices. The power supply unit can be connected to a standard AC outlet or can use a battery or other power source to provide the necessary voltage and current for the system.

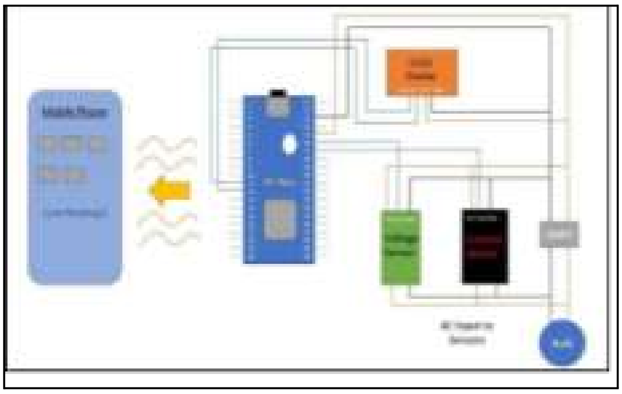


fig 2.1 Proposed System Architecture

III. LITERATURE SURVEY

The papers under review in this literature survey collectively delve into the realm of IoT-based electricity consumption monitoring and control, a domain of paramount significance in the contemporary era marked by the need for efficient energy utilization. As each paper adopts distinct technological approaches, sensor configurations, and microcontroller choices, understanding the unique advantages and disadvantages of these methods is crucial for comprehending the evolving landscape of electricity consumption monitoring systems.

In the first study by L. Ashok Kumar, V. Indra Gandhi, V. Vijayakumar, and Logesh Ravi, the incorporation of voltage and current sensors alongside the ATmega328P microcontroller, ESP8266 Wi-Fi chip, and SIM module 900 GSM forms a robust foundation for data collection. Yet, concerns arise regarding the cost-effectiveness and the separation of Wi-Fi and GSM components from the microcontroller.[1] Mohammad H Yaghmaee and Hossein Hejazi offer an alternative, focusing on data transmission to an Android HTTP gateway hosted on a Raspberry Pi 3. However, this method introduces complexity through the requirement of OS installation on the Raspberry Pi.[2] The research by Anirudh Kumar, Sreyasi Thakur, and Partha Bhattacharjee makes innovative use of Automatic Meter Reading (AMR) energy meters, relying on LED frequencies to estimate energy consumption and ESP8266-based data transmission, offering a pragmatic approach with potential inaccuracies.[3] Boqiang Wu and Nianxiong, in their study, employ a System on Chip (SoC) based on Cortex, providing detailed electrical signal monitoring but limiting its general applicability due to the specificity of DSP components.[4] Finally, Woong Hee Kim, Sunyoung Lee, and Jongwoon Hwang explore the utilization of ZigBee wireless sensors in conjunction with an intelligent home gateway, offering advanced data collection and presentation capabilities. However, these benefits come at the cost of limited range, ongoing monitoring needs, and privacy concerns.[5]

In conclusion, these research papers collectively illuminate the diverse and evolving landscape of IoT based electricity consumption monitoring and control systems. Each approach is marked by unique strengths and weaknesses, from comprehensive data collection through sensors and microcontrollers to simplified data transmission via Android gateways or specialized SoCs. The choice of communication protocols, including Wi-Fi, GSM, and ZigBee, introduces further variations in the capabilities and challenges of these systems. A comprehensive understanding of these techniques is crucial for designing effective and reliable solutions for electricity consumption monitoring and control. The identified limitations in the reviewed studies, such as cost concerns, accuracy, and privacy issues, can guide future research to develop more integrated and versatile solutions for this vital domain.

.

IV. APPLICATIONS

1. Home Energy Management

In a residential setting, this system provides homeowners with detailed insights into their electricity consumption. By monitoring and controlling energy usage, they can identify energy-intensive appliances or behaviours. This data empowers homeowners to make informed decisions on how to reduce energy costs and lower their environmental footprint. For example, they can schedule appliances to run during off-peak hours, set energy consumption alerts, and automate energy-saving actions.

2. Smart Buildings

This system's applications in smart buildings are extensive. In a commercial context, it allows facility managers to efficiently manage and optimize energy consumption throughout the building. For instance, lighting, HVAC, and other systems can be controlled intelligently, responding to occupancy and environmental conditions. By reducing energy waste, businesses can significantly lower their operational costs and enhance sustainability, all while maintaining comfort and safety for occupants.

3. Electric Vehicle Charging

The system can be integrated into electric vehicle (EV) charging stations. Users can monitor their EV charging sessions and associated power consumption. This information enables them to choose the most cost-effective times to charge their vehicles, benefiting from lower electricity rates during off-peak hours. This is particularly useful for EV owners looking to reduce their charging costs.

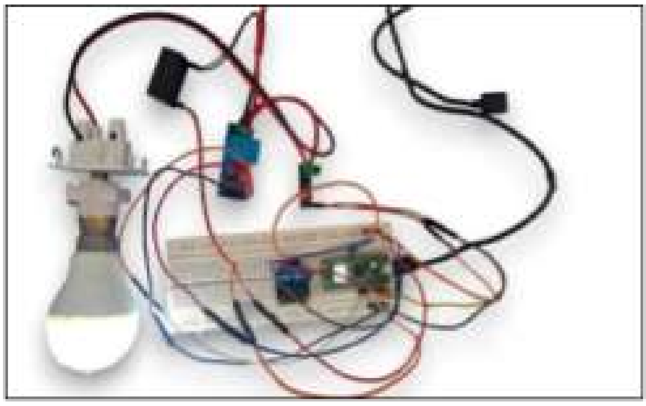
4. Data Centre's

Data centre's consume massive amounts of electricity. The system can be utilized to closely track power usage and temperature within these facilities. With real-time data, data centre operators can adjust cooling systems, optimize server usage, and ensure that power is distributed efficiently. This results in lower operational costs and a reduced environmental impact.

5. Industrial Energy Monitoring

In industrial settings, this system plays a crucial role in energy management. It allows factories and plants to monitor the electricity consumption of various machines, production lines, and processes. This information can be used to optimize production schedules, implement energy-efficient technologies, and identify equipment that might need maintenance. Ultimately, it leads to cost savings and reduced environmental impact.

