IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.67
Volume 5, Issue 1, March 2025

Gas Leakage Detection System using Arduino

Mst. Suraj Deepak Jadhav[1], Ms. Aditi Adhikrao Jadhav[2], Mst. Siddhant Mahesh Patil[3], Prof. Rahul Patil[4]
Students, Department of Computer Technology[1,2,3]
Lecturer, Department of Computer Technology[4]
Bharati Vidyapeeth Institute of Technology, Navi Mumbai, Maharashtra, India

Abstract: *This paper presents the design and implementation of a gas leakage detection system using the SIM800L module. Gas leakage poses significant risks, including explosions, fires, and asphyxiation, which can lead to substantial property damage, environmental pollution, and loss of life. Traditional gas detectors often rely on manual inspection or localized alarms, which may not provide timely alerts, especially when the user is not present. To address these limitations, the proposed system utilizes the MQ-5 gas sensor to detect combustible gases such as Methane, Propane, and Butane. The integration of the SIM800L GSM module enables the system to send real-time SMS alerts to users, ensuring immediate notification and prompt action to prevent potential disasters. The system is designed using Arduino UNO as the microcontroller for efficient processing and control. Additionally, an LCD is used for real-time gas concentration display, and a buzzer provides audible alerts in case of leakage. The proposed design is cost-effective, user-friendly, and easily deployable in residential, industrial, and automotive environments. It significantly enhances safety by providing remote monitoring and rapid response to gas leak incidents. Gas leakage is a significant safety concern in residential, industrial, and vehicular environments due to its potential to cause explosions, fires, and health hazards. Conventional gas detection systems are often limited by range, reliability, and response time. The proposed system detects gas leakage using an MQ-5 sensor and promptly alerts users via SMS using the SIM800L module. The use of the SIM800L module ensures that alerts are sent even when the user is not on the premises, thereby enhancing safety by enabling quick response times and mitigating potential hazards. Additionally, the system is designed to be cost-effective and easily deployable in residential and industrial environments. The integration of Arduino UNO ensures efficient processing and control of the system components, making the overall system reliable and user-friendly.*

Keywords: Gas Leakage Detector, SIM800L, MQ-5 Sensor, Arduino UNO, SMS Alert, Safety System

I. INTRODUCTION

Gas leakage is a critical issue in residential, industrial, and automotive applications. Incidents resulting from gas leaks can lead to property damage, environmental hazards, and severe health risks, including poisoning, explosions, and fires. Liquefied Petroleum Gas (LPG) and Compressed Natural Gas (CNG) are commonly used as fuels due to their high calorific value and efficiency. However, they are highly flammable and can form explosive mixtures with air, posing significant safety hazards. For example, the Bhopal gas tragedy is a notable incident that highlights the catastrophic consequences of gas leakage. In recent years, there has been an increase in gas-related accidents, primarily due to substandard cylinders, worn-out valves, lack of maintenance, and improper handling. Conventional gas detection systems typically use alarms or manual inspection, which are not reliable for timely alerts, especially if the user is away from the premises. Therefore, there is a need for a more efficient solution that provides real-time notifications and remote monitoring to ensure safety. The proposed system utilizes the MQ-5 gas sensor, which is highly sensitive to Methane, Propane, and Butane gases, to detect leakage. By integrating the SIM800L GSM module, the system can send SMS alerts to users' mobile phones, allowing them to take immediate action. Arduino UNO is used as the microcontroller to process sensor data and control the system components. The design also includes an LCD for real-time gas concentration display and a buzzer for audio alerts. This paper presents the design, implementation, and testing of the gas leakage detection system, highlighting its effectiveness, cost-efficiency, and ease of deployment. Incidents

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.67
Volume 5, Issue 1, March 2025

resulting from gas leaks can lead to property damage, environmental hazards, and loss of life. Traditional gas detection methods rely on manual inspection or alarm systems that may not provide timely alerts, thus necessitating a more efficient solution. In addition, gas leaks from sources such as LPG, Methane, and other combustible gases are often odorless, making them difficult to detect without specialized equipment. This paper proposes a gas leakage detection system using the MQ-5 gas sensor integrated with the SIM800L GSM module to send real-time SMS alerts. The system leverages Arduino UNO for processing and controlling the components. This design ensures rapid notification to users, allowing them to take immediate preventive actions. Moreover, the system includes an LCD for real-time display of gas concentration levels and a buzzer for audible alerts, making it a comprehensive safety solution.

II. PROBLEM STATEMENT

Gas leakage is a significant safety concern in residential, industrial, and automotive environments. Incidents resulting from gas leaks can cause explosions, fires, and health hazards, leading to severe injuries, property damage, and loss of life. Conventional gas detection systems primarily rely on manual inspection or localized alarm-based mechanisms, which are ineffective when users are not present to respond immediately.

Additionally, traditional gas detectors often have limitations such as short detection ranges, lack of real-time alerts, and an inability to provide remote monitoring capabilities. These limitations increase the risk of delayed responses, which can result in catastrophic consequences.

To address these challenges, there is a need for a **cost-effective, reliable, and automated gas leakage detection system** that can:

- Accurately detect the presence of hazardous gases such as **Methane, Propane, and Butane**.
- Provide **real-time notifications** to users even when they are away from the premises.
- Integrate **wireless communication technology**, such as the **SIM800L GSM module**, to send SMS alerts upon detecting gas leaks.
- Be **easily deployable and scalable** for use in residential homes, industries, and vehicles.

This research focuses on developing a **smart gas leakage detection system** using an **MQ-5 gas sensor, Arduino UNO, and SIM800L module**, ensuring real-time monitoring, remote notifications, and immediate preventive action to enhance safety.

III. LITERATURE SURVEY

Gas leakage detection systems have evolved significantly with advancements in sensor technologies, communication modules, and automation techniques. Researchers have explored various methodologies to enhance gas leakage detection efficiency, reduce response time, and improve safety measures.

Mane et al. (2023) proposed an IoT-based gas leakage detection and alerting system that integrates gas sensors with cloud computing. The system sends alerts to users through notifications and alarms, ensuring real-time data analytics on gas concentrations for enhanced safety in residential areas **(1)**.

Asafe et al. (2022) developed a sensor-based gas leakage detection system utilizing an MQ-series gas sensor and an Arduino microcontroller. Their system automatically detects gas leaks, triggers an alarm, and activates an exhaust fan to prevent hazardous situations. The integration of exhaust fans ensures that leaked gases are promptly removed from enclosed environments **(2)**.

Imade et al. (2018) introduced a microcontroller-based LPG gas leakage detector that improves conventional systems by incorporating a stepper motor to shut off gas supply valves in case of a leak. Additionally, the system utilizes a GSM module to send SMS alerts to users, providing an extra layer of safety and remote monitoring capability **(3)**.

Chourasia et al. (2022) presented an IoT-enabled gas leakage detection and warning system that employs an MQ-5 gas sensor and an Arduino UNO. The system transmits gas concentration data to a cloud-based dashboard, allowing remote monitoring. Additionally, it features an automated exhaust fan activation mechanism upon detecting a leak, reducing the risk of explosion or poisoning **(4)**.

Yadav et al. (2016) explored the application of Tiny Machine Learning (TinyML) for gas leakage detection. Their system leverages advanced machine learning algorithms to efficiently identify gas leaks and provide real-time alerts via

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.67
Volume 5, Issue 1, March 2025

BLE technology and an LCD interface. The study emphasizes the potential of AI-driven gas detection systems in enhancing accuracy and reducing false alarms **(5)**.

Alshammari and Chughtai (2020) introduced a gas leakage detection system that employs IoT and cloud-based monitoring techniques. Their research highlights the importance of remote surveillance and automation in enhancing gas detection efficiency and safety measures **(6)**.

Tsoukas et al. (2023) developed an advanced gas leakage detection device based on TinyML technology. This system integrates AI-based anomaly detection and provides real-time alerts through BLE and LCD notifications, improving detection accuracy and reducing false alarms **(7)**.

The literature indicates that modern gas leakage detection systems focus on integrating IoT, AI, and real-time monitoring to improve safety and response times. The proposed system in this study builds upon these advancements by utilizing the SIM800L GSM module for remote notifications, MQ-5 sensors for accurate gas detection, and Arduino UNO for efficient processing and control.

IV. METHODOLOGY

The system utilizes the **MQ-5 gas sensor**, which is highly sensitive to Methane, Propane, and Butane gases.

The sensor detects changes in conductivity caused by gas concentration and produces an **analog output proportional to the gas level**.

The output is fed into the **Arduino UNO**, which serves as the **primary processing unit**.

Arduino UNO is programmed using the Arduino IDE and is responsible for:

- Processing gas sensor data.
- Controlling alert mechanisms.
- Interfacing with the **SIM800L module** for SMS notifications.

The **SIM800L module**, a **GSM-based communication device**, enables **wireless transmission of alert messages** to predefined mobile numbers.

When gas concentration **exceeds the safety threshold**, the **Arduino triggers the SIM800L module to send an SMS alert**.

The system includes an **LCD module** to display real-time **gas concentration levels**.

A **buzzer is integrated** to produce an **audible alarm** for immediate alerting.

Components are interconnected using **jumper wires** and powered by a **5V adapter** for stable operation.

The hardware design is implemented on a **breadboard**, facilitating **easy prototyping and testing**.

Wiring layout is carefully planned to minimize noise interference and optimize space utilization.

The software is implemented using **C++**, leveraging libraries for:

- **MQ-5 sensor**
- **LCD display**
- **SIM800L module**

The code **continuously reads gas concentration values**, compares them against the **safety threshold**, and triggers the appropriate alert mechanisms.

A **reset function** allows users to **acknowledge alerts** and resume normal operation **once the gas concentration returns to safe levels**.

The prototype is **tested in controlled environments** using different gas sources (**LPG and Methane**) to ensure:

- Accuracy
- Sensitivity
- Reliability

Test scenarios include:

- Low gas concentration levels
- Moderate gas concentration levels
- High gas concentration levels

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.67
Volume 5, Issue 1, March 2025

The system's **response time, alert accuracy, and SMS delivery efficiency** are evaluated and documented.
The **prototype was constructed on a breadboard** for testing and validation.
The **Arduino UNO processes gas sensor data** and triggers alarms and SMS alerts **when gas levels exceed the threshold**.
The **LCD displays real-time gas concentration**, and the **buzzer provides an audible warning**.
The **SIM800L module sends SMS alerts to predefined mobile numbers**, ensuring users are notified even if they are not on the premises.
The **components were arranged efficiently** to optimize space and **minimize noise interference**.

V. OVERVIEW

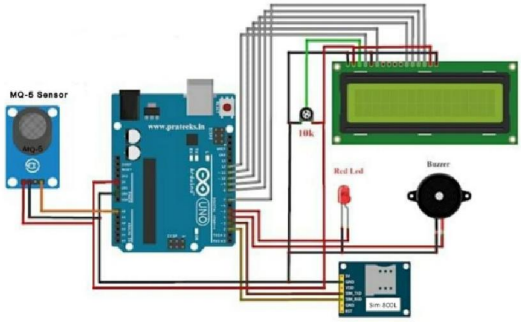

Fig 1. Circuit Diagram of Gas Leakage Detector

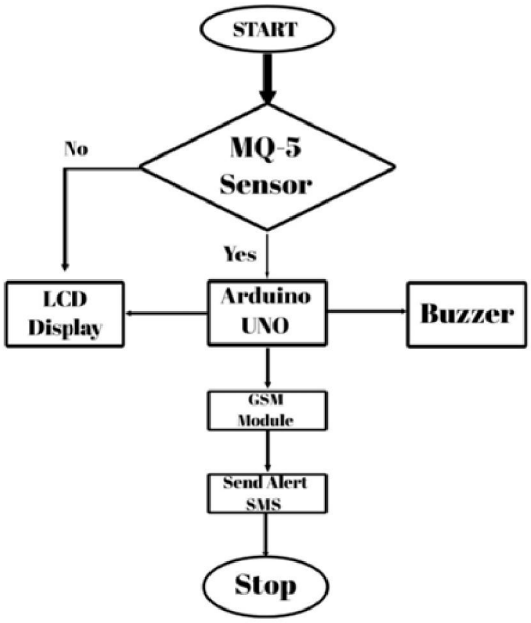

Fig 2 Block diagram of Gas Leakage Detector

VI. FUTURE SCOPE

The gas leakage detection system can be further enhanced with several advancements to improve its efficiency, reliability, and scalability. Future developments may include:

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.67
Volume 5, Issue 1, March 2025

