GAS AND SMOKE DETECTION SYSTEM USING MQ-5 AND MQ-2 SENSOR

A PROJECT REPORT

submitted by

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in partial fulfillment for the award of the degree of

BACHELOR OF ENGINEERING

in

COMPUTER SCIENCE AND ENGINEERING

RAJALAKSHMI ENGINEERING COLLEGE,

ANNA UNIVERSITY : CHENNAI 600 025

MAY 2024

RAJALAKSHMI ENGINEERING COLLEGE, CHENNAI

BONAFIDE CERTIFICATE

Certified that this project report titled "**GAS AND SMOKE DETECTION SYSTEM USING MQ-5 AND MQ-2 SENSOR"** is the bonafide work of "**SRIMATHI G (210701259), SRIMATHY R (210701260)"** who carried out the work under my supervision. Certified further that to the best of my knowledge the work reported herein does not form part of any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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ABSTRACT

The LPG gas leakage detector project utilizes an Arduino board interfaced with an MQ-5 gas sensor, MQ-2 Smoke sensor, buzzer, and LED to detect the presence of LPG gas and smoke which alert users of potential leaks and fire. The MQ-5 gas sensor, capable of detecting various gases, also MQ-2 sensor detects the smoke and triggers the Arduino board upon sensing LPG gas, activating both the buzzer and LED for immediate notification. This cost-effective solution finds utility in home, industrial, and commercial settings, offering a reliable means of gas detection and smoke detection to prevent accidents and safeguard lives and property.

The LPG gas leakage detector can be enhanced by assigning distinct sounds to the buzzer for gas and smoke detection, aiding users in identifying the type of hazard detected. This customization improves the system's usability and response efficiency, allowing for quick and accurate action in emergency situations. Whether ensuring household safety, enhancing workplace security, or complying with safety regulations in commercial establishments, this approach facilitates proactive monitoring, enabling prompt action to mitigate risks and avert potential disasters.

ACKNOWLEDGEMENT

First, we thank the almighty God for the successful completion of the project. Our sincere thanks to our chairman **Mr. S. Meganathan, B.E., F.I.E.,** for his sincere endeavor in educating us in his premier institution. We would like to express our deep gratitude to our beloved Chairperson **Dr. Thangam Meganathan, Ph.D.,** for her enthusiastic motivation which inspired us a lot in completing this project, and Vice-Chairman **Mr. Abhay Shankar Meganthan**, **B.E., M.S.,** for providing us with the requisite infrastructure. We also express our sincere gratitude to our college principal, **Dr.S.N.Murugesan M.E., PhD.,** and **Dr. P. Kumar M.E., Ph.D., Head of the Department of Computer Science and Engineering,** and our project guide **Ms. S. Ponmani M.E.,MBA,** for her encouragement and guiding us throughout the project. We would like to thank our parents, friends, all faculty members, and supporting staff for their direct and indirect involvement in the successful completion of the project for their encouragement and support.

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CHAPTER 1

INTRODUCTION

Gas and smoke detection systems play a pivotal role in safeguarding lives and property across diverse environments, ranging from industrial facilities to residential homes. The integration of Internet of Things (IoT) technology has revolutionized gas and smoke detection systems, enhancing their efficiency, versatility, and accessibility. IoT connectivity allows these systems to gather real-time data from sensors distributed throughout the monitored area, enabling comprehensive coverage and precise detection capabilities. Moreover, IoT-enabled systems can transmit alerts and updates seamlessly across various devices and platforms, ensuring that relevant stakeholders remain informed and empowered to take necessary actions.

This convergence of traditional safety systems with cutting-edge IoT technology has ushered in a new era of proactive safety management. With enhanced monitoring capabilities and seamless connectivity, gas and smoke detection systems are better equipped than ever to identify potential hazards and avert crises before they escalate. As a result, they not only protect human health and safety but also contribute to the preservation of valuable assets and the continuity of operations in critical environments.

1.1 Motivation

System is motivated by the imperative to prioritize safety, protect health, and safeguard the environment. These systems play a crucial role in detecting hazardous gas leaks early, enabling timely responses to prevent accidents and injuries. Additionally, they help mitigate environmental pollution and property damage, ensuring regulatory compliance and effective risk management. By continuously monitoring gas levels and providing real-time alerts, gas detection systems offer peace of mind to individuals and organizations, assuring them that potential gas hazards are being effectively monitored and addressed.

