Gas Leakage Detecting and Alerting System using IoT

A PROJECT REPORT

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BONAFIDE CERTIFICATE

Certified that this project report titled "**Gas Leakage Detecting and Alerting System using IoT"** is the bonafide work of "**Vaishnavi Sri S M(210701299),Varshini L(210701301),Vilashini G(210701308)"** 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

Hazardous gas leakage occurs in the Oil and Gas Industry and may lead to various environmental effects. This project presents a cost-effective and reliable Internet of Things (IoT) system for detecting gas leaks and promptly alerting occupants and authorities. Our system “Gas explosion detecting and alerting system using IoT” aims to detect the hazardous gas leakage and alert the workers and company management. We have integrated IoT (Internet of Things) and GSM (Global System for Mobile Communication) to send SMS messages conveying the critical situation to the corresponding workers and management. This project uses MQ135 gas leakage detection sensors to detect hazardous gases like NH3(ammonia), sulphur, Benzene, CO2, Smoke and other harmful gases. This sensor is connected with Arduino NANO. When the sensor detects leakage of gas, the arduino will activate the alarm buzzer to alert the workers. Additionally, a red LED illuminates to provide a visual confirmation of the gas leak. and the Arduino is interfaced with GSM module to send alert messages to the management of the company.

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CHAPTER 1

INTRODUCTION

Gas explosions are a persistent concern in residential and industrial settings. Natural gas leaks can be extremely hazardous, leading to devastating consequences if left undetected. To address this challenge, this project proposes an IoT-based gas explosion detection and alerting system that employs readily available components to create a robust and cost-effective solution. Our project presents an innovative, IoT-based gas explosion detection and alerting system. By harnessing the capabilities of readily available components, this system provides a cost-effective and robust solution for safeguarding homes, businesses, and industrial facilities. This response goes beyond simply detecting a leak; it offers a multi-layered approach by alerting by means of alert messages. This MQ-135 gas sensor module, sensor is specifically designed to identify combustible gases like methane, NH3, Sulphur dioxide, Carbon monoxide and common smoke and some primary components of natural gas. As the gas concentration increases, the MQ-135's electrical resistance changes, sending a clear signal to the Arduino NANO microcontroller. The GSM shield, another key component, allows the system to connect to a cellular network using a SIM card. This connectivity enables the system to send SMS alerts to pre-programmed phone numbers. These phone numbers can be designated for individuals within the building, such as a building manager, or emergency services personnel, ensuring a response to the gas leak. With an optional LCD display, the system

can showcase real-time gas concentration readings, allowing users to monitor gas levels and assess the severity of the leak.

1.1 Motivation

The motivation behind this project are

- Limitations of Traditional Methods as they often rely on human senses, which can be unreliable, especially for odourless gases
- The advent of the Internet of Things (IoT) presents a unique opportunity to create cost-effective and automated solutions for gas leak detection.

1.2 Objectives

The primary goal of this project is to develop a cost-effective and reliable Internet of Things (IoT)-based system for detecting gas leaks and promptly alerting authorities by employing a high-sensitivity MQ-135 gas sensor module specifically designed to detect combustible gases like methane, the primary component of natural gas. Continuously monitor gas concentration levels within the designated area

CHAPTER 2

LITERATURE REVIEW

Research paper on “Gas Explosion Detecting and Alerting System using IoT”. [1] Gas Leak Detection and Smart Alerting using IoT. published in the year 2021 was said to be done by only alerting the workers near the area.

[2] The “An Enhanced Smart Intelligent Detecting and Alerting System for Industrial Gas Leakage using IoT in Sensor Network. ” by the IEEE journal on 2023 proposed solution for the leakage detection in gas-containing area .

[3] The “Development of toxic gas monitoring and alarm system.” literature proposed in 2020 , the simple demo on the alerting system while hazardous gas leakage happens .It uses MQ6 to detect the gas leakage.

[4] The “Design of an IoT Based Gas Wastage Monitoring, Leakage Detecting and Alerting System” published in may 2021 by the IEEE journal proposed that the model was build to detect and alert the area near the waste or hazardous gas leakage occurs.

[5] The “Modeling and Simulation of a Gas Detecting Device for providing safety; and reducing the risk of accidents due to gas explosion or fire” published in the year 2021 had an inference about the measure and precaution activities need to be taken before the gas leakage.

2.1 Existing System

Existing system provides only an alerting system . in existing model the Arduino or other microcontroller is connected with any gas detecting sensor (like MQ135,MQ6) and when the sensor detects the gas leakage the buzzer buzzed and LED glows.The existing system only provides the alert to the workers who are nearby the Hazardous gas container .