V. RESULT



CONCLUSION

While designing the system we came to the following conclusions:

1. The design and implementation of the circuit on the breadboard was done successfully.
2. The output values were displayed on an oled display and sent to the Blynk IOT platform to read and store them in a cloud server.
3. For the time being the circuit is running on a microcontroller which processes the values of voltage, current and power used by the appliance and gives us the number of units used and estimate cost of running the appliance.

REFERENCES

[1] *Kumar L.A., Indra Gandhi V., Selvamathi R., Vijayakumar V., Ravi L., Subramaniyaswamy, V., (2021).* "Design, power quality analysis, and implementation of smart energy meter using internet of things, Computers and Electrical Engineering", 93, 107203. https://doi.org/10.1016/j.compeleceng.2021.107203 M. Wegmuller, J. P. von der Weid, P. Oberson, and N. Gisin, "High resolution fiber distributed measurements with

coherent OFDR," in *Proc. ECOC'00*, 2000, paper 11.3.4, p. 109.

[2]*Yaghmaee M.H., Hejazi H., (2018)*. "Design and Implementation of an Internet of Things Based Smart Energy Metering", In 2018 IEEE International Conference on Smart Energy Grid Engineering (SEGE), IEEE,Canada.[4]https://doi.org/10.1109/SEGE.2018.8499458 (2002) The IEEE website. [Online]. Available: http://www.ieee.org/

[3] *Kumar A., Thakur S., & Bhattacharjee P., (2018).* "Real time monitoring of AMR enabled energy [5] meter for AMI in smart city-an IoT application", IEEE International Symposium on Smart Electronic Systems (iSES) (Formerly iNiS), IEEE, India. https://doi.org/10.1109/iSES.2018.00055*FLEX Chip Signal Processor (MC68175/D)*, Motorola, 1996. *Wu B., Tan N., (2019).* "An energy metering and measurement SoC with a novel low-power DSP architecture", IEEE Internet of Things Journal, 6(2), 3298–3308. https://doi.org/10.1109/JIOT.2018.2882494 *Woong Hee K, Sunyoung L., Jongwoon H., (2011).* "Real-time Energy Monitoring and Controlling System based on ZigBee Sensor Networks, Procedia Computer Science", 5, 794-797. https://doi.org/10.1016/j.procs.2011.07.108

FACE RECOGNITION SYSTEM

Vishesh Rana, Meeran Momin, Siddharth Pradhan, Dhiraj Wafare
Guided By:- YogeshKene

Abstract: In this 21st century, nowadays the number of thefts and identity fraud has become a serious issue. In order to avoid these thefts and identity fraud, a face recognition system must be established. The scope of this project is to develop a security access control application based on face recognition. we use Open CV libraries and python computer language. Training and identification is done in embedded device known as Raspberry Pi. The main aim of this paper is to offer an advanced security system in automotive, which consists of a face detection system, a Wi-Fi module, and an IOT control platform.

I. INTRODUCTION

Face is a part of human body which is unique for every other human. It is possible to build a facial recognition system using Raspberry Pi ZERO W model and Pi camera which is cost efficient. In addition of being compact, with the help of machine learning, it ensures the password is entered by the authorized person otherwise it will display whether the person is authorized else gives intruder alert message along with the alarm if required. When facial recognition is applied along with or without passcodes, the system becomes more secure and hence cannot be tricked and, in that manner, unauthorized person will not gain access to sensitive information which is confidential and hence fraudulent activities can be prevented

II. LITERATURE REVIEW

Provide an overview of the importance of face detection in various applications, such as security, human- computer interaction, and surveillance. Explain the relevance of using Raspberry Pi for face detection due to its low-cost, portability, and energy efficiency
Viola-Jones Face Detection Algorithm:
Viola, Paul, and Jones, Michael J. (2001). "Rapid object detection using a boosted cascade of simple features." International Journal of Computer Vision, 57(2), 137-154. This seminal paper introduced the Viola-Jones algorithm, which uses Haar-like features and boosted classifiers for real-time face detection. It has been adapted for Raspberry Pi implementations due to its speed and accuracy.
Deep Learning Approaches:
Taigan, Yaniv, et al. (2014). "Deep Face: Closing the gap to human-level performance in face verification." Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 1701-1708. This paper discusses Deep Face, a deep learning-based approach to face recognition that has been adapted for face detection tasks on Raspberry Pi using deep learning frameworks like TensorFlow and OpenCV

III. PROPOSED METHODOLOGY

For this project of facial recognition, we have used Raspberry Pi ZERO W, being cost-effective it has rich support for python face recognition related libraries. We have used libraries like inutile, face recognition, open CV which has hear cascade classifier embedded in it as algorithm for this system. 5V power supply was used, 16GB micro-SD card for installing operating system, Pi camera V2 module of 5MP was interfaced with Raspberry Pi Zero model through CSI port. The operating system used for this project is Raspberry Pi OS Buster. It was installed on micro-SD card using micro-SD card adapter through Raspberry Pi Imager software that converts it into bootable device which is then inserted into Raspberry Pi. Raspberry Pi is nothing but a credit card size minicomputer and not surprisingly also has unique. Ip address like other devices. Ip address of Raspberry Pi was determined and by establishing SSH connection, pi's terminal access was obtained. Desktop instance was generated using VNC software.

A) Steps followed for facial recognition are:

1)Face Detection: Face detection is the process of focusing only on Faial regions of the human body by

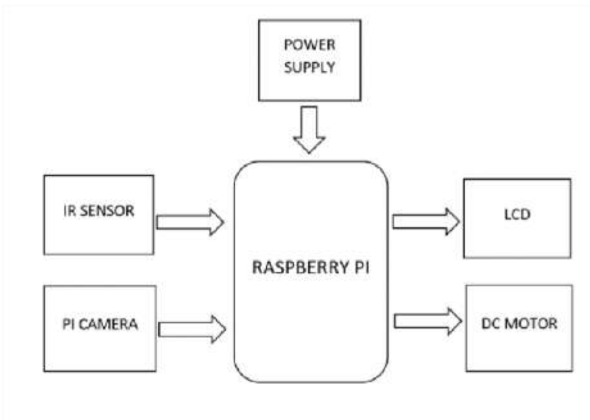


Fig 3.1 Design of face recognition system using Raspberry Pi

discarding all other areas.