1.2 Objectives

- ✓ To detect gases like LPG, natural gas, methane, and propane, the MQ5 sensor is commonly employed.
- ✓ To serve as an early warning system, the MQ5 sensor can detect gas concentrations that could pose risks to human health or safety, and also MQ-2 sensor detect the smoke promptly triggering alarms .
- ✓ To ensure a safe environment, particularly in gas-prone areas or where combustible gases are utilized or stored, continuous monitoring of gas levels is essential.
- ✓ To enhance overall safety measures, integrating the MQ5 gas sensor with IoT technology enables remote monitoring and data analysis capabilities

CHAPTER 2

LITERATURE REVIEW

Baballe, M. Ahmad, et al[1] . This paper is about enhancing fire security using IoT technology. The detection system includes an Arduino microcontroller, an MQ-5 gas sensor, and an active buzzer. It uses flame sensors to detect fires and measure heat intensity in various locations. Notifications are sent to mobile phones to enable quick action and minimize damage before emergency services arrive.

RC Pandey, M Verma, LK Sahu et al 2017 [2] . The detection system includes an Arduino microcontroller, an MQ-5 gas sensor, and an active buzzer. It uses flame sensors to detect fires and measure heat intensity in various locations. Notifications are sent to mobile phones for quick action to minimize damage before emergency services arrive.

IKN Trisnawan, AN Jati, N Istiqomah et al, 2019 [3] This research paper focuses on enhancing fire security using IoT technology, primarily employing the MQ-2 gas sensor known for its high sensitivity to flammable gases like LPG. Integrated with an Arduino microcontroller and an active buzzer, the system provides early fire detection and warning capabilities.

JBA Gomes, JJPC Rodrigues, RAL Rabêlo et al, 2019 [4] The author highlights advancements in wireless gas sensors and IoT-enabled gas sensors, focusing on their improved remote monitoring and data transmission capabilities. Integration of IoT technology enhances real-time detection and enables swift response to potential risks, benefitting various environments from industrial to residential settings.

SA Yadav, S Sharma, L Das, S Gupta… - 2021 [5] IoT-powered wireless sensor network for gas detection is presented, leveraging IoT technology for real-time monitoring and communication among sensors. This innovative system enhances flexibility and scalability while providing efficient gas detection and early warning capabilities, contributing to improved safety measures.

T. Todorov and P. Vela, et al [6] This research is about enhancing fire security using IoT technology. It employs flame sensors with an Arduino device to detect fires and measure heat intensity in homes, offices, and other places. These sensors serve as early alarm systems, sending notifications to mobile phones to prompt quick action and minimize damage before emergency services arrive.

A. H. Altowaijri, M. S. Alfaifi, T. A. Alshawi, A. B. Ibrahim and S. A. Alshebeili, [7] The author presents a novel solution for fire detection using IoT devices equipped with cameras, addressing concerns about privacy violation associated with cloud-based systems. By sending only extracted features instead of raw footage to the cloud, the proposed system preserves privacy while achieving high accuracy in fire detection. Utilizing binary video descriptors and Convolutional Neural Network (CNN), the algorithm achieves a classification accuracy of 97.5%, surpassing existing methods. Real-time processing is demonstrated using a Raspberry Pi 4 platform, ensuring practical feasibility.

2.1 Existing System

Traditional gas detection systems often suffer from limited coverage, high installation and maintenance costs, complex installation processes, and limited connectivity. These systems may struggle to detect gases effectively in larger areas or complex environments, and their high costs make them less accessible for smaller-scale applications or DIY projects. Moreover, the complex installation process and lack of user-friendly interfaces require specialized knowledge and professional assistance. Additionally, traditional systems may lack connectivity features, making it challenging to integrate them with other devices or systems for remote monitoring and data analysis.

2.1.1 Advantages of the existing system

- Enhanced Coverage : IoT gas detection systems offer wider coverage, efficiently monitoring larger areas or complex environments.
- Cost-effectiveness: They are more accessible due to reduced installation and maintenance costs, making them suitable for smaller-scale applications.

2.1.2 Drawbacks of the existing system

- Technical Complexity: Setup and configuration require technical expertise, potentially limiting accessibility for non-technical users.
- Connectivity Reliability: Dependency on wireless networks introduces reliability challenges, impacting effectiveness, especially in remote areas.