2.1.1 Advantages of the existing system

1. Its alerting provides the alerting sound like a buzzer or alarm.
2. It helps the nearby workers to escape from the region where the gas explosion happened.

2.1.2 Drawbacks of the existing system

1. **On-Site Alerts Only:** Many existing systems rely solely on on-site alarms (buzzers, sirens) to alert workers of gas leaks.
2. **No Remote Notification:** Without the capability to send alerts to remote management or workers who are off-site, the response to gas leaks can be delayed, potentially leading to greater hazards.
3. **No Continuous Monitoring:** Many systems do not provide continuous real-time monitoring and data logging.
4. **Limited Scalability:** Existing systems might not be easily scalable to cover larger areas or multiple locations within a facility.

2.2 Proposed System

- The MQ135 sensor is connected with Arduino NANO and placed near the gas container(that is., where the hazardous gas is stored.
- Arduino NANO is connected with a GSM shield using a SIM card to send alert messages.
- Further the Arduino NANO is connected with LED and Buzzer to alarm the worker in that corresponding place.

When the sensor detects the gas leakage, the LED glows and Buzzer (alarm) alerts the workers and alert message is sent to the management quickly through the GSM shield.

2.2.1 Advantages of the proposed system

1. Remote Notification: The integration of GSM technology allows the system to send SMS alerts to management and workers, ensuring that alerts are received promptly even if they are not on-site.
2. Local Alerts: The system includes both LED indicators and buzzers to provide immediate visual and audible alerts to workers in the vicinity of the gas leak.
3. Continuous Monitoring: The system continuously monitors gas levels, ensuring that any leaks are detected as soon as they occur.
4. Easily Scalable: The system can be scaled to cover larger areas or additional locations within a facility, making it adaptable to various sizes and types of facilities.
5. Customizable: The system can be customised to meet specific industry needs, allowing for tailored solutions based on the particular gases and risks present.

CHAPTER 3

SYSTEM DESIGN

3.1 Development Environment

3.1.1 Hardware Requirements

- MQ135 gas detection sensor module
- Arduino NANO
- GSM Shield
- SIM card
- LED light
- Buzzer or alarm

MQ135 gas detection sensor module

MQ135 is a sensor that detects gas like NH3, Sulphur dioxide, carbon monoxide, methane and smoke etc. This sensor is used to detect gas leakage. It works with the principle of resistance changes in response to the presence of different gases. To use this sensor, we should connect it to a microcontroller. The pins A0, GND, VCC are the main pins that should be connected to the microcontroller.

Arduino NANO

Arduino NANO is a microcontroller. The Arduino nano is one of the most popular and widely used development boards in the Arduino ecosystem. It is based on the ATmega328 microcontroller and provides a simple and easy-touse platform for building electronic projects, prototyping, and learning about electronics and programming

GSM Shield

GSM 900A Global System for Mobile communication module with 900 Hz frequency is used to send messages to the connected mobile. It is commonly used in various applications that require cellular communication capabilities, such as IoT (Internet of Things) devices, remote monitoring systems, tracking systems, and communication modules for embedded systems. In our project, GSM is connected with the microcontroller Arduino NANO in order to send alert messages.

SIM Card

A SIM card, or Subscriber Identity Module card, is a small electronic chip that is used in mobile phones and other cellular-enabled devices to identify and authenticate users on a mobile network. This SIM card is inserted in the GSM Module to send messages to the respected person or a management.

LED

A Light Emitting Diode (LED) is a semiconductor device, which can emit light when an electric current passes through it. To do this, holes from p-type semiconductors recombine with electrons from n-type semiconductors to produce light.

3.1.2 Software Requirements

- Arduino IDE
- Google Chrome or any browser

CHAPTER 4

PROJECT DESCRIPTION

The "Gas Explosion Detecting and Alerting System using IoT" is an innovative safety solution designed for the oil and gas industry to detect hazardous gas leaks and promptly alert both on-site workers and remote management. Utilising the MQ135 gas sensor, the system can identify various harmful gases such as ammonia, sulphur, benzene, CO2, and smoke. The sensor is connected to an Arduino NANO, which triggers an alarm buzzer and LED light to immediately warn nearby workers of any detected leaks. Additionally, the Arduino NANO is integrated with a GSM module to send SMS alerts to designated personnel, ensuring swift action even if they are off-site. This IoT-enabled system not only enhances real-time monitoring and comprehensive detection capabilities but also significantly improves safety, operational efficiency, and environmental protection by providing quick and reliable alerts, thus preventing potential accidents and ensuring regulatory compliance.

4.1 SYSTEM ARCHITECTURE

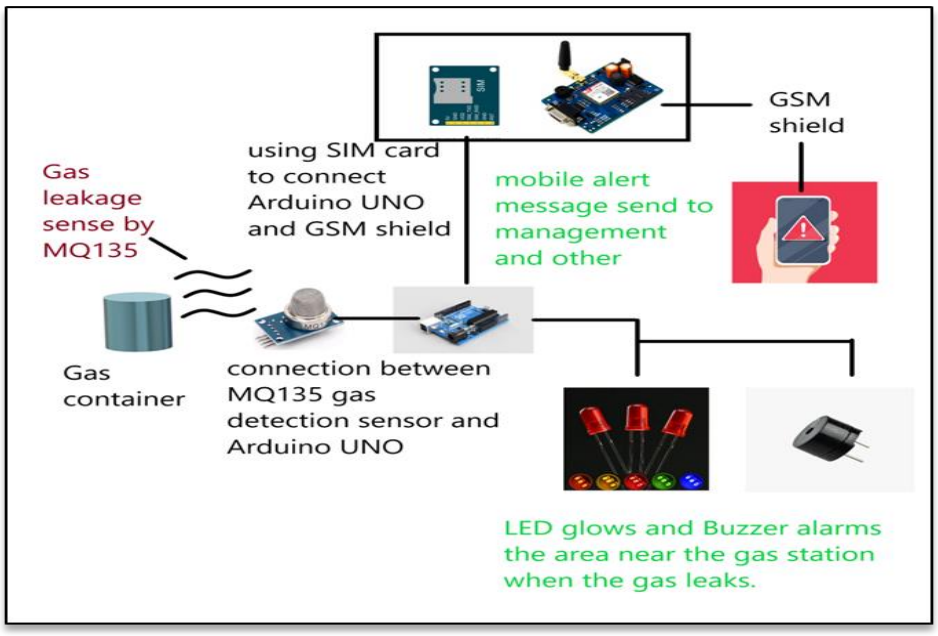

Fig 4.1 System Architecture

4.2 METHODOLOGY

In the development of a cost-effective and reliable Internet of Things (IoT)-based system for detecting gas leaks and promptly alerting occupants and authorities. By leveraging the capabilities of readily available components, this system provides a multi-layered approach to mitigating the risks associated with gas explosions in homes, businesses, and industrial facilities. Wiring the MQ-135 sensor to the Arduino sensor's datasheet specifications. Typically, the sensor's analog output connects to an analog pin on the Arduino. Also, connect the GSM shield to the Arduino. Integrate the LED with a current-limiting resistor and connect it to a digital pin on the Arduino. Connect the buzzer or alarm directly to the Arduino or via a transistor for driving higher currents. An LCD display is connected using an I2C interface or SPI communication depending on the display's requirements. In the Arduino IDE the code is integrated such that the code will initialise communication with the MQ-135 sensor and potentially calibrate it for optimal accuracy. Set up the GSM shield and configure the SIM card for SMS message transmission. Define a threshold gas concentration level that triggers the alert system. Continuously read data from the MQ-135 sensor. Compare the sensor readings with the threshold. If the threshold is exceeded, activate the buzzer or alarm to generate an audible alert. Turn on the red LED for a visual indication. Utilise the GSM shield to send an SMS alert to predefined phone numbers notifying them of a gas leak. The system operates continuously, providing real-time gas leak detection and alerting capabilities. The Arduino constantly reads data from the MQ-135 sensor. The sensor output, an analog voltage, corresponds to the gas concentration in the surrounding air. The Arduino code compares the sensor readings with a predefined threshold value. This threshold represents the maximum acceptable gas concentration level. If it exceeds alerts will be shown.

CHAPTER 5

RESULTS AND DISCUSSION

The primary results of this project encompass the development and testing of a functional IoT-based gas explosion detection and alerting system. The system successfully utilises the MQ-135 gas sensor module to detect the presence of combustible gases like methane. The Arduino code effectively interprets sensor readings and compares them to a predefined threshold. Upon exceeding the threshold, the system triggers an appropriate alerting sequence. The system generates a loud and noticeable audible alert through the buzzer or alarm, prompting immediate action from occupants in the vicinity. The LED provides a clear visual confirmation of a potential gas leak, even in dimly lit environments. The GSM shield and SIM card combination facilitates the transmission of SMS alerts to designated phone numbers, ensuring notification of relevant authorities or individuals. The project serves as a valuable educational tool, highlighting the importance of gas leak detection and safety protocols. It encourages users to Install the system in a well-ventilated location to prevent sensor saturation, regularly inspect and maintain gas lines and appliances, have a clear evacuation plan in place for the event of a gas leak, contact a qualified gas service provider to address any detected leaks safely and effectively

CHAPTER 6

CONCLUSION AND FUTURE WORK

6.1 Conclusion

This project has presented a cost-effective gas explosion detection and alerting system leveraging the power of the Internet of Things (IoT). By utilising readily available components and a multi-layered approach, the system offers a proactive solution for safeguarding homes, businesses, and industrial facilities from the dangers of gas leaks. The system effectively addresses the limitations of traditional gas leak detection methods, which often rely on human senses and infrequent inspections. The continuous monitoring capabilities of the MQ-135 sensor, coupled with the Arduino's processing power and the GSM shield's communication features, create a robust system for early detection and timely notification. The multi-faceted alerting system, encompassing a loud buzzer or alarm, a bright LED, and SMS notifications, ensures that occupants and authorities are alerted promptly, allowing for swift evacuation and corrective action.

6.2 Future Work

- **Sensor Integration:** Explore the integration of additional sensors for a more comprehensive approach. Sensors for detecting smoke, carbon monoxide (CO), or temperature fluctuations could provide a more holistic picture of potential hazards.
- **Cloud Connectivity:**Consider incorporating cloud connectivity. This would enable remote monitoring of gas concentration levels, allowing for real-time data analysis and potentially triggering automated responses, such as shutting off gas valves remotely.
- **Machine Learning and AI:** Implement machine learning algorithms to analyse sensor data over time and learn patterns. This could help the system distinguish between normal gas fluctuations and actual leaks, further reducing false alarms.
- **Mobile App Integration:** Develop a mobile application that allows users to monitor gas concentration levels remotely, receive alerts, and potentially control the system settings.

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

```
#include <LiquidCrystal.h>

const int rs = A0, en =A1, d4 = A2, d5 = A3, d6 = A4, d7 = A5;

LiquidCrystal lcd(rs, en, d4, d5, d6, d7);



#define MQ135Pin A6

const int DOUTpin3 =2;

int limit3;

int value3;

int buzzer =
11;

int led = 12;

#define serial
```

```
void message1(void);
void setup()
{
  Serial.begin(9600);//sets the baud rate


  pinMode(buzzer, OUTPUT);
  pinMode(led, OUTPUT);
    digitalWrite(buzzer, LOW);
    digitalWrite(led, LOW);

lcd.begin(16, 2);
  lcd.setCursor(0, 0);
  lcd.print("GasLeakageDetect");
  delay(2000);
}
void loop()
{
  /*.........GAS (MQ135).........*/
```

```
        value3 = analogRead(MQ135Pin);
        limit3 = digitalRead(DOUTpin3);
        #ifdef serial
        Serial.print("MQ135 value: ");
        Serial.print(value3);
       //prints the alcohol value
        Serial.print("  Limit: ");
        Serial.println(limit3);
       /*prints the limit reached as either LOW or
HIGH (above or underneath) */
        #endif
         lcd.setCursor(0, 1);
        lcd.print("MQ135 Value:");

lcd.print(value3);
        lcd.print("
");
         delay(500);
```

```
 #ifdef serial
Serial.println("**************************************************");
Serial.println(" ");
#endif
 if(limit3 ==
0)
{
  digitalWrite(buzzer, HIGH);
  digitalWrite(led, HIGH);
  delay(200);
  message1();

Serial.println();
  delay(200);

delay(1000);
}
else
```

```
            {
              digitalWrite(buzzer, LOW);
              digitalWrite(led, LOW);
              delay(200);
            }
             delay(2000);
          }
void message1(void)
          {
            Serial.print("AT\r\n");
          delay(800);
            Serial.print("AT+CMGF=1\r\n");
          delay(800);
            Serial.print("AT+CMGS=");
          delay(500);

  Serial.write("");
          delay(500);
```

```
        Serial.print("9600156153");

      delay(500);


Serial.write("");


Serial.print("\r\n");
delay(500);
        Serial.print("'Gas Leakage Detected'\r\n");delay(500);//17
        delay(500);


Serial.write(26);
      }
```

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