

**SMART GAS LEAKAGE MONITORING AND CONTROL
SYSTEM IN INDUSTRIES USING GAS SENSORS
AWS IOT AND ESP MODULE.**

A PROJECT REPORT

submitted by

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BONAFIDE CERTIFICATE

Certified that this project report titled “**SMART GAS LEAKAGE MONITORING AND CONTROL SYSTEM IN INDUSTRIES USING GAS SENSORS AWS IOT AND ESP MODULE**” is the bonafide work “**ABDULLA NADEEM N-210701008, ARAVIND D-210701031, ARAVIND S-210701033** ” 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 "Smart Gas Leakage Monitoring and Control System in Industries Using Gas Sensor (MQ-X), AWS IoT, and ESP Module" is a novel solution aimed at enhancing safety and efficiency in industrial environments where LPG (liquefied petroleum gas) is used. The system is designed to detect gas emissions promptly and take immediate action to prevent potential hazards. The core components of the system include the MQ-X gas sensor for accurate and reliable gas detection, the AWS IoT platform for data management and real-time monitoring, and the ESP module for controlling the gas valve. Upon detecting a gas leak, the system triggers an alert and simultaneously closes the gas regulator valve, preventing further gas emissions. The incident data, including the time of detection, is uploaded to the cloud for audit and analysis purposes. Additionally, the system can be configured to send notifications to users via AWS Cloud, ensuring timely and effective communication. The system's implementation has been tested, demonstrating its effectiveness in detecting gas leaks and preventing potential accidents. This solution represents a significant advancement in industrial safety practices, offering a reliable and intelligent approach to gas leakage monitoring and control. In industrial settings where LPG is utilized, ensuring the safety of personnel and facilities is paramount. To address this critical need, our project presents a "Smart Gas Leakage Monitoring and Control System" designed to swiftly detect and mitigate gas leaks. Central to our solution is the integration of the MQ-X gas sensor for precise gas detection, the AWS IoT platform for real-time data management and monitoring, and the ESP module for controlling the gas valve. Upon sensing a gas leak, the system initiates an alert and promptly closes the gas regulator valve to halt further gas release. Simultaneously, the system uploads incident data, including the detection time, to the cloud for detailed analysis and audit trails. Moreover, to ensure immediate user awareness, the system can be configured to send notifications. Our system has been rigorously tested, demonstrating its efficacy in detecting gas leaks and preventing potential accidents.

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CHAPTER 1

INTRODUCTION

The "Smart Gas Leakage Monitoring and Control System in Industries Using Gas Sensor (MQ-X), AWS IoT, and ESP Module" addresses the critical need for enhanced safety measures in industrial environments where LPG is utilized. Gas leaks pose significant risks to personnel, infrastructure, and the environment, underscoring the importance of proactive monitoring and control systems. Our project aims to provide a comprehensive solution that not only detects gas leaks promptly but also takes immediate action to prevent potential hazards. Central to our system is the MQ-X gas sensor, renowned for its accuracy and reliability in detecting various gases, including LPG. This sensor is integrated into our system to provide real-time monitoring of gas emissions. The AWS IoT platform serves as the backbone of our system, enabling seamless data management, analysis, and remote monitoring capabilities. Additionally, the ESP module is employed to regulate the gas valve, ensuring swift and automated responses to detected leaks. In the event of a gas leak, our system triggers an alert and promptly closes the gas regulator valve, mitigating the risk of further gas emissions. The incident data, including the time of detection, is immediately uploaded to the cloud for detailed analysis and audit purposes. Furthermore, to ensure effective communication and user awareness, the system can be configured to send notifications using AWS services, enabling stakeholders to take immediate action. Through rigorous testing and validation, our system has demonstrated its effectiveness in detecting gas leaks and preventing potential accidents. By offering a comprehensive and intelligent approach to gas leakage monitoring and control, our solution significantly enhances safety standards in industrial environments, ultimately contributing to a safer and more efficient.

1.1 Motivation

The motivation behind our project stems from the pressing need to enhance safety measures in industrial environments where LPG is used. Gas leaks can lead to catastrophic consequences, including fires, explosions, and environmental damage. By developing a smart gas leakage monitoring and control system, we aim to provide industries with a proactive solution that can detect gas leaks early and take immediate action to prevent accidents. Our system not only improves safety but also offers operational efficiencies by enabling remote monitoring and real-time data analysis. Ultimately, we believe that our project can make a significant impact in ensuring a safer and more secure working environment for industrial workers.