2.1 Proposed System

The LPG gas leakage detector project utilizing Arduino and MQ-5 gas sensor addresses these shortcomings. By utilizing an MQ-5 gas sensor capable of effectively detecting LPG gas within its range, the proposed system provides localized detection and alerting. Moreover, by utilizing affordable components such as the Arduino board, MQ-5 gas sensor, buzzer, and LED, the proposed system offers a cost-effective solution, making gas detection technology more accessible and added advantage of detecting smoke using MQ-2 Sensor . Simplifying the installation process with a user-friendly interface for programming and operation, the proposed system enables even non-experts to set up and use the system effectively. Furthermore, by incorporating IoT technology, the proposed system enables remote monitoring and data analysis capabilities, overcoming the limited connectivity of traditional systems and enhancing overall safety and convenience.

2.2.1Advantages of the proposed system

- Cost-effective with accessible components: Utilizing widely available and affordable components like Arduino and MQ-5 sensor makes the system economically viable for various users.
- Enables remote monitoring via IoT: Integrating IoT technology enables real-time monitoring and analysis of gas levels, enhancing safety and convenience by providing remote access to crucial information.

CHAPTER 3

SYSTEM DESIGN

3.1.1 Development Environment

3.1.1 Hardware Requirements

- MQ5 sensor
- Arduino Uno
- Buzzer
- Led light
- Bread board
- Battery

1. MQ5 Sensor: The MQ5 sensor is a versatile electronic sensor renowned for its ability to detect a range of gases including LPG, methane, and propane. Its chemiresistor-based design allows it to sense changes in gas concentration by altering its resistance, making it an essential component in gas detection projects for both residential and industrial applications.

2. Arduino Uno: The Arduino Uno is a popular open-source microcontroller board renowned for its simplicity and versatility. With a plethora of digital and analog input/output pins, it serves as the brain of the gas leakage detection system, facilitating communication between the sensors and actuators, and can be easily programmed using the Arduino IDE software.

3. Buzzer: The buzzer is a passive electronic component that produces audible alerts when an electrical signal is applied to it. In the gas leakage detection project, it serves as an auditory alarm, emitting a loud sound to alert users of a potential gas leak detected by the MQ5 sensor, ensuring timely response and safety.

4. LED Light: The LED (Light Emitting Diode) is a semiconductor light source that emits light when current passes through it. In the gas leakage detection system, it acts as a visual indicator, illuminating to visually alert users of a detected gas leak alongside the buzzer alarm, providing redundancy and accessibility in notifying users.

5. Breadboard: The breadboard is a fundamental tool for prototyping electronic circuits without the need for soldering. It allows for easy and temporary connections between components, facilitating the assembly and testing of the gas leakage detection system before final deployment.

6. Battery: The battery serves as the power source for the gas leakage detection system, providing portable and autonomous operation. Depending on the system's requirements, various types and capacities of batteries can be utilized to ensure reliable and continuous operation, even in the absence of mains power.

3.1.1Software Requirements

- Arduino ide

Arduino IDE: The Arduino Integrated Development Environment (IDE) is an intuitive software platform used for programming Arduino microcontroller boards. It provides a user-friendly interface for writing, compiling, and uploading code to the Arduino Uno, enabling customization and configuration of the gas leakage detection system's behavior and functionality.

CHAPTER 4

PROJECT DESCRIPTION

The LPG gas leakage detector project employs an Arduino board connected to an MQ-5 gas sensor, MQ-2 smoke sensor, buzzer, and LED to detect LPG gas and smoke, providing immediate alerts to users. The MQ-5 sensor identifies various gases, including LPG, while the MQ-2 sensor detects smoke. Upon detection of gas or smoke, the Arduino activates the buzzer and LED, ensuring quick notification of potential hazards. The system can be improved by assigning distinct sounds to the buzzer for gas and smoke alerts, allowing users to distinguish between the two hazards and respond more effectively. This customization enhances the system's practicality and response efficiency, promoting proactive monitoring and quick action to mitigate risks and prevent disasters.