- **IoT Integration:** Implementing Internet of Things (IoT) technology to enable real-time cloud monitoring, allowing users to track gas levels remotely via a mobile application or web dashboard.
- **Artificial Intelligence and Machine Learning:** AI-based predictive analytics can be used to analyze gas leakage patterns and predict potential hazards before they occur.
- **Multi-Gas Detection:** Expanding the system to detect additional hazardous gases like Carbon Monoxide (CO), Hydrogen Sulfide (H_2S), and Ammonia (NH_3) for broader safety applications.
- **Automated Gas Shut-off Mechanism:** Integrating an automatic solenoid valve that can shut off gas supply upon leakage detection to prevent potential accidents.
- **Long-Range Communication Technologies:** Utilizing LoRa (Long Range) or NB-IoT (Narrowband IoT) for better connectivity in remote and industrial environments where GSM coverage may be weak.
- **Solar-Powered Operation:** Implementing solar energy-based power sources to enhance system sustainability, especially in off-grid locations.
- **Voice and Smart Home Integration:** Connecting the system with voice assistants like Alexa or Google Assistant for instant voice alerts and smart home automation.

VII. CONCLUSION

This paper presents a reliable gas leakage detection system using the SIM800L GSM module and MQ-5 gas sensor. The system effectively detects gas leaks and promptly alerts users through SMS notifications, enabling quick response times and minimizing potential hazards. The MQ-5 sensor's high sensitivity to Methane, Propane, and Butane ensures accurate gas concentration readings, displayed in real-time on an LCD module. The integration of Arduino UNO ensures efficient processing and control, while the buzzer provides an audible alert mechanism for enhanced safety. The use of the SIM800L GSM module allows remote monitoring and real-time communication, overcoming the limitations of conventional gas detectors. The system is cost-effective, easy to deploy, and suitable for residential and industrial applications. Future enhancements may include IoT integration for remote monitoring and additional sensors for detecting other hazardous gases, increasing its versatility and effectiveness.

Key Project Milestones:

- **Project Conceptualization:** Identified the need for a gas leakage detection system and defined the project scope.
- **Component Selection:** Researched and selected suitable components including the MQ-5 sensor, SIM800L module, Arduino UNO, LCD, and buzzer.
- **Circuit Design and Prototyping:** Designed and assembled the hardware prototype on a breadboard for initial testing.
- **Software Development:** Developed the Arduino code for processing sensor data, triggering alerts, and communicating with the SIM800L module.
- **System Testing:** Conducted controlled experiments to validate sensor accuracy, SMS alert functionality, and overall system performance.
- **Final Implementation:** Integrated all components into a stable platform and conducted real-world testing in different environments.
- **Documentation and Report:** Compiled results, findings, and conclusions into a structured research paper.

REFERENCES

[1] **Mane, M., Kamble, S., Mandpalkar, N., Gavali, S., &Gavade, S. S. (2023).** IoT-Based Gas Leakage Detector for Home. *Journal of Emerging Technologies and Innovative Research (JETIR)*, 10(6), 615-616.

[2] **Asafe, Y. N., Oyeranmi, A. J., Olamide, O. A., & Abigael, A. O. (2022).** Gas Leakage Detector and Monitoring System. *I.J. Engineering and Manufacturing*, 12(5), 56-65.

[3] **Imade, S., Rajmane, P., Gavali, A., &Nayakwadi, V. N. (2018).** Gas Leakage Detection and Smart Alerting System Using IoT. *International Journal of Innovative Research & Studies*, 8(2).

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.67
Volume 5, Issue 1, March 2025

[4] **Chourasia, N., Ajmire, P., Shambharkar, S., Khobragade, S., Bhajgaware, S., &Janbandhu, S. (2022).** Sensor-Based Gas Leakage Detector System. *International Journal of Creative Research Thoughts (IJCRT)*, 10(6).

[5] **Yadav, V., Shukla, A., Bandra, S., Kumar, V., Ansari, U., & Khanna, S. (2016).** A Review on Microcontroller-Based LPG Gas Leakage Detector. *Journal of VLSI Design and Signal Processing*, 2(3), 1-10.

[6] **Alshammari, B. F., & Chughtai, M. T. (2020).** IoT Gas Leakage Detector and Warning Generator. *Engineering, Technology & Applied Science Research*, 10(4), 6142-6146.

[7] **Tsoukas, V., Gkogkidis, A., Boumpa, E., Papafotikas, S., &Kakarountas, A. (2023).** A Gas Leakage Detection Device Based on the Technology of TinyML. *Technologies*, 11(45).