HAZARDOUS GAS DETECTION SYSTEM USING IoT

A DESIGN PROJECT REPORT

Submitted by

BALA VAISHNAVI K (REG NO: 811721001004)

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KEERTHANA S (REG NO: 811721001017)

SANDHYA SHALINI S.M (REG NO: 811721001035)

in partial fulfilment for the award of the

degree of

BACHELOR OF TECHNOLOGY

in

ARTIFICIAL INTELLIGENGE AND DATA SCIENCE

K.RAMAKRISHNAN COLLEGE OF TECHNOLOGY

(An Autonomous Institution, affiliated to Anna University Chennai and Approved by AICTE, New Delhi)

SAMAYAPURAM–621112

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BONAFIDE CERTIFICATE

Certified that this design project report titled **"HAZARDOUS GAS DETECTION SYSTEM USING IoT"** is the bonafide work of **BALA VAISHNAVI K (REG.NO : 811721001004) FAHMITHA NASRIN S (REG.NO : 8117221001008) KEERTHANA S (REG.NO : 811721001017) SANDHYA SHALINI S.M (REG.NO : 811721001035)** who carried out the project under my supervision. Certified further, that to the best of my knowledge the work reported here in does not form part of any other project report or dissertation based on which a degree or award was conferred on an earlier occasion on this or any other candidate.

SIGNATURE	**SIGNATURE**
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Submitted for the viva-voce examination held on ………………

INTERNAL EXAMINER **EXTERNAL EXAMINER**

DECLARATION

We jointly declare that the project report on **"HAZARDOUS GAS DETECTION SYSTEM USING IoT"** is the result of original work done by us and best of our knowledge, similar work has not been submitted to **"ANNA UNIVERSITY CHENNAI"** for the requirement of Degree of **BACHELOR OF TECHNOLOGY**. This design project report is submitted on the partial fulfilment of the requirement of the award of Degree of **BACHELOR OF TECHNOLOGY**.

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It is with great pride that we express our gratitude and in - debt to our institution "**K.RAMAKRISHNAN COLLEGE OF TECHNOLOGY (AUTONOMOUS)**", for providing us with the opportunity to do this project.

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ABSTRACT

The Hazardous Gas Detection System presented in this project aims to enhance household safety by deploying an intelligent and efficient gas detection solution. The system integrates cutting-edge sensor technology, data analytics, and wireless communication to provide real-time monitoring and early detection of hazardous gases in our surroundings. The core components of the system include a network of advanced gas sensor **MQ-6** capable of detecting a range of hazardous gases. These sensors continuously collect data, which is processed by a central control unit utilizing state-of-the-art algorithms like threshold and ANN based algorithm ,pattern recognition & bayesian networks for accurate and rapid gas identification .The collected data is transmitted wirelessly to a central monitoring station, allowing real-time surveillance of the home. In the event of a gas leak or abnormal gas concentration, the system triggers immediate alerts, enabling swift response measures to mitigate potential risks. Furthermore, the system incorporates machine learning techniques for predictive analysis based on historical data. This proactive approach enhances the system's ability to anticipate potential gas-related incidents, thereby reducing response time and improving overall safety measures .The implementation of the Autonomous Hazardous Gas Detection System not only provides a reliable and comprehensive solution for gas monitoring but also contributes safety measures. By mitigating the risks associated with hazardous gas exposure, the system plays a crucial role in safeguarding the well-being of family members. The project signifies a significant step towards creating smarter, safer, and more resilient environment through the integration of advanced technology in gas detection and monitoring.

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LIST OF FIGURES

LIST OF ABBREVIATIONS

LPG	Liquified Petroleum Gas
CNG	Compressed Natural gas
LCD	Liquid Crystal Display
MOS	Metal Oxide Semiconductor
CO	Carbon Monoxide
IoT	Internet Of Things
GSM	Global System for Mobile Communication
WSN	Wireless Sensor Networks
MCS	Mobile Crowd Sensing
PPM	Parts Per Million(Mg/L)
ASCII	American Standard Code for Information Interchange
I/O lines	Input and Output Lines
Vcc	Common Collector Voltage
VEE	Voltage At Emitter

CHAPTER 1
INTRODUCTION

Implementing a household hazardous gas detection system introduces a crucial layer of safety to residential spaces. These systems, equipped with sophisticated sensors, continuously monitor the air for potentially harmful gases like carbon monoxide, natural gas, or propane. Upon detecting any abnormal levels, they trigger alarms to promptly alert occupants, mitigating health risks and preventing potential disasters due to gas leaks or accumulation. By integrating user-friendly interfaces and smart connectivity, these systems offer real-time alerts via mobile apps or audible alarms, ensuring immediate action can be taken. Their compact design enables easy installation in various areas prone to gas leaks, like kitchens or utility rooms. The introduction of such a system not only enhances home safety but also provides peace of mind to occupants, creating a proactive approach to safeguarding against hazardous gas-related incidents within the household.

1.1 BACKGROUND :

Hazardous gas detection systems in households employ sensors to monitor air quality, identifying potentially dangerous gases like carbon monoxide and natural gas. These systems use advanced technology to swiftly detect leaks or irregular gas levels, triggering alarms to alert occupants and mitigate risks of fire, explosions, or health hazards. Typically integrated into smart home setups, these systems ensure prompt response, enhancing safety and offering peace of mind to residents. Their compact design, affordability, and ease of installation make them vital components in modern homes, safeguarding lives and property against the silent threats posed by invisible gases.

1.2 PROBLEM STATEMENT:

The safety of households is of paramount importance, and one potential threat is the presence of hazardous gases within the indoor environment. Gases such as methane, carbon monoxide, and propane can pose serious risks to occupants if they go undetected. To address this concern, there is a need for an efficient and reliable Hazardous Gas Detection System tailored for household use.