4.1 SYSTEM ARCHITECTURE

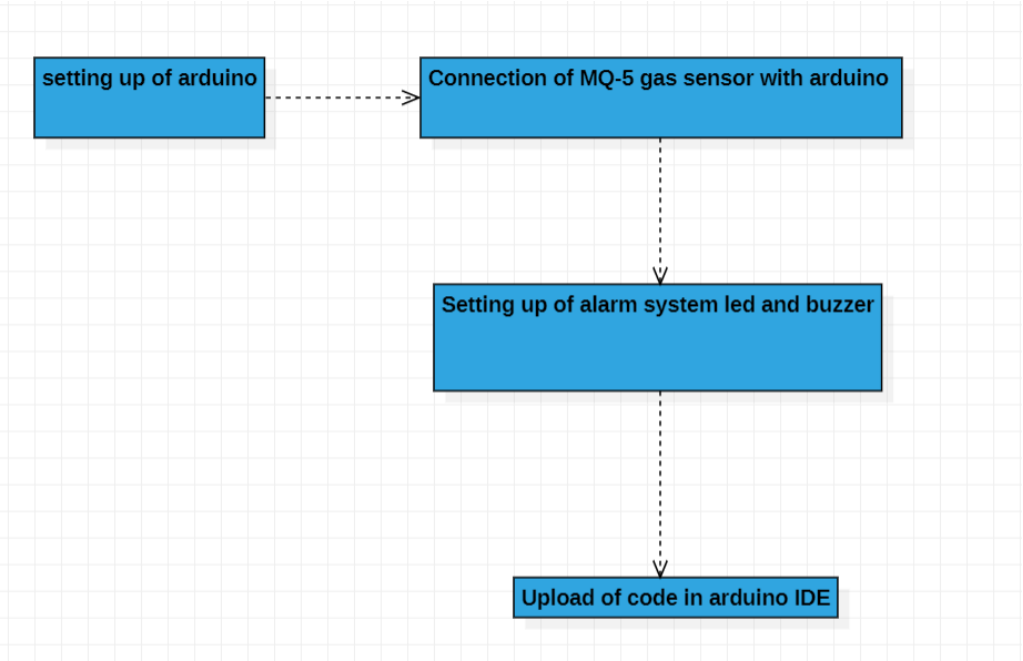


Fig 4.1 System Architecture

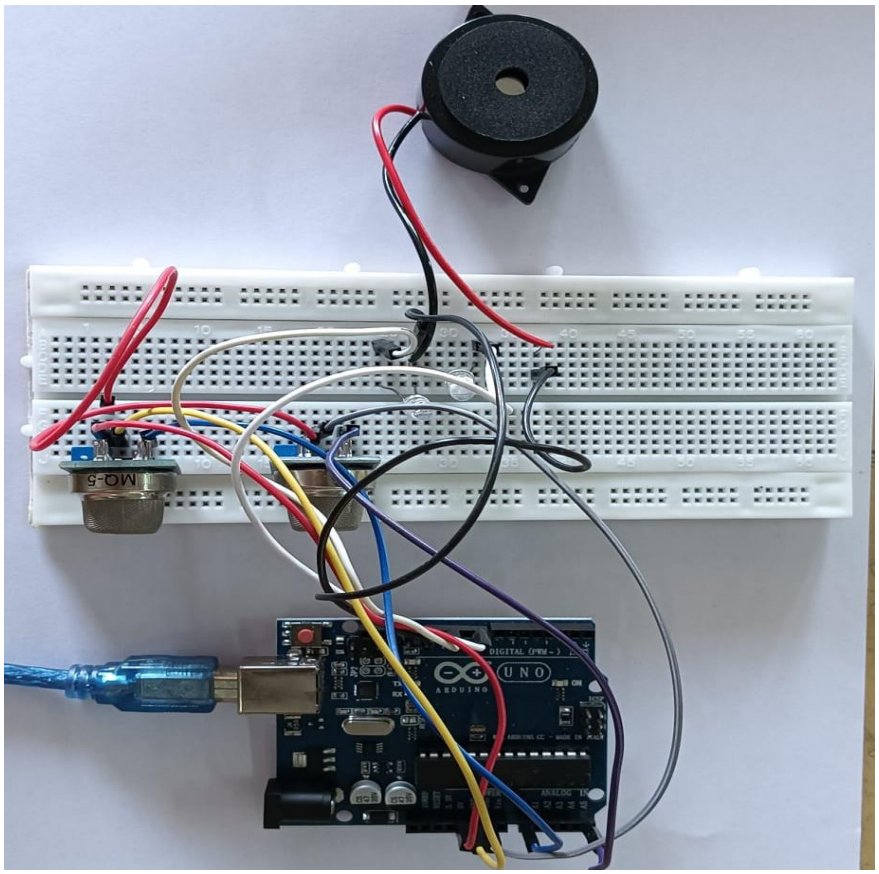
4.2 METHODOLOGY

The methodology of the LPG gas leakage detector project involves integrating an Arduino board with an MQ-5 gas sensor, MQ-2 smoke sensor, buzzer, and LED to form a comprehensive detection system. The MQ-5 sensor is calibrated to detect LPG and other gases, while the MQ-2 sensor is tuned for smoke detection. When either sensor detects a hazardous level of gas or smoke, it sends a signal to the Arduino, which processes the input and triggers the buzzer and LED to alert users. The system can be further refined by programming the Arduino to produce distinct sounds from the buzzer for gas and smoke detection, helping users identify the specific type of hazard quickly. This method ensures real-time monitoring and rapid response, making it an effective solution for enhancing safety in various environments.

CHAPTER 5

RESULTS AND DISCUSSION

The LPG gas leakage detector project successfully combines an Arduino board with MQ-5 and MQ-2 sensors to detect LPG gas and smoke, triggering an alert through a buzzer and LED. The system's ability to emit distinct sounds for gas and smoke detection enhances user awareness and response efficiency. Testing in diverse environments confirmed the device's sensitivity and reliability, making it a cost-effective and practical safety solution for homes, industries, and commercial spaces. While environmental factors like ventilation and sensor placement can impact performance, the overall design significantly improves safety by enabling quick detection and response to potential hazards. Future enhancements could include wireless alerts and integration with home automation systems for even greater effectiveness.



CHAPTER 6

CONCLUSION AND FUTURE WORK

6.1.Conclusion

The system provides the control action during gas leakage and it activate the alarm within a short time it is an economical system can be installed in apartments what else and wherever it is needed the cost of the proposed system is lesser than the commercially available detectors in the market it can help us to prevent from accidents in all directions. There are some products available which is which are similar to this classic case detector but those are not caused efficient and does not have any safety mechanism if this product becomes commercial it will overcome all demerits of other similar products.

6.2.Future Work

Future enhancements in gas and smoke detection systems using IoT will feature advancements in sensor technology, AI integration for data analysis, and edge computing for real-time responses. Autonomous sensor networks with self-configuring capabilities will ensure continuous monitoring coverage, while integration with smart infrastructure and predictive maintenance will optimize system performance. Additionally, blockchain technology will enhance data security, and augmented reality interfaces will improve situational awareness for better decision-making during gas incidents.

APPENDIX

SOFTWARE INSTALLATION

Arduino IDE

To run and mount code on the Arduino NANO, we need to first install the Arduino IDE. After running the code successfully, mount it.

Sample

code

```
const int buzzerPin = 13;
void setup()
{
pinMode(buzzerPin,OUTPUT);
pinMode(8,OUTPUT);
Serial.begin(9600);
}

void loop()
{
int val = analogRead(A0);
int sal=analogRead(A5);
if(val>400)
{
digitalWrite(buzzerPin,HIGH);
digitalWrite(8,LOW);
digitalWrite(10,HIGH);
Serial.println(val);
delay(40);
}
if(sal>400)
{
buzzDifferentSound('G');
digitalWrite(8,LOW);
digitalWrite(10,HIGH);
Serial.println(val);
```

```
delay(40);
}
else
{
digitalWrite(13,LOW);
digitalWrite(8,HIGH);
digitalWrite(10,LOW);
Serial.println("no Smoke");
delay(10);
}
}

void buzzDifferentSound(char sensorType)
{
if (sensorType == 'S')
{
// Sound pattern for smoke detected
tone(buzzerPin, 1000); // 1 kHz sound
delay(500);
noTone(buzzerPin);
delay(500);
}
else if (sensorType == 'G')
{
tone(buzzerPin, 2000); // 2 kHz sound
delay(250);
noTone(buzzerPin);
delay(250);
tone(buzzerPin, 2000);
delay(250);
noTone(buzzerPin);
delay(250);
}
}
```

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