2) Face Pre-processing: Face Pre-processing speeds up the detection process. This includes resizing, orienting, and color corrections.

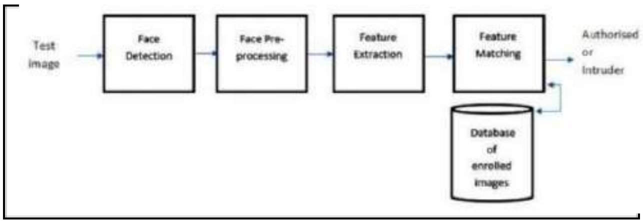


Fig 3.2 Methods of face recognition system

3) Feature Extraction: It is the process that separates out face component features like nose, mouth, and eyes. It is crucial for the initialization of processing techniques like face recognition for obtaining the face print or face id.

4) Feature Matching: It is the process of comparing the face print of a given dataset with that of an existing dataset and giving inferences accordingly whether matched or not.

B. System Design

It includes Raspberry Pi 3 W development kit, connecting cables, LCD, DC motor, Power Supply, keyboard, mouse, and Pi cam.

1) Raspberry Pi 3: The Raspberry Pi Zero 2 W is a compact single- board computer developed by the Raspberry Pi Foundation. It features: *LCD*: The LCD used here is 16 x 2 alphanumeric LCD. It isa very basic module which overcomes the disadvantage of the seven-segment display as well as multi-segment LCD. It consists of command register to perform the user defined instructions and data register to display the data on LCD. *DC Motor*: The speed of the motor can be changed by varying the voltage levels. Here the motor rotates in clockwise and anticlockwise direction at a speed of 10,000RPM, representing opening and closing of gate. Processor: It is powered by a 64-bit quad-core ARM Cortex-A53 processor running at 1 GHz, providing a significant performance boost compared to the original Pi Zero. Memory: It has 512MB of LPDDR4 RAM. Connectivity: The "2 W" in its name stands for wireless. It includes both Wi-Fi 802.11b/g/n and Bluetooth 4.2 support, making it suitable for IoT and wireless communication projects Ports: It has a micro-HDMI port, a micro- USB OTG port, and a mini-CSI camera port for connecting a camera module. GPIO Pins**:** Like other Raspberry Pi models, it features 40 GPIO pins for various hardware connections and expansion. Size: It is extremely small, similar to the original Pi Zero, making it suitable for projects with space constraints.

i) Power: It can be powered via a micro-USB connector, and it’s energy-efficient.

ii) Operating System: It can run various operating systems, including Raspberry Pi OS (formerly Raspbian), making it versatile for different applications.

1) Camera module 5MP: A 5-megapixel (5 MP) camera module typically refers to a camera sensor that can capture images with a resolution of 5 million pixels. It's a relatively lower resolution compared to modern smartphone cameras, which often have sensors with 12MP or more. The image quality and detail captured by a 5 MP camera may be suitable for basic photography but might not provide the level of detail and clarity you'd get from higher-resolution cameras.

2) Monitor: Monitor are full-color LCDs that offer brilliant, vibrant colors as well as the capacity to display fast animations, intricate images, and unique fonts with various touchscreen possibilities. obtainable in sizes and resolutions that meet industrial standards. Our TFT module range features a unique PCB that provides an HDMI interface, audio support, or HMI solutions with an integrated.

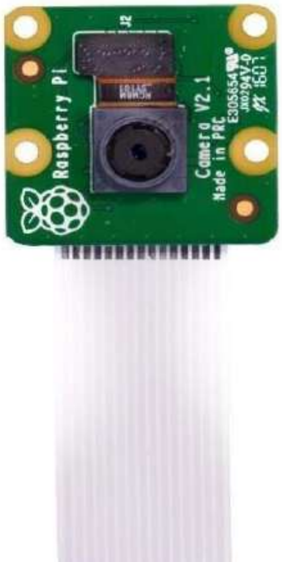


Fig. 3.4 Pi cam moduleI

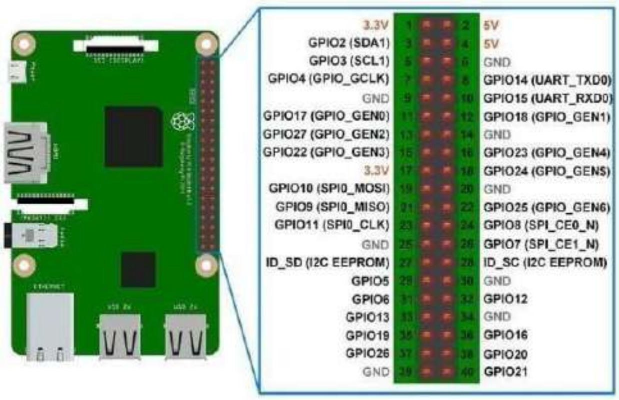


Fig.3.3 pin specification of raspberry pi

IV. FUTURE SCOPE

The future of face recognition systems lies in improving accuracy, speed, and overcoming limitations. Advancements in artificial intelligence and deep learning algorithms will enhance the technology's capabilities

[1] Security and Access Control: Face recognition technology will play a significant role in enhancing security and access control systems. It will be used for unlocking devices, accessing secure locations, and verifying identity in various sectors, including airports, government facilities, and private businesses.

[2] Biometric Authentication: Face recognition will become an integral part of biometric authentication methods, offering a convenient and secure way to verify an individual's identity. This can be used for online banking, ecommerce, and other digital services, reducing the reliance on traditional passwords.

[3] Law Enforcement and Surveillance: Law enforcement agencies will continue to use face recognition for criminal identification and tracking. Additionally, surveillance systems will incorporate facial recognition to improve public safety and monitor public spaces.

[4] Healthcare: In healthcare, face recognition can be used for patient identification, access control, and monitoring vital signs. It may also aid in diagnosing certain medical conditions based on facial features and expressions.