1.3 AIM & OBJECTIVES :

- **Safety Assurance:** The primary aim is to ensure the safety of occupants by detecting and alerting them to the presence of hazardous gases like carbon monoxide (CO), natural gas (Methane), or propane, which can be life-threatening in high concentrations.

- **Early Warning:** Detecting gases at low concentrations helps provide early warnings before they reach dangerous levels, giving residents time to evacuate or rectify the issue.

- **Prevent Health Risks:** Minimize health risks associated with gas exposure by promptly identifying leaks or abnormal gas levels.

- **Property Protection:** Safeguard homes and property from potential damage or explosions caused by gas leaks.

- **Continuous Monitoring:** Ensure continuous monitoring of gas levels to maintain a safe living environment, especially in areas prone to gas leaks or with gas-operated appliances.

- **User-Friendly Design:** Create an easily understandable and user-friendly system that can be installed, operated, and maintained by homeowners without much complexity.

- **Alerting Mechanism:** Develop an effective alerting mechanism, such as audible alarms, mobile notifications, or integration with smart home systems, to promptly notify residents in case of gas detection.

- **Reliability and Accuracy:** Aim for high reliability and accuracy in gas detection to avoid false alarms and ensure trust in the system's functionality.

- **Integration with Home Systems:** Enable integration with other home systems or devices for remote monitoring or automated responses in case of detected gas levels.

- **Cost-Effectiveness:** Strive for a cost-effective solution that is accessible and affordable for households, encouraging widespread adoption for enhanced safety.

Each of these aims contributes to the overall effectiveness and utility of a hazardous gas detection system in households.

CHAPTER 2

LITERATURE SURVEY

2.1 TITLE : DESIGN AND IMPLEMENTATION OF HAZARDOUS GAS LEAKAGE DETECTION SYSTEM FOR INDUSTRIAL AREA

AUTHOR : K.R. Katole, S. N. Tamgade, P.R. Morey

YEAR OF PUBLICATION : 2019

ABSTRACT : Air pollution acts as the major problem since other type of pollution can be detected visually and by taste, but the toxic air cannot be detected, as it can be colourless, odourless and tasteless. Hence, there is an increasing demand for the environmental pollution control and monitoring systems..This work changes the presently available systems that are set industrial areas and this system can also be used in houses and at work place. The primary aim of the work is to design hazardous gas detecting system using four as sensors. This paper is based on a system, which is used to detect various hazardous gases with the help of Arduino microcontroller. The toxic gases like butane (also known as LPG), methane and carbon monoxide are sensed and displayed on the LCD screen. The concentration of the gasses will be shown in the form of percentage by LCD display.

MERITS : Early detection, Reduce health risks, process optimization

DEMERITS : Cost, False alarms, Limited gas coverage

2.2 TITLE : MULTI-SENSING PARADIGM BASED URBAN AIR QUALITY MONITORING AND HAZARDOUS GAS SOURCE ANALYZING

AUTHOR : Zhengqiu Zhu , Bin Chen , Yong Zhao , Yatai Ji

YEAR OF PUBLICATION : 2021

ABSTRACT : Previous works, such as long-term observations by monitoring stations, cannot provide customized data services and in-time emergency response under urgent situations. To bridge the gap between present solutions and practical requirements,design a conceptual framework, namely MAsmed, to provide fine-grained concentration maps, customized data services, and on-demand emergency management. In this framework, leverage the hybrid design of wireless sensor networks (WSNs) and mobile crowdsensing (MCS) to sense urban air quality and relevant data .Using the sensed data, can create a fine-grained air quality map for the authorities and relevant stakeholders, and provide on-demand source term estimation and source searching methods to estimate, seek, and determine the sources, thereby aiding decision-makers in emergency response In this paper, also identify several potential opportunities for future research.

MERITS : Comprehensive data collection, Improved Accuracy, Multi-sensing systems

DEMERITS : Data integration challenges, power consumptions, data privacy and security

2.3 TITLE : TOXIC GAS DETECTION AND MONITORING UTILIZING INTERNET OF THINGS

AUTHOR : Dr. Chalasani Srinivas, Mohan Kumar.Ch

YEAR OF PUBLICATION : 2017

ABSTRACT : Gas leakage can be easily detected and controlled by using latest trends in information technology by applying internet of things. This project intended to avoid industrial accidents and to monitor harmful gases and to intimate alert message to safety control board of industry using Arduino Uno R3 and internet of things. Ardunio Uno R3 board is used as central microcontroller which is connected with sensor. Such as temperature, gas sensor, alcohol sensor which can continuousl monitor respective environmental parameters.Hence this device may be used as multi gases detection apparatus more over the rate of response is high. An alarm is produced instantly if the level of the gases goes above the normal level means indication through the internet specific receiver section. Data received by sensor is stored in internet which can be used for further processing and it can be analysed for improving safety regulations. This model can be future extended for providing better living environment for people in and around industries with a pollution controlled environment.