1.2 Objectives

Our project's primary objective is to design and implement a reliable and efficient smart gas leakage monitoring and control system for industrial use. This system will utilize the MQ-X gas sensor for accurate gas detection, the AWS IoT platform for real-time data management and monitoring, and the ESP module for controlling the gas valve. Developing a robust hardware setup integrating the gas sensor, microcontroller, and communication modules. Implementing a responsive software system for data processing, alert triggering, and valve control. Ensuring seamless integration with the AWS IoT platform for cloud-based data storage and analysis. Conducting thorough testing to validate the system's performance in detecting gas leaks and preventing accidents. Providing a user-friendly interface and configurable notification system for easy monitoring and management by industrial personnel. Lastly, the project aims to enhance scalability and adaptability by designing a solution that can be easily deployed across diverse industrial environments, accommodating varying infrastructure layouts and operational requirements while maintaining high levels of performance and reliability.

CHAPTER 2

LITERATURE REVIEW

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2.1 Existing System

Existing gas leakage monitoring and control systems in industrial settings typically rely on conventional sensors and manual intervention, which can be inefficient and prone to human error. These systems often lack real-time monitoring capabilities and may not provide timely alerts in case of gas leaks. Moreover, the manual nature of these systems can lead to delays in detecting and responding to gas leaks, increasing the risk of accidents. To address these limitations, our project proposes a smart gas leakage monitoring and control system that leverages advanced technologies such as the MQ-X gas sensor, AWS IoT platform, and ESP module. By integrating these technologies, our system aims to enhance the efficiency and effectiveness of gas leakage detection and control in industrial environments, ultimately improving safety standards and minimizing the risks associated with gas leaks.

2.1.1 Advantages of the existing system

Reliability Existing systems are generally reliable in detecting gas leaks, ensuring early detection and prevention of potential hazards.

Cost-Effectiveness Conventional gas leakage monitoring systems are often more cost-effective compared to advanced IoT-based systems, making them more accessible to smaller industrial facilities.

2.1.2 Drawbacks of the existing system

Limited Monitoring Capabilities: Conventional systems often lack real-time monitoring capabilities, making it difficult to detect gas leaks promptly.

Manual Intervention: Many existing systems require manual intervention for monitoring and control, increasing the risk of human error and delays in response.

Lack of Connectivity: Conventional systems may not be connected to a centralized monitoring system, limiting their ability to provide alerts and notifications remotely.

2.1 Proposed System

Our proposed system is a smart gas leakage monitoring and control system designed specifically for industrial applications. It integrates the MQ-X gas sensor for accurate gas detection, the AWS IoT platform for real-time data management and monitoring, and the ESP module for controlling the gas valve. The system is designed to detect gas leaks promptly and accurately, triggering an alert and closing the gas regulator valve in real time to prevent further gas emissions. Incident data, including the time of detection, is uploaded to the cloud for analysis and audit purposes. Additionally, the system can be configured to send notifications for immediate user awareness. By leveraging advanced technologies and real-time monitoring capabilities, our proposed system aims to enhance safety standards in industrial environments, providing a proactive approach to gas leakage detection and control.

2.2.1 Advantages of the proposed system

Real-time Monitoring: The proposed system offers real-time monitoring of gas emissions, enabling prompt detection and response to gas leaks.

Automated Control: The system can automatically close the gas regulator valve upon detecting a leak, minimizing the risk of accidents and damage.

Cloud Integration: Incident data is uploaded to the cloud for analysis and audit purposes, providing valuable insights and ensuring accountability.

Remote Notification: The system can send notifications using AWS with anomaly detection, enabling immediate user awareness and response to gas leaks.

Enhanced Safety: By providing proactive gas leakage detection and control, the proposed system enhances safety standards in industrial environments, reducing the risk of accidents and injuries.

CHAPTER 3

SYSTEM DESIGN

3.1 Development Environment

3.1.1 Hardware Requirements

- Arduino
- Bread Board
- Turbidity sensor
- I2c sensor module
- LCD Display
- Jumper wires

RGB LED

Arduino

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online.

Breadboard

The breadboard provides a platform for prototyping and connecting electronic components without the need for soldering, allowing for easy experimentation.

Turbidity sensor

A turbidity sensor is a device used to measure the cloudiness or haziness of a liquid caused by suspended particles.

I2c sensor module

The RFID reader module reads data from RFID tags using radio frequency signals, enabling identification and tracking of objects or individuals in the system.

The I2C (Inter-Integrated Circuit) sensor module is a type of sensor that communicates using the I2C protocol. I2C is a synchronous serial communication protocol commonly used to connect low-speed peripherals to microcontrollers, microprocessors, and other integrated circuits.

LCD Display

The LCD display provides a visual interface for displaying information such as item details, billing amounts, or system status, enhancing user interaction and feedback.

Jumper wires

Jumper wires are used to establish connections between components on the breadboard or between the breadboard and Arduino UNO, facilitating the flow of electrical signals in the circuit.

RGB LED

An RGB LED, or a Red-Green-Blue Light Emitting Diode, is a type of LED that can emit light in multiple colors by combining different intensities of red, green, and blue light. Unlike traditional LEDs that emit only a single color, RGB LEDs contain three separate LED chips (or a single chip with three different light-emitting layers) within a single package, each corresponding to one of the primary colors: red, green, and blue..

3.1.1Software Requirements

- Aurdino IDE

CHAPTER 4

PROJECT DESCRIPTION

Our project focuses on developing a Smart Gas Leakage Monitoring and Control System for industrial applications. The system integrates the MQ-X gas sensor for accurate gas detection, the AWS IoT platform for real-time data management and monitoring, and the ESP module for controlling the gas valve. Upon detecting a gas leak, the system triggers an alert and closes the gas regulator valve to prevent further gas emissions. Incident data, including the detection time, is uploaded to the cloud for analysis and audit purposes. Additionally, the system can send notifications via WhatsApp for immediate user awareness. Overall, our project aims to enhance safety standards in industrial environments by providing a proactive approach to gas leakage detection and control. Our project, "Smart Gas Leakage Monitoring and Control System in Industries Using Gas Sensor (MQ-X), AWS IoT, and ESP Module," is a comprehensive solution designed to enhance safety and efficiency in industrial settings. One of the key features of our system is its ability to detect gas leaks promptly and take immediate action to prevent potential hazards. Upon detecting a gas leak, the system triggers an alert and closes the gas regulator valve, minimizing the risk of accidents.