[5] Smart Cities: Face recognition can contribute to the development of smart cities by enhancing public services, traffic management, and public safety. It can be used for identifying individuals in crowded areas and improving overall urban infrastructure.

[6]Retail and Marketing: Retail businesses will utilize facial recognition for personalized customer experiences, targeted advertising, and inventory management. Analyzing customer demographics and behavior can help improve sales and marketing strategies.

[7] Human-Computer Interaction: Face recognition will play a significant role in improving human-computer interaction, enabling devices to respond to users' facial expressions and emotions. This can be used in gaming, virtual reality, and augmented reality applications.

[8] Healthcare Monitoring: Face recognition systems may be employed for continuous health monitoring. Devices could track vital signs, stress levels, and emotional states by analyzing facial expressions, which can be valuable for telemedicine and general well-being.

[9] Education and Student Attendance: Educational institutions can use face recognition to track student attendance, enhance campus security, and provide a more efficient and secure learning environment.

[10] User Experience and Personalization: Companies can leverage face recognition for enhancing user experience and personalization in various sectors, from entertainment and hospitality to customer service.

ACKNOWLEDGMENTS

We would like to express our sincere gratitude to our mentor Mr. Yogesh Kene, Assistant Professor in Department of Electronics and Telecommunication, PCE, Panvel for her guidance, encouragement, and valuable suggestion. We would also like to thank faculty of who helped us to complete our project successfully.

REFERENCES

1] Hoyle and M. Rattray, ‘‘PCA learning for sparse high dimensional data,’’ Eutrophic. Lett. (EPL), vol. 62, no. 1, pp. 117–123, Apr. 2003.

[2] J. Li, B. Zhao, H. Zhang, and J. Jiao, ‘‘Face recognition system using SVM classifier and feature extraction by PCA and LDA combination,’’ in Proc. Int. Conf. Compute. Intel. Soft. Eng., Dec. 2009, pp. 1–4

[3]] E.-J. Cheng, K.-P. Chou, S. Rajouri, B.-H. Jin, M. Tanveer, C.-T. Lin, K.-Y. Young, W.-C. Lin, and M. Prasad, ‘‘Deep sparse representation classifier for facial recognition and detection system,’’ Pattern Recognin. Lett., vol. 125, pp. 71–77, Jul. 2019.

[4] M. Pytamine, ‘‘Local binary patterns,’’ Schlepped, vol. 5, no. 3, p. 9775, 2010.

[5] V. Sze, Y.-H. Chen, T.-J. Yang, and J. S. Emer, ‘‘Efficient processing of deep neural networks: A tutorial and survey,’’ Proc. IEEE, vol. 105, no. 12, pp. 2295–2329, Dec. 2017.

[6] J. Zhang, S. Shan, M. Kan, and X. Chen, ‘‘Coarse-to-fine auto-encoder networks (CFAN) for real-time face alignment

Ultra-low power vision sensor For Iot

Nikita Patil, Poonam Metkari, Mansi Punde, Kiran Rane, Prof. Ruchira Patole

Abstract - This abstract explores the design and applications of an ultra-low-power vision sensor. Leveraging advanced energy efficient technologies, this sensor aims to revolutionize power consumption in computer vision systems. The abstract delves into the sensor's key features, such as low-power image acquisition, on-chip processing, and its potential impact on battery-operated devices. Additionally, it discusses the implications of this innovation for fields like IoT, robotics, and surveillance, highlighting the significance of energy conservation in next-generation vision sensors.

Keywords—Delivery, Raspberry pi Zero 2W

I. INTRODUCTION

Vision Sensor Nodes (VSN) are the building blocks of Wireless Vision Sensors Networks (WVSN), a promising technology for its extended application domain that ranges from structural health analysis to urban scenarios observation. While developing an algorithm for a VSN, it is crucial to consider the amount of data transmitted, which can be prohibitive and have a high impact on energy efficiency. Literature suggests two viable solutions: bandwidth compression or hardware solutions such as the near-sensor image processing paradigm. For the latter, it is crucial to reduce the amount of redundant information to be processed; therefore, event-based Smart Vision Sensors (SVS) enabling in-hardware motion detection algorithms are used. To exploit the full potential of these sensor technologies - which usually are also characterized by lower quality images (e.g. lower spatial and pixel resolution) - application-specific processing pipelines are the most promising option, offering trade-off between performance and power consumption

II. BLOCK DIAGRAM OF PROPOSED SYSTEM

A. Overview of the project

A vision sensor, in general, refers to a device that can capture and process visual information. These sensors are commonly used in various applications, including robotics, surveillance, automotive safety systems, and more. An "ultra-low power" version of this technology would imply a sensor that operates with minimal power consumption. Here are some general features such a sensor might have:

1. Low Power Consumption:

Ultra-low power vision sensors are designed to operate on minimal power, making them suitable for battery-powered devices and applications where power efficiency is critical. 2. Energy-Efficient Image Processing:

These sensors would likely feature energy-efficient image processing algorithms, allowing them to perform tasks like object recognition, motion detection, or even simple scene analysis without consuming excessive power.

3. Optimized Hardware Design:

The hardware architecture of these sensors would be optimized

for efficiency, ensuring that the components themselves consume minimal power during operation.

4. Edge Computing Capabilities:

Instead of sending all the data to a central processing unit, these sensors could have edge computing capabilities. This means they can process data locally, reducing the need for constant communication and, consequently, reducing power usage.

B. Existing System Architecture

1.Sensor Module:

Low Power Image Sensor: The core component capturing visual data. These sensors are designed to consume minimal power during image capture.

Optimized Optics: High-quality lenses and optics to ensure clear image capture, minimizing the need for excessive processing. 2. Processing Unit:

Low Power Processor: An energy-efficient processor capable of handling image processing tasks. This could be a microcontroller or a specialized image processing unit (GPU or DSP) optimized for low power consumption.

Hardware Accelerators: Specialized hardware units for accelerating specific computations (e.g., neural network inference) without consuming excessive power.

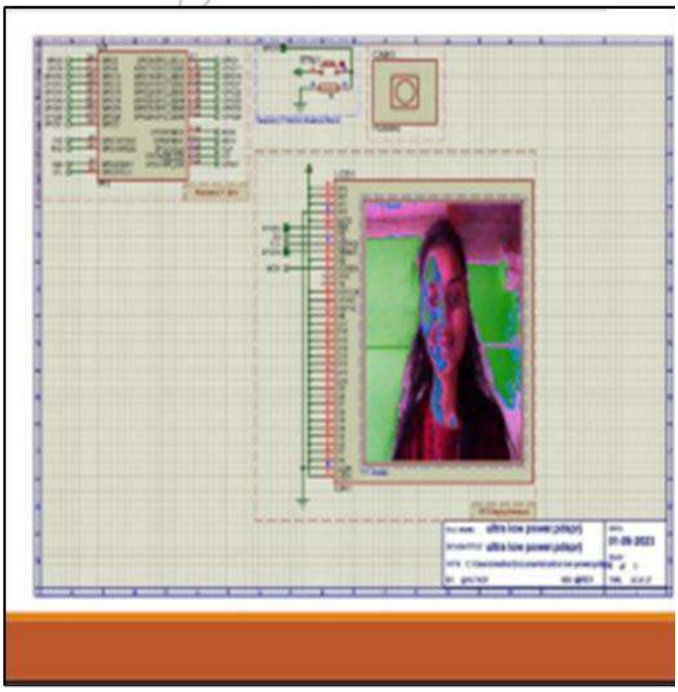


Fig. 2.1 Circuit diagram

1)The method of delivery used in this study The perspective of logistical operations is used to study ultra-low power vision sensors. The complexity that exists in the final stage begins with the raspberry pi, vision sensor, camera module 5MPand compass sensors being initialized. This sensor initialization's purpose is to control the low power

2)Author Ch Gangadhar, K Pratyusha, Paparao Nalajala, Sankararao Majji, Ashok Kumar, Manoj Kumar P. developed it (Member, IEEE). In this research, they present a low power temperature-sensing circuit operating in the time domain for use in the Internet of Things. In this, we investigate how to create a machine vision system for medical imaging that operates in real time. Much effort has been put into optimizing the power efficiency of the RX's individual sub-blocks, further reduction of its power allocation becomes more difficult as certain key RF blocks. The low intrinsic gain and high threshold voltage of the nanometre-scale CMOS Area.

3)Although the concept of low power vision sensor is new, there are still a number of technological challenges to be solved. Nikolaos Schizas, Aristeidis Karras, Christos Karras used TinyML intends to deliver on- premises analytics that bring significant value to IoT services, particularly in environments with limited connection. This review article defines TinyML, presents an overview of its benefits and uses and provides background information based on up-to-date literature. In addition, we explore the integration of TinyML with network technologies such as 5G and LPWAN. Ultimately, we anticipate that this analysis will serve as an informational pillar for the IoT/Cloud research community and pave the way for future studies.

4)Author Norah N. Alajlan and Dina M. Ibrahim developed it (member IEEE). In this research, they have there is a new technology called Tiny Machine Learning (TinyML), that has paved the way to meet the challenges of IoT devices. The aim of this paper is to provide an overview of the revolution of TinyML and a review of tinyML studies, wherein the main contribution is to provide an analysis of the type of ML models used in tinyML studies; it also presents the details of datasets and the types and characteristics of the devices with an aim to clarify the state of the art and envision development requirements.

III. SOFTWARE IMPLEMENTATION AND WORKING

Working and Components description

Raspberry pi zero 2w: The Raspberry Pi Zero 2 W is a compact single-board computer developed by the Raspberry Pi Foundation. It features:

Processor: It is powered by a 64-bit quad-core ARM Cortex-A53 processor running at 1 GHz, providing a significant performance boost compared to the original Pi Zero.

Memory: It has 512MB of LPDDR4 RAM.

Connectivity: The "2 W" in its name stands for wireless. It includes both Wi-Fi 802.11b/g/n and Bluetooth 4.2 support, making it suitable for IoT and wireless communication projects.

Ports: It has a micro-HDMI port, a micro-USB OTG port, and a mini-CSI camera port for connecting a camera module.

GPIO Pins: Like other Raspberry Pi models, it features 40 GPIO pins for various hardware connections and expansion.

Size: It is extremely small, similar to the original Pi Zero, making it suitable for projects with space constraints. Power: It can be powered via a micro-USB connector, and it's energy-efficient.

1)Operating System: It can run various operating systems, including Raspberry Pi OS (formerly Raspbian), making it versatile for different applications.

Fig. 3.1 Pin specification of raspberry

2)Camera module 5MP: A 5-megapixel (5 MP) camera module typically refers to a camera sensor that can capture images with a resolution of 5 million pixels. It's a relatively lower resolution compared to modern smartphone cameras, which often have sensors with 12 MP or more. The image quality and detail captured by a 5 MP camera may be suitable for basic photography but might not provide the level of detail and clarity you'd get from higher-resolution cameras.

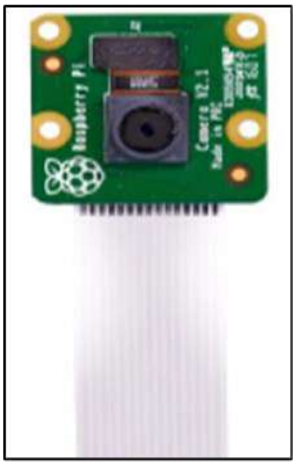


Fig. 3. 2 Pi cam module

3)Monitor: Monitor are full-color LCDs that offer brilliant, vibrant colors as well as the capacity to display fast animations, intricate images, and unique fonts with

various touchscreen possibilities. obtainable in sizes and resolutions that meet industrial standards. Our TFT module range features a unique PCB that provides an HDMI interface, audio support, or HMI solutions with an integrated FTDI Embedded Video.

IV. FUTURE SCOPE

The combination of ultra-low-power vision sensor

IoT (Internet of Things), and Raspberry Pi Zero offers a promising field with numerous future applications. Here are some potential future scopes and applications for this technology:

1. Retail and Customer Analytics:

Implementing smart shelves with vision sensors to track inventory levels and customer behaviour for better stock management and store layout optimization.

2.Search and Rescue:

Deploying vision sensors in drones or autonomous robots for search and rescue missions to locate missing persons in various terrains.

3. Gesture Recognition:

Implementing gesture recognition systems in gaming, AR/VR applications, and smart TVs.

4. Education:

Developing educational kits and projects that leverage these sensors for teaching IoT, computer vision, and robotics.

5. Energy Efficiency:

Enabling smart lighting systems to adjust brightness based on the presence of people and natural light, contributing to energy savings.

6. Aquatic and Marine Applications:

Deploying underwater vision sensors for marine life monitoring and exploration.

7. Autonomous Vehicles:

Integrating ultra-low-power vision sensors into self-driving cars and drones for obstacle detection and navigation. To pursue these opportunities, it's essential to focus on power efficient algorithms, sensor technology, and data transmission methods to minimize energy consumption and ensure long lasting operation. Additionally, addressing privacy and security concerns will be critical in many of these applications. The field of ultra-low-power vision sensors and IoT with Raspberry Pi Zero is dynamic and will continue to evolve as technology advances and new use cases emerge.

V. CONCLUSION

In this report, the study of different domain techniques is presented. Integration of ultra-low-power vision sensors with the Raspberry Pi Zero holds immense promise for a wide range of applications across various domains. This innovative combination offers the potential to revolutionize industries such as home automation, agriculture, healthcare, industrial automation, and more, by providing efficient, real time visual data processing and analysis at minimal energy costs. The Raspberry Pi Zero's compact form factor and affordability, combined with the capabilities of ultra-low

power vision sensors, pave the way for energy-efficient, long-lasting IoT solutions. As technology continues to advance, the use of these systems is expected to grow, enabling smarter, more sustainable, and interconnected environments while addressing the pressing need for energy conservation and efficiency in the modern world.

VI. ACKNOWLEDGEMENT

We want to express our sincere gratitude to Prof. Ruchira Patole, who served as our project guide with unsurpassed knowledge and immense encouragement. We are grateful to Dr. Avinash Vaidya, Professor & Head of the

Department, Electronics and Telecommunication Engineering, for providing us with the required facilities for the completion of the project work.

VII. REFERENCES

[1] Citation: Schizas, N.; Karras, A.; Karras, C.; SioutasS TinyML forUltra-Low Power AI and Large Scale IoT Deployments: A Systematic Review. Future Internet 2022, 14, 363. https://doi.org/10.3390/fi14120363

[2] Citation: Alajlan, N.N.; Ibrahim, D.M. TinyML: Enabling of Inference Deep Learning Models on Ultra-Low-Power IoT Edge Devices for AI Applications. Micromachines 2022, 13, 851. https://doi.org/10.3390/mi13060851

[3] Hyochan An, Student Member, IEEE, Sam Schiferl, Kyojin D. Choo, Member, IEEE, Shiyu Liu: An Ultra-Low Power Image Signal Processor for Hierarchical Image Recognition with Deep Neural Networks IEEE JOURNAL OF SOLID-STATE CIRCUITS, VOL. 56, NO. 4, APRIL 2021

[4] Marco Giordano, Nicolas Baumann, Michele Crabolu, Raphael Fischer, Giovanni Bellusci, and Michele Magno, Senior Member, IEEE: “Design and Performance Evaluation of an Ultra-low-Power Smart IoT Device with Embedded TinyML for Asset Activity Monitoring” IEEE TRANSACTIONS ON INSTRUMENTATION AND

MEASUREMENT, VOL. 71, 2022

[5] Ace Dimitrievskia, Eftim Zdravevskia, Petre Lameskia Vladimir Trajkovika a Faculty of Computer Science and Engineering, ul. Rugjer Boshkovik 16, P.O. 393, Skopje 1000, Macedonia:” Facilitating privacy-preserving activity recognition in age-friendly environments through low-power devices” 2022 The author Published by Elsevier. B.V Peer

review under responsibility of the Conference Program Chairs 10.1016/j.procs.2022.07.103

FIRE FIGHTING ROBOT

Saniya Ramesh Mahadik, Tejal Sharad Kakade, Pratiksha Mohan Chaudhari, Yash Pravinkumar Deokar, Prof. Sweta Waghmare

***Abstract*-With the advent of technology, humans are replaced with robots in life-threatening situations. We aim to design a robot capable of detecting and suppressing fires. By designing and implementing an autonomous robot capable of detecting and extinguishing flames, disasters can be avoided with minimal risk to human life. In this research, we illustrate an autonomous robot capable of detecting flames indoors and maneuvering towards the flame to extinguish it with the help of carbon dioxide.**

Keywords- Firefighting, Arduino UNO

I. INTRODUCTION

Firefighters routinely encounter hazardous situations during firefighting and rescue operations, an inherent aspect of their profession. In contrast, the deployment of robots offers a safer alternative, allowing firefighting and rescue tasks to be conducted remotely or autonomously. This technology mitigates the risks faced by firefighters. Specifically, robots play a crucial role in reducing the necessity for firefighters to enter perilous environments, addressing the significant issue of fire hazards and their severe consequences. Higher consequences associated with fire incidents elevate the risks linked to detecting and extinguishing fires. Firefighting encompasses numerous perilous tasks that pose potential harm to firefighters, emphasizing the importance of adopting safertechnologies. Firefighters encounter additional challenges,especially in confined spaces, where they must navigate structural complexities and overcome obstacles to effectively extinguish fires and rescue victims.

II. LITERATURE REVIEW

For many years robotics have become popular in many ways because of its variety of design and technological advancement. Our motivation to design a fire fighter robot is to help the community in effectively firefighting by sensing the fire and quickly acting without heavy losses of property or life. [1] Systems, Man and Cybernetics, 2006. SMC '06. IEEE International Conference on 8-11 Oct.2006 The adaptive fusion method is proposed for fire detection of firefighting robots. [2] “Firefighting robot” by S. Kannan, R. Karthikeyan, and S. Sathish Kumar, Chennai, MAY 2006. Design a Firefighting robot using an embedded system. [3] “Fire Fighting Robot” invented by Hadi A. Al-Azemi, Feb 26, 2013. This invention relates to a firefighting robot with a caterpillar drive assembly including a left and right drive unit and an engine for each drive unit. [4] “Fire Fighting Robot” Choong, Cheat Sun 2015-11. This project mainly portrays the basic function of a real big scale firefighting robot into a small-scale robot.

III. PROBLEM STATEMENT

Fire-fighting task is one of the extreme and dangerous tasks to be carried out by human beings generally or specifically the firefighters. Theoretically, the execution of the routine and basic fire-fighting tasks can be assisted or partially replaced by robots. Hence, this embedded project owns the practicality of implementation in the real industry. This project requires me to design and implement an Autonomous Fire-Fighting Mobile Platform that has the practicality of implementation in the real hazardous sites, attracting my field of interests and attention. Upon the completion of this project, the AFFMP, which is equipped with the basic 13 fire-fighting knowledge is hoped to share out the burden of fire-fighters and reduce the risks associated with the fire- fighting tasks encountered by the fire-fighters tremendously.

A. NEED:

Firefighters face a wide range of risks when working in hazardous environments, such as exposure to toxic chemicals, high temperatures, and smoke inhalation. By using firefighting robots, firefighters can stay out of harm's way and avoid these risks.

B. OBJECTIVES:

The main objective of this project is to design and implement an Autonomous Fire Fighting Mobile Platform that is able to patrol and monitor a prescribed area, detect for the occurrence of fire, locate for exact location of fire source, extinguish the flame and safely return to continue with the patrolling once the extinguishing task is completed.

IV. PRINCIPLE AND WORKING

[1] The main components of a firefighting robot are flaming sensor, servo motor, water pump, l293 motor driver module etc. [2] So, there in the working of Fire fighter robot we are providing the algorithm first so you can have the idea about the basic working of the robot. [3] We are using 3 flame sensors which are continuously seeking for fire or flame. [4]All three sensors are always searching for fire. if any of the sensors will find it, the robot will and start walking toward the fire. [5] The flame sensor senses the fire and sends the information to the Arduino which is the brain of this robot.[6] The brain will take the action according to the condition and information getting from the sensor. [7] Arduino will give the commands to the Motors to start in the walk in the desired direction. [8] If the left sensor gives the information about the fire, then the Arduino will run the motor in the left direction. same for the front and right-side motor.

[9] The robot will stop near the fire and start watering it till the fire will be under control.

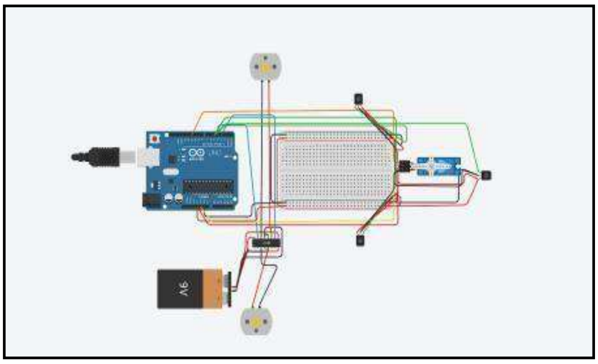


Fig 4.1 Circuit Diagram

V. COMPONENT DESCRIPTION

A. HARDWARE:

1) Arduino Uno: Arduino is an open source platform used for building Electronics projects. Arduino consist of both a physical programmable circuit board. (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer. Used to write and upload computer code to the physical board

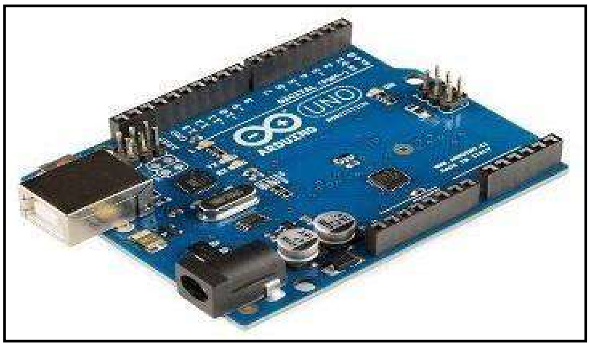


Fig 5.1 Arduino uno

2) Flame Sensor: A flame sensor is a type of sensor that responds most strongly to ambient light. This sensor module is utilized in flame alarms as a result. This sensor picks up flames coming from the light source with wavelengths between 760 and 1100 nm. High temperatures have the potential to easily harm this sensor. So, a specific distance from the flame can be chosen for this sensor's placement. Theflame can be detected from a distance of 100 cm. This sensoroutputs either an analogue signal or a digital signal. These sensors serve as a flame alert in firefighting robots.

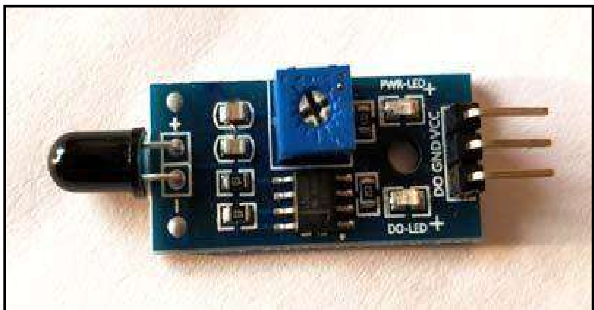


Fig 5.2 Flame sensor

3) L293D Motor Driver: The L293D is a popular 16- Pin Motor Driver IC. As the name suggests it is mainly used to drive motors. A single L293D IC is capable of running twoDC motors at the same time; also the direction of these two motors can be controlled independently. So if you motors which have operating voltage less than 36V and operating current less than 600mA, which are to be controlled by digital circuits like Op-Amp, 555 timers, digital gates or even Microcontrollers like Arduino, PIC, ARM etc. The IC works on the principle of Half H-Bridge.

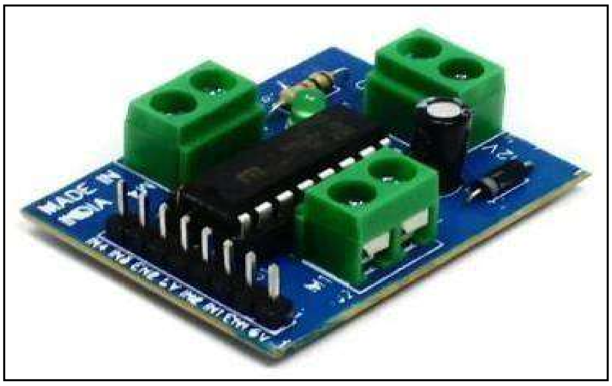


Fig 5.3 L293D Motor Driver

4) BO Motor: This BO (Battery Operated) Motor is a lightweight DC geared motor which gives good torque and rpm at lower voltages. This motor can run at approximately 100 rpm when driven by a single Li-Ion cell. Great for battery operated lightweight robots. DC Geared BO Motor Original vigor, voltage: 3V-12V, Speed: 10-100 RPM.

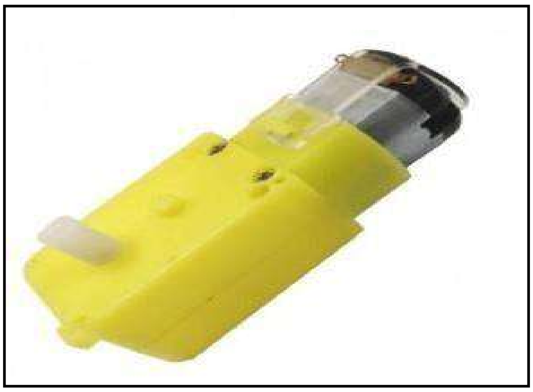


Fig 5.4 BO Motor

5) Relay Module: A power relay module is an electrical switch that is operated by an electromagnet. The electromagnet is activated by a separate low-power signal from a microcontroller. When activated, the electromagnet pulls to either open or close an electrical circuit. The relay module function is mainly to switch electrical devices and systems on or off. It also serves to isolate the control circuit from the device or system being controlled.

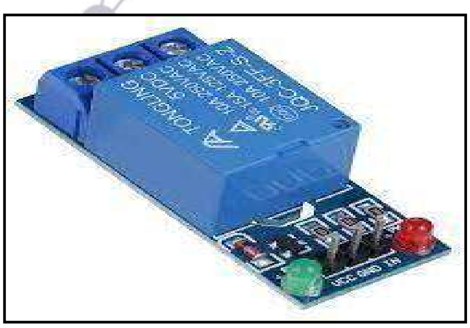


Fig 5.5 Relay module

6) Water Pump: A water spraying nozzle is attached to a servo motor. A water pump is used to transfer water from the main water tank to the water nozzle.

Fig 5.6 Water Pump

B. SOFTWARE:

1) Arduino IDE: [1] The Arduino IDE is an open-source software, which is used to write and upload code to the Arduino boards. [2] The IDE application is suitable for different operating systems such as Windows, Mac OS X, and Linux. It supports the programming languages C and C++. Here, IDE stands for Integrated Development Environment. [3] The program or code written in the Arduino IDE is often called sketching. We need to connect the Genuine and Arduino board with the IDE to upload the sketch written in the Arduino IDE software.

VI. RESULTS AND DISCUSSION

In this project, an autonomous Firefighting Robot has been implemented which can detect flames & smokes and extinguishing them successfully. This robot can move forward, move left & right flawlessly. The motors and Arduino code work together to control the movement of the robot. If any of the flame sensors or smoke sensors are triggered, the motor will start to rotate & move the robot to the danger point upon receiving a signal about the danger environment & start to pump the water with the help of servo motors. This process will be continued until the fire or smoke has been extinguished completely. Then it will display a safe environment.

VII. CONCLUSION

In conclusion, the emergence of firefighting robots marks a significant technological advancement with the potential to transform firefighting strategies. These robots excel in maneuvering through blazing structures, swiftly identifying fire origins, and effectively extinguishing flames. Their primary merit lies in their ability to operate in perilous conditions where human intervention would pose a severe risk. Additionally, the prompt response capabilities of firefighting robots could prove instrumental in saving lives, outpacing the efficiency of human firefighters. Consequently, the integration of firefighting robots into firefighting resources stands as a valuable addition to enhance overall firefighting capabilities.

VIII. FUTURE SCOPE

The future of firefighting robots is very promising. In the coming years, it is expected that robots will become increasingly autonomous and will be able to navigate dangerous environments, detect and analyze fires, and take action extinguish them. Arguably, the most impactful and significant of these recent technological advances are firefighting robots. Since they were first introduced by Howe & Howe Technologies, firefighting robots have been a game-changer in helping battle blazes of all kinds For anybody looking to rise through the firefighting ranks, becoming familiar with all the new technology to fight fires is crucial.

ACKNOWLEDGEMENT

We extend our heartfelt appreciation to Prof. Sweta Waghmare for her invaluable guidance and unwavering support as our project guide. Her extensive knowledge and constant encouragement were instrumental in the success of our project. Our gratitude also extends to Dr. Avinash Vaidya, Professor & Head of the Department, Electronics and Telecommunication Engineering, for generously providing us with the necessary facilities to successfully complete our project.

REFERENCES

[1] http://www.arduino.cc

[2] https://youtu.be/yiTJZJmxDmA

[3] https://youtu.be/nMdZ2xcrKRk?si=0M-aPfLPsIlVmlM9

JOURNAL COMMITTEE 2023-24

MANAGEMENT TEAM

Ganesh Waghmode (Head)
Rachna Soni
Vatsalya Saladi
Saniya Mahadik
Mihir Kumbhar

EDITING TEAM

Supriya Katkar (Head)
Achintya Pednekar
Riddhi Samarth
Pratiksha Chaudhari
Tejal Kakade
Mansi Singh
Mohit Jadhav

GRAPHICS TEAM

Priya Moolya (Head)
Narayan Yadav
Shreyash Zope
Prasad Bhor
Kashish Patil
Shruti Patil

JOURNAL COMMITTEE 2023-24

CORE TEAM

EDITING TEAM

GRAPHICS TEAM