MERITS : Remote access and control, Automation and alerts, Cost-Efficiency

DEMERITS : Security concerns, Reliability Issues, Data Privacy, Maintenance and Upkeep

2.4 TITLE : HARMFUL GAS DETECTION AND MONITORING SYSTEM IN INDUSTRIES USING IOT

AUTHOR : Dr. Savita Sonoli, Akash H, Bhargavi Y, Gudiputi Dharani, Avinashgouda A Hiregoudar, Vice Principal & HOD

YEAR OF PUBLICATION : 2022

ABSTRACT : This project intended to avoid industrial accidents and to monitor harmful gases and to intimate alert message to safety control board of industry using Arduino Uno R3 and internet of things. Arduino Uno R3 board is used as central microcontroller which is connected with sensor. Such as temperature, gas sensor, alcohol sensor which can continuously monitor respective environmental parameters. Hence this device may be used as multi gases detection apparatus more over the rate of response is high. An alarm is produced instantly if the level of the gases goes above the normal level means indication through the internet specific receiver section. Data received by sensor is stored in internet which can be used for further processing and it can be analyzed for improving safety regulations. This model can be future extended for providing better living environment for people in and around industries with a pollution controlled environment.

MERITS : Remote monitoring, Data analytics, Integration with Existing System

DEMERITS : Initial costs, complexity, maintenance challenges, Dependency on Connectivity

2.5 TITLE : HAZARDOUS GAS DETECTION SYSTEM WITH AN ALERTING MECHANISM

AUTHOR : Sudeep sagar , Tanuja N G , Akanksha K A and Harshitha

YEAR OF PUBLICATION : 2023

ABSTRACT : Several head-ways are made with technological advancement in our day-to-day lives providing us with improved living standards, safety, and security. One such development is the IoT. This paper proposes a detection setup for harmful gas emission with an alert system using IoT. Harmful gas leakage in industrial plants and oil refineries, can lead to devastating consequences, including death. To prevent all these, this paper lays out a system that can pass an alert, whenever a gas discharge occurs. Arduino is used in this setup, along with various Gas Sensors (MQ-2, MQ-3, MQ-6, MQ-135), which identifies gasses such as Carbon Monoxide, LPG, propane and many more. It also detects power outages and smoke/fire in the work environment. The Arduino is in coalition with a Wifi module. An alert is sent to the person by calling or sending an alert SMS. If a gas leakage occurs, the system would detect it and automatically generate an alert signal.

MERITS : Safety enhancement, compliance with regulations, data logging and analysis

DEMERITS : Sensor calibration, limited coverage, Costly

CHAPTER 3

SYSTEM ANALYSIS

3.1 EXISTING SYSTEM :

1. Sensor Technology: Utilizes various sensor types (electrochemical, catalytic, infrared, etc.) to detect and measure different types of gases.

2. Fixed and Portable Systems: Includes both fixed installations in industrial settings and portable devices for personal safety.

3. Alarm and Warning Systems: Triggers alarms (audible, visual, or both) upon detecting hazardous gas levels, alerting individuals to take necessary precautions or evacuate.

4. Data Monitoring and Logging: Tracks gas levels over time, storing data for analysis and regulatory compliance.

5. Integration with Control Systems: Integrated with safety and control systems to automatically initiate safety protocols (such as shutting down processes or activating ventilation systems).

6. Wireless Connectivity: Some systems incorporate wireless technology for remote monitoring and control, enabling real-time data access from various locations.

7. Calibration and Maintenance: Regular calibration and maintenance ensure accurate readings and reliable performance.

8. Explosion-Proof Designs: Designed with safety measures to prevent explosions in potentially explosive atmospheres.

3.1.1 DRAWBACKS

1. False Alarms:

One common issue is the occurrence of false alarms. Environmental conditions or system malfunctions can trigger alarms even when there is no actual gas leak. This can lead to complacency or a lack of trust in the system over time.

2. Sensor Calibration and Maintenance:

Gas sensors require regular calibration and maintenance to ensure accurate and reliable performance. Failure to calibrate sensors or neglecting maintenance can result in inaccurate readings and compromised safety.

3. Sensor Sensitivity and Cross-Sensitivity:

Sensors may have varying levels of sensitivity to different gases. Cross-sensitivity, where a sensor responds to gases other than the target gas, can lead to inaccurate readings or false alarms.

4. Response Time:

The response time of gas detection systems can be critical. Some systems may have a delay in detecting and alerting to the presence of hazardous gases. In high-risk environments, a rapid response is essential for effective safety measures.

5. Limited Gas Types:

Some detection systems are designed to detect specific types of gases, and may not be effective in identifying a broader range of hazardous substances. Users need to choose a system that meets the specific requirements of their environment.

6. Cost and Complexity:

High-quality gas detection systems can be costly to purchase, install, and maintain. The complexity of some systems may also require specialized training for users, increasing overall costs.

7. Environmental Factors:

Environmental conditions, such as humidity, temperature, and atmospheric pressure, can affect the performance of gas sensors. Extreme conditions may impact the accuracy of the readings, leading to potential safety risks.

8. Power Supply Dependency:

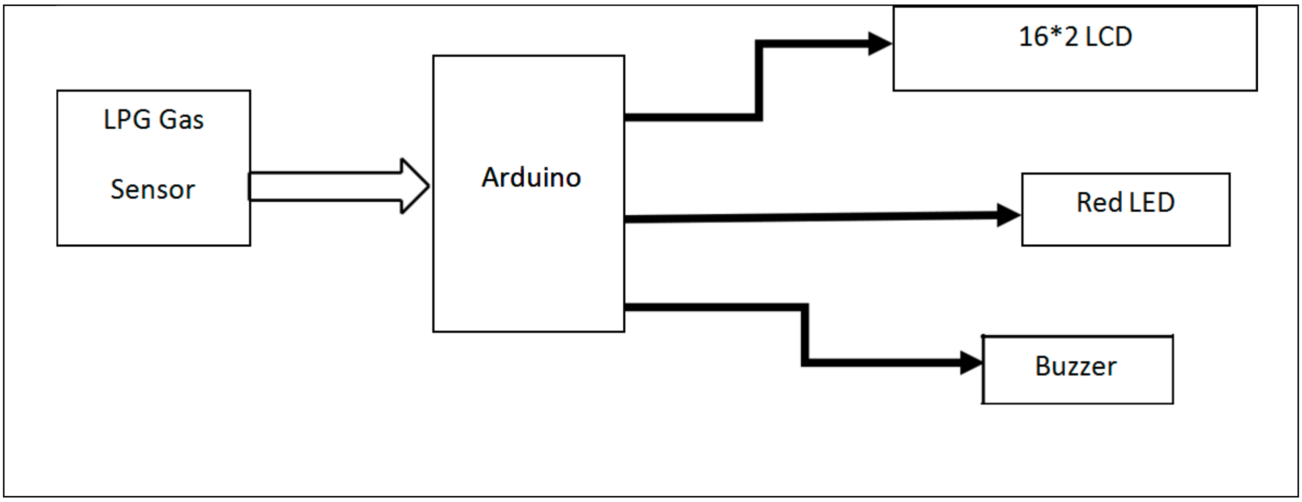
Some gas detection systems are dependent on a continuous power supply. In the event of a power failure or disruption, the system may become non-functional, compromising safety during critical moments.

9. Integration with Other Systems:

Integration with other safety systems or emergency response mechanisms may be challenging. Compatibility issues between different systems can hinder the overall effectiveness of safety measures.

3.2 PROPOSED SYSTEM

Block diagram :



In this semiconductor sensors are used to detect LPG gas. An MQ6 semiconductor sensor is used. Sensitive material of the MQ-6 gas sensor is SnO2, which has lower conductivity in clean air. When the target combustible gas exists, the sensor conductivity increases along with the rising gas concentration. The MQ6 gas sensor has a high sensitivity to Propane, Butane and LPG, and response to Natural gas. The sensor could be used to detect different combustible gasses, especially Methane; it has a low cost and is suitable for different applications. The MQ-6 can detect gas concentrations anywhere from 200 to 10,000 ppm. The sensor's output is an analog resistance. Figure above shows the block diagram of the gas leakage detection and alert system.

This system is based on the Arduino UNO R3 and MQ-6 gas sensor. When the sensor detects gas in the atmosphere, it will give digital output 1 and if gas in not detected the sensor will give digital output 0. Arduino will receive the sensor output as digital input. If the sensor output is high, then the buzzer will start tuning along with the LCD that will show that "Gas detected: Yes". If the sensor output is low then buzzer will not be tuning, and the LCD will show that "Gas detected: No". The buzzer most commonly consists of a number of switches or sensors connected to control unit that determines which button was pushed or whether a preset time has lapsed, and usually illuminates a light on the appreciate button or control panel, and sounds a warning in the form of a continuous or intermittent buzzing or beeping sound.

3.2.1 Advantages :

• Can monitor the amount of gases in the environment.

• Can escape from higher chance of poisoning, explosion, fire orasphyxiation.

• Get real time -alerts about the gaseous presence in theatmosphere

• Prevent the fire hazards and explosion

• Supervise gas concentration levels

• Ensure workers health

• Ensure workers health

• Real-time update about leakage

• Cost-effective installation

• Data analytics for improved decision

• Measure oxygen level accuracy

• Get immediate gas leak alerts

CHAPTER 4

ARCHITECTURE DESIGN

ARCHITECTURE :