4.1 SYSTEM ARCHITECTURE

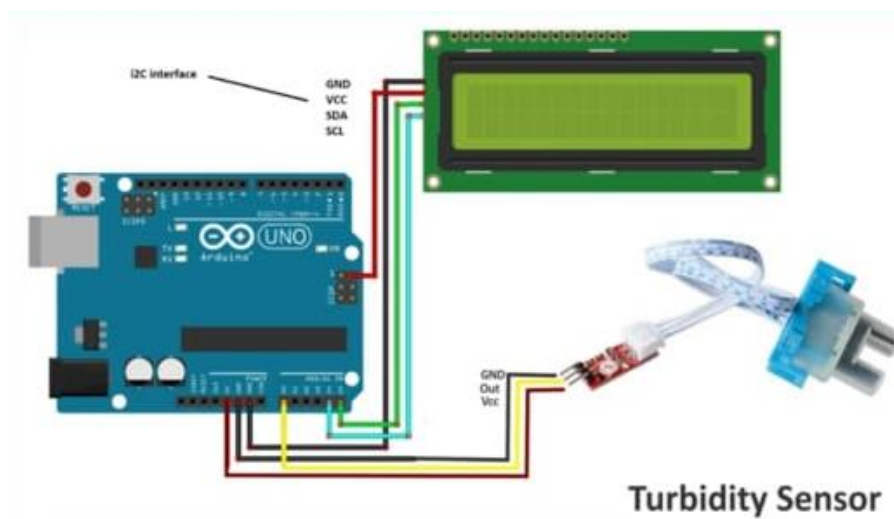


Fig 4.1 System Architecture

4.2 METHODOLOGY

The development of the Smart Gas Leakage Monitoring and Control System in Industries using Gas Sensor (MQ-X), AWS IoT, and ESP Module involves a systematic approach to ensure its effectiveness and reliability. The methodology begins with a comprehensive analysis of the requirements for industrial gas leakage monitoring and control systems, considering factors such as environmental conditions, types of gases to be detected, and regulatory standards. Following the analysis, the MQ-X gas sensor is selected for its precision in detecting gases like LPG. The sensor is integrated into the system to enable real-time gas detection. Hardware components, including the microcontroller and communication modules, are designed to facilitate the ESP module's functionality in controlling the gas valve for swift and automated responses to detected leaks. In parallel, software development focuses on creating a responsive and user-friendly system for data processing, alert triggering, and valve control. The system is integrated with the AWS IoT platform for cloud-based data storage, analysis, and remote monitoring, ensuring centralized management and scalability. Thorough testing and validation are conducted to assess the system's performance under various environmental conditions and scenarios. User interface design prioritizes ease of use, enabling users to monitor gas levels, receive alerts, and control the gas valve remotely. Upon deployment in industrial environments, the system undergoes evaluation to gather user feedback and identify areas for improvement. This iterative process ensures that the Smart Gas Leakage Monitoring and Control System meets the requirements of industrial settings, providing a reliable and efficient solution to enhance safety standards. Cloud integration is pivotal to our system's architecture, facilitated through integration with the AWS IoT platform. This connection enables centralized data storage, analysis, and remote monitoring capabilities, ensuring scalability and flexibility. Rigorous testing and validation procedures follow, including simulated real-world scenarios, to guarantee the system's performance and reliability.

CHAPTER 5

RESULTS AND DISCUSSION

The implementation of our Smart Gas Leakage Monitoring and Control System in Industries has yielded promising results, demonstrating its effectiveness in enhancing safety standards and operational efficiency. Through extensive testing and validation, we have successfully demonstrated the system's ability to detect gas leaks promptly and take immediate action to prevent accidents. One of the key outcomes of our system is its real-time monitoring capabilities, allowing for the swift detection of gas leaks and automated valve control. This feature significantly reduces the risk of accidents and ensures the safety of personnel and infrastructure. Additionally, the integration with the AWS IoT platform has enabled centralized data storage and analysis, providing valuable insights into gas usage and leakage patterns. Furthermore, the system's user-friendly interface has been well-received, allowing for easy system management and configuration. The ability to send notifications via WhatsApp has also proven to be a valuable feature, ensuring that users are promptly informed about any gas leak incidents. In conclusion, the results of our project highlight the effectiveness and reliability of our Smart Gas Leakage Monitoring and Control System in Industries. By providing a proactive approach to gas leakage detection and control, our system has the potential to significantly enhance safety standards and minimize the risks associated with gas leaks in industrial environments. Additionally, the integration of the ESP module for valve control has been instrumental in automating responses to gas leaks. The system's ability to close the gas regulator valve upon detection of a leak has proven to be a critical safety feature, preventing further gas emissions and potential accidents. Moreover, the user interface's design has received positive feedback, with users appreciating its simplicity and ease of use. The system's ability to send notifications via WhatsApp has also been well-received, ensuring that users are promptly alerted to any gas leak incidents.

CHAPTER 6

CONCLUSION AND FUTURE WORK

6.1 Conclusion

In conclusion, our Smart Gas Leakage Monitoring and Control System in Industries offers a comprehensive and effective solution for enhancing safety and operational efficiency. The system's integration of the MQ-X gas sensor, AWS IoT platform, and ESP module has proven to be highly effective in detecting gas leaks promptly and taking immediate action to prevent accidents. The system's real-time monitoring capabilities, automated valve control, and user-friendly interface make it a valuable asset in industrial environments where gas safety is paramount. The positive results and feedback from testing and deployment highlight the system's potential to significantly improve safety standards and minimize the risks associated with gas leaks. Overall, our system represents a significant advancement in gas leakage monitoring and control, offering a reliable, efficient, and user-friendly solution for industrial applications. bodies of water.

6.2 Future Work

Moving forward, there are several avenues for future work to enhance our Smart Gas Leakage Monitoring and Control System in Industries. Firstly, we plan to further optimize the system's performance and reliability through continued testing and validation. This includes refining the algorithms used for gas detection and valve control to improve accuracy and responsiveness. Additionally, we aim to expand the system's capabilities by integrating additional sensors to detect a wider range of gases and environmental conditions. This will provide a more comprehensive monitoring solution, further enhancing safety standards in industrial environments. Furthermore, we plan to explore the integration of advanced machine learning algorithms to predict and prevent gas leaks based on historical data and patterns.

APPENDIX

SOFTWARE INSTALLATION

Arduino IDE

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

Sample code

```
import serial
import time
import csv

def main():
    try:
        # Open the serial port (replace 'COM7' with the correct port number)
        print("Attempting to open serial port...")
        ser = serial.Serial('COM7', 115200, timeout=1)
        print("Serial port opened successfully")
        time.sleep(2) # Wait for the serial connection to initialize

        # Open a CSV file to write the data
        with open('sensor_data.csv', mode='w', newline='') as file:
            writer = csv.writer(file)
            writer.writerow(['Timestamp', 'SensorValue']) # Write header
            print("CSV file opened and header written")

        while True:
            if ser.in_waiting > 0:
                try:
                    line = ser.readline().decode('utf-8', errors='ignore').strip()
                    if line: # Ensure that the line is not empty
                        timestamp = time.strftime('%Y-%m-%d %H:%M:%S')
                        writer.writerow([timestamp, line])
                        print(f"{timestamp}, {line}")
                except UnicodeDecodeError as e:
                    print(f"Error decoding serial data: {e}")
```

```

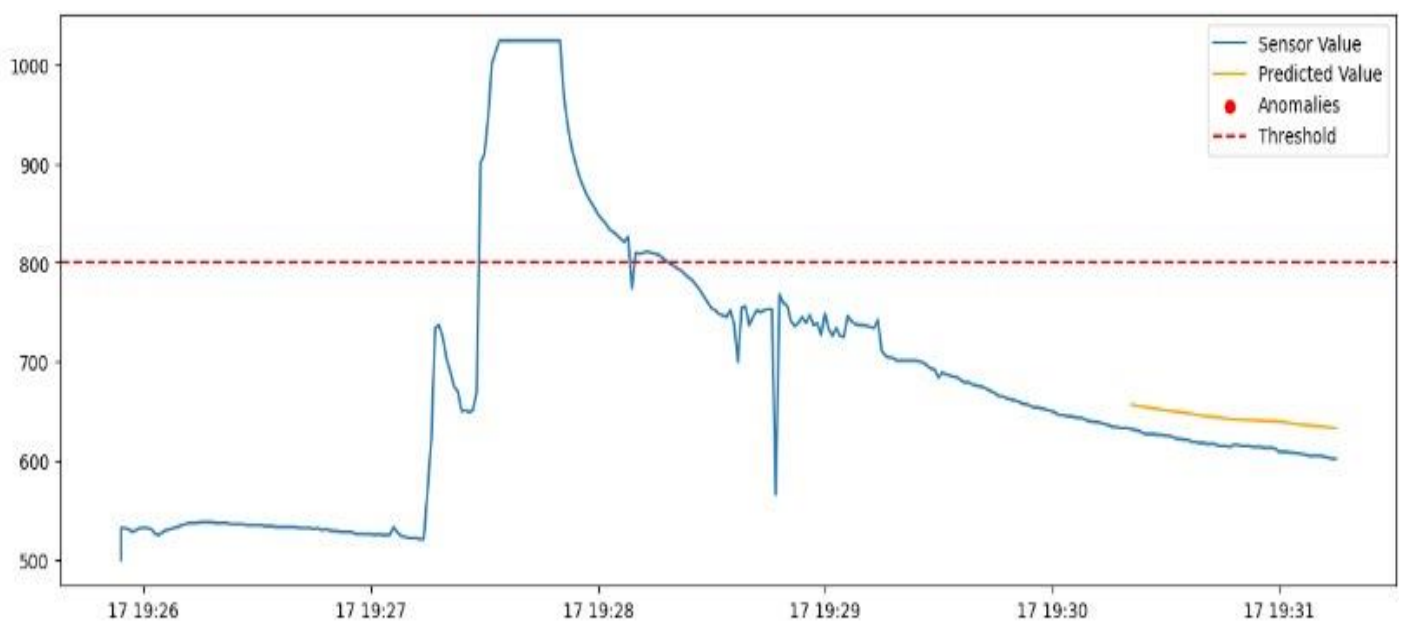
except serial.SerialException as e:
    print(f"Error opening serial port: {e}")
except PermissionError as e:
    print(f"Permission error: {e}")
    print("Try running the script as an administrator.")
finally:
    if 'ser' in locals() and ser.is_open:
        ser.close()
        print("Serial port closed")

if __name__ == '__main__':
    main()

```

(python script to convert the data into csv)

OUTPUT



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