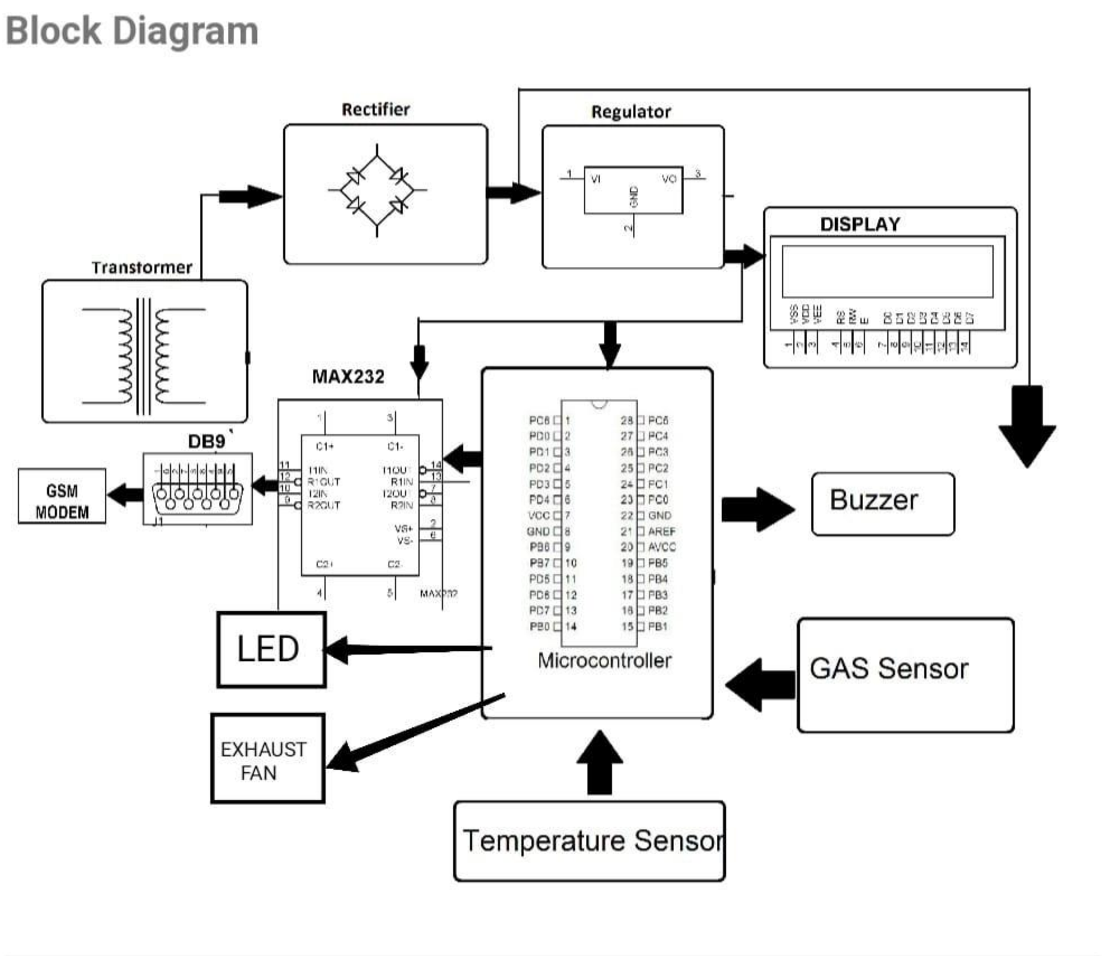


Fig 4.1 : Architecture Diagram

a) **Transformer :** An electrical device that can change the A.C. current is known as a transformer. Principle – A transformer works on the principle of mutual induction. Mutual induction is the phenomenon by which when the amount of magnetic flux linked with a coil changes, an E.M.F. is induced in the neighbouring coil.

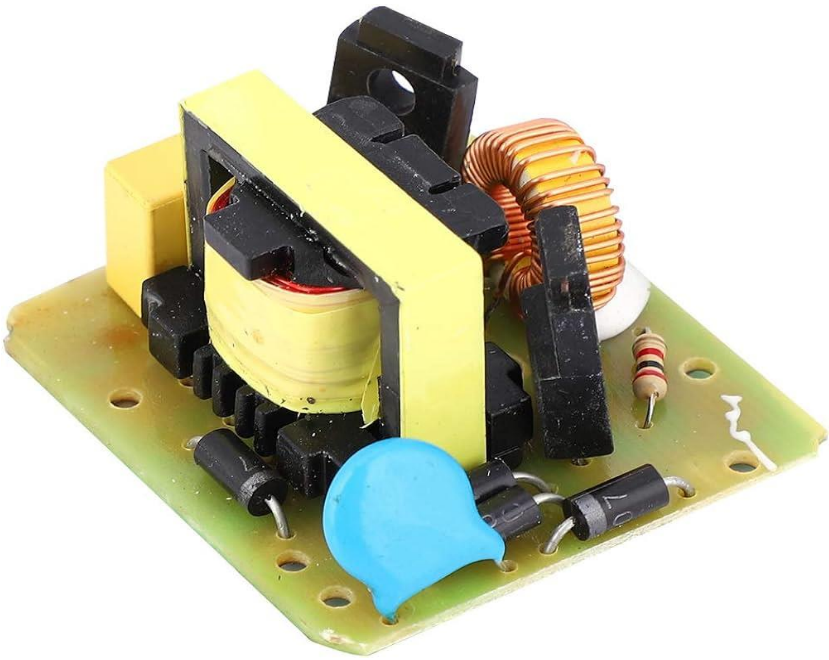


Fig 4.1 (a) : Transformer

Rectifier : An electrical device which converts an alternating current into a direct one by allowing a current to flow through it in one direction only.

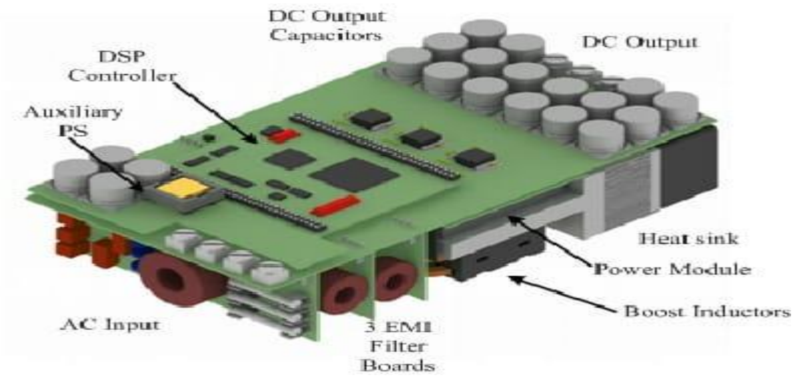


Fig 4.1 (b) : Rectifier

b) **Regulator :** voltage regulator, any electrical or electronic device that maintains the voltage of a power source within acceptable limits. The voltage regulator is needed to keep voltages within the prescribed range that can be tolerated by the electrical equipment using that voltage.

Fig 4.1 (c) : Regulator

c) **LCD Display :** LCD (Liquid Crystal Display) is a type of flat panel display which uses liquid crystals in its primary form of operation.

Fig 4.1 (d) : LCD Display

e) **Microcontroller :** A microcontroller is a compact integrated circuit designed to govern a specific operation in an embedded system. A typical microcontroller includes a processor, memory and input/output (I/O) peripherals on a single chip.

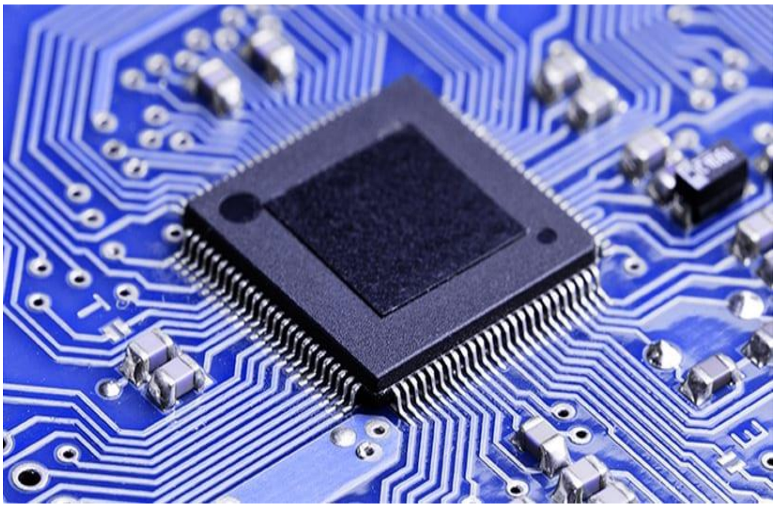


Fig 4.1 (e) : Microcontroller

f) **Max232 :** The MAX232 is an integrated circuit by Maxim Integrated Products, now a subsidiary of Analog Devices, that converts signals from a TIA-232 (RS-232) serial port to signals suitable for use in TTL-compatible digital logic circuits. The MAX232 is a dual transmitter / dual receiver that typically is used to convert the RX, TX, CTS, RTS signals.

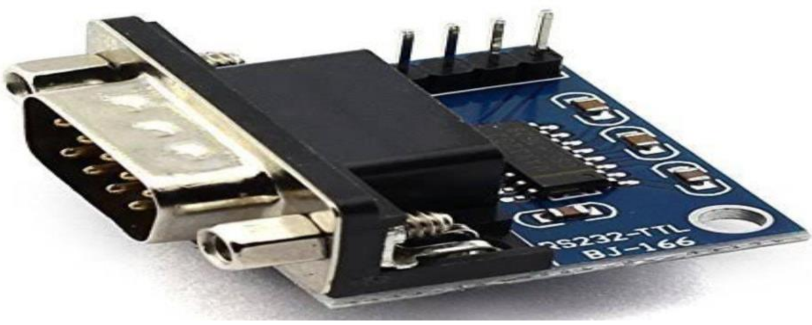


Fig 4.1(f) : Max232

g) **DB9 Connector :** The DB9 connector (originally named DE-9) is an analog socket, with 9 pins, from the D-Sub miniatures (D-Sub) connector family. The DB9 has the smallest "footprint" of the D-Sub miniature connectors. The prefix “D” represents the D-shape of the connector shell.

Fig 4.1 (g) : DB9 Connector

h) **GSM Modem :** A GSM modem is a dedicated device that can connect to the PC or server to send and receive SMS messages.

Fig 4.1 (h) : GSM Module

i) **Buzzer :** A piece of equipment that makes a buzzing sound.

Fig 4.1(i) : Buzzer

j) **Gas Sensor :** Gas sensors are devices that help us understand the amount of gas in the environment and the natural state of its movement.

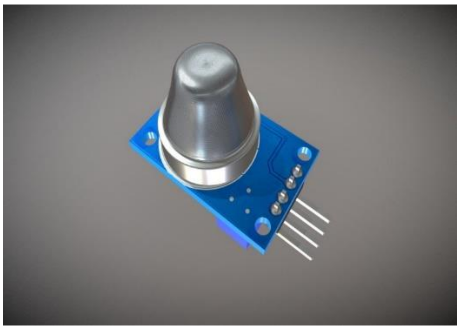


Fig 4.1 (j) : Gas sensor

k) **Temperature sensor :** A temperature sensor is a device that detects and measures hotness and coolness and converts it into an electrical signal.

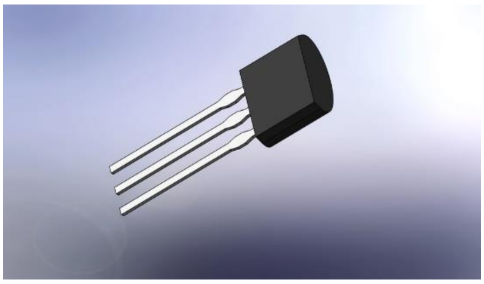


Fig 4.1 (k) : Temperature Sensor

l) **LED :** light emitting diode (a device that produces a light on electrical and electronic equipment).

Fig 4.1 (l) : LED

m) **Exhaust Fan :** An exhaust system is used to guide reaction exhaust gases away from a controlled combustion inside an engine or stove. The entire system conveys burnt gases from the engine and includes one or more exhaust pipes.

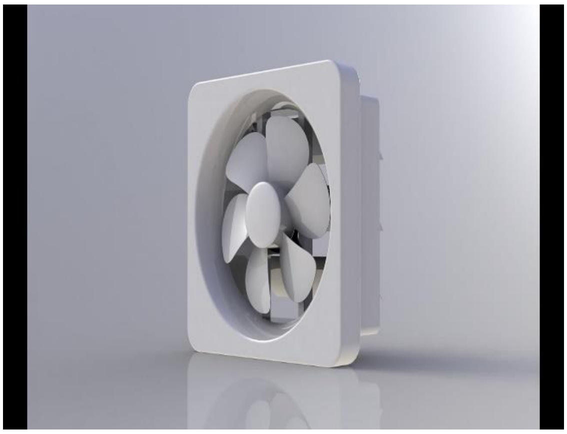


Fig 4.1 (m) : Exhaust Fan

4.1 COMPONENTS REQUIRED :

S.NO	EQUIPMENT
1	ARDUNIO
2	MQ-6 GAS SENSOR
3	16*2 LCD
4	BUZZER
5	10 K VARIABLE RESISTOR
6	MALE TO MALE/FEMALE WIRE
7	GAS LIGHTER
8	9V BATTERY / CHARGER TO GIVE SUPPLY
9	ATMEGA328P

CHAPTER 5

GAS SENSOR

A gas sensor is a device which detects the presence or concentration of gas in the atmosphere. Based on the concentration of the gas the sensor produces a corresponding potential difference by changing the resistance of the material inside the sensor , which can be measured as output voltage . based on this voltage value the type and the concentration of the gas can be estimated. The type of the gas sensor could detect depends on the sensing material present in side the sensor. Normally these sensors are available as modules with comparators . These comparators can be set for a particular threshold value of gas concentration . When the concentration of the gas exceeds this threshold value the digital pins goes high .The analog pin can be used to measure the concentration of gas.

5.1 Different types of Gas Sensor :

S.No	Sensor	Detects
1	MQ-2	METHANE,BUTANE,LPG,SMOKE.
2	MQ-3	ALCOHOL,ETHENOL,SMOKE.
3	MQ-4	METHANE,CNG GAS.
4	MQ-5	NATURAL GAS,LPG
5	MQ-6	LPG,BUTANE GAS.
6	MQ-7	CARBON MONOXIDE
7	MQ-8	HYDROGEN GAS
8	MQ-9	CARBON MONOXIDE,FLAMMABLE GASSES.
9	MQ-131	OZONE.
10	MQ-135	AIR QUANTITY(BENZENE,ALCOHOL,SMOKE).

11	**MQ-136**	HYDROGEN SULFIDE GAS.
12	**MQ-137**	AMMONIA.
13	**MQ-138**	BENZENE,TOLUENE,ALCOHOL,ACETONE, PROPANE,F ORMALDEHYDE GAS,HYDROGEN.
14	**MQ-241**	METHANE,NATURAL GAS
15	**MQ-216**	NATURAL GAS, COAL GAS.
16	**MQ303A**	ALCOHOL,ETHANOL,SMOKE.
17	**MQ306A**	LPG,BUTANE GAS.
18	**MQ307A**	CARBON MONOXIDE.
19	**MQ309A**	CARBON MONOXIDE,FLAMMABLE GASSES.
20	**MQ-131**	CARBON DIOXIDE(C02)
21	**AQ-104**	AIR QUALITY

5.2 MQ6 Gas Sensor :

The below image shows the MQ6 sensor pin diagram. However, the left image is a module-based MQ6 sensor for interfacing with the microcontroller unit, the pin diagram of the module is also shown in that image.

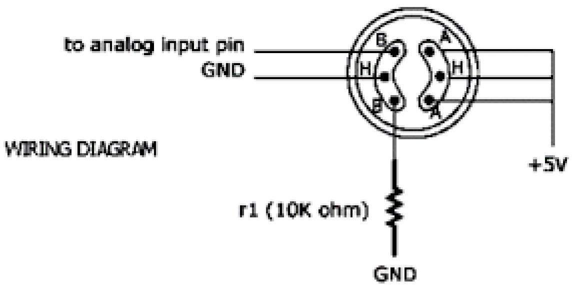


Fig 5.1 : GAS SENSOR PINS

Pin 1 is VCC, Pin 2 is the GND, Pin 3 is the Digital out (Logic low when gas is detected.) and Pin 4 is the Analog output. The pot is used to adjust the sensitivity. It is not RL. The RL resistor is the right resistor of the DOUT LED.

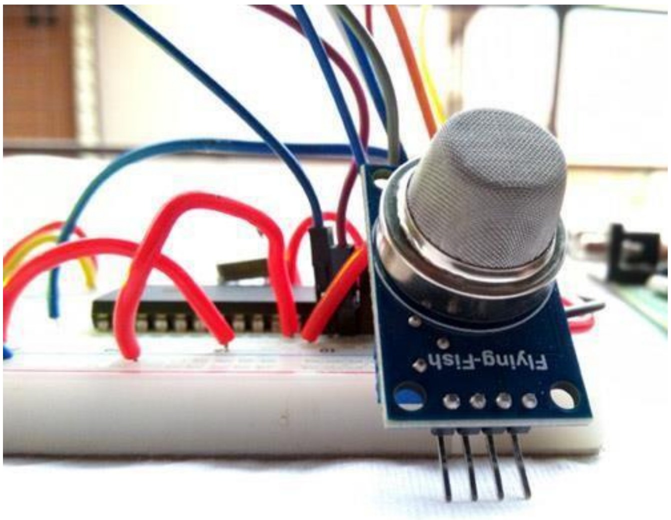


Fig 5.2 : MQ-6 gas sensor

Each MQ series sensor has a heating element and a sensing resistance. Depending on the concentration of the gas, the sensing resistance gets changed and by detecting the changing resistance, the gas concentration can be measured. To measure the gas concentration in PPM all MQ sensors provide a logarithmic graph which is very important. The graph provides an overview of the gas concentration with the ratio of RS and RO.

CHAPTER 6

MODULES DESCRIPTION

6.1 Sensor Modules:

At the core of a gas detection system are the sensors designed to detect various gases. These sensors vary based on the type of gas they're designed to detect—common ones include electrochemical sensors for specific gases like carbon monoxide or hydrogen sulphide, infrared sensors for hydrocarbons, and photoionization detectors for volatile organic compounds (VOCs). These sensors are calibrated to detect specific gas concentrations and are strategically placed in hazardous areas.

6.2 Data Acquisition and Processing:

The data acquisition module collects information from the sensors continuously. It includes analog-to-digital converters (ADCs) that transform sensor readings into digital data. The processing unit then interprets this data, often employing various algorithms like threshold-based triggers, pattern recognition, or machine learning algorithms to analyse gas concentrations and patterns. This module determines when gas levels reach dangerous thresholds and triggers alarms or alerts.

6.3 Communication and Alerting:

Once the gas detection system identifies hazardous gas levels, a communication module transmits this information to a central control unit or a monitoring station. This can be achieved through wired or wireless communication protocols such as Ethernet, Wi-Fi, Zigbee, or cellular networks. Alarms, notifications, or alerts are generated to notify personnel, triggering safety protocols or emergency responses to mitigate risk

6.4 Control and Response Mechanisms:

The control module governs the system's response to detected gas levels. It manages safety measures like activating ventilation systems, shutting down machinery, initiating evacuation protocols, or triggering suppression systems to prevent a potential disaster. This module might also include automated responses and protocols for specific gas types or concentrations.

6.5 Power Supply and Backup:

To ensure continuous operation, gas detection systems require a reliable power supply. This module includes primary power sources like mains electricity, along with backup systems such as battery packs or generators. Uninterrupted power is crucial for the system to remain functional during power outages or emergencies.

6.6 Maintenance and Calibration:

Regular maintenance and calibration modules are essential to ensure the accuracy and reliability of the gas detection system. These modules schedule routine checks, sensor calibrations, and equipment maintenance to prevent false alarms or inaccurate readings due to sensor drift or degradation over time.

Each of these modules plays a critical role in a comprehensive hazardous gas detection system, collectively working to detect, analyse, communicate, and respond to potentially dangerous gas leaks or concentrations, thereby safeguarding both life and property in industrial, commercial, or residential settings.

CHAPTER 7

HARDWARE DESIGN

Hardware :

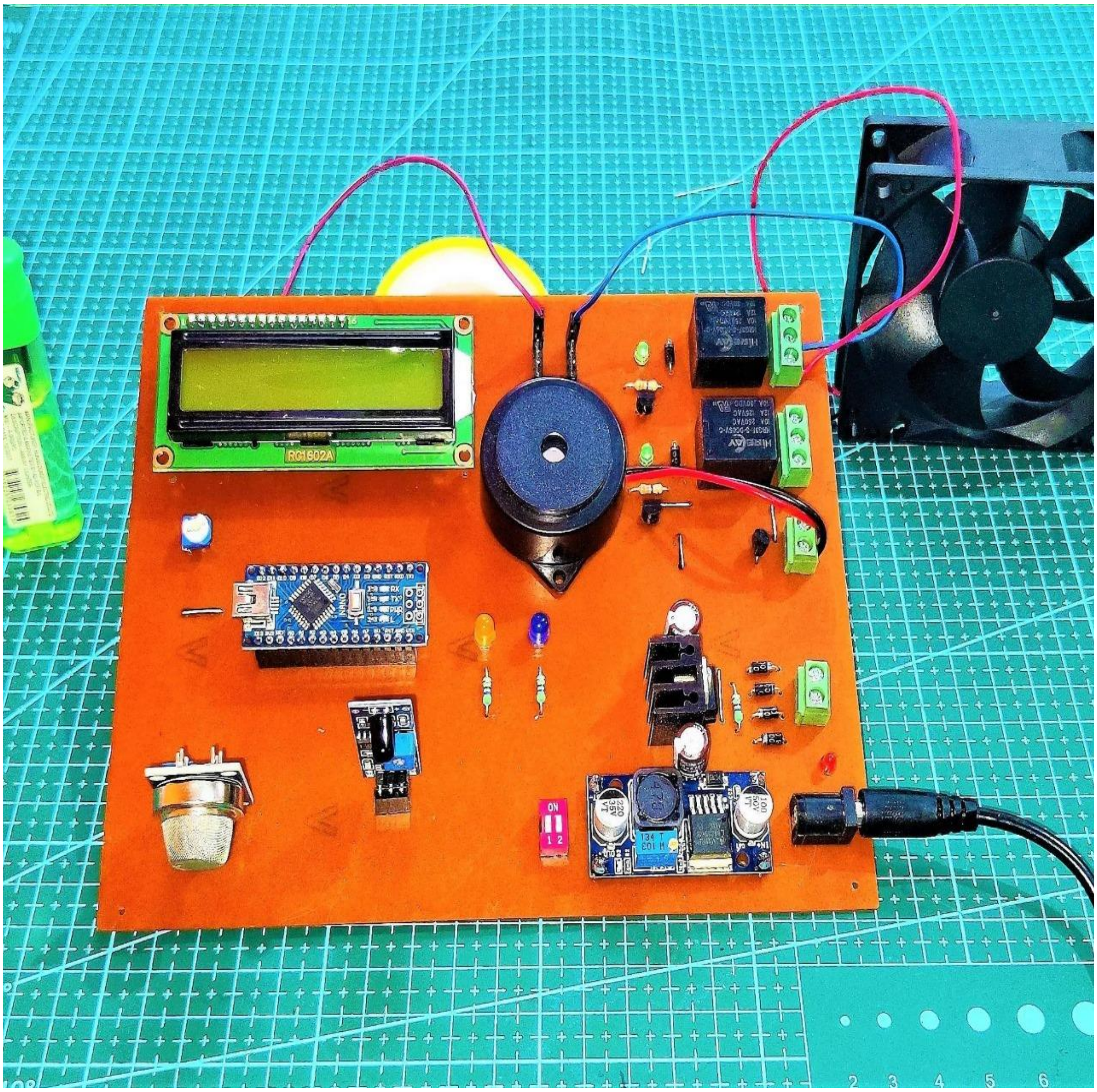


Fig 7.1 : Hardware design

The Arduino UNO is the main heart of this project. MQ2,MQ7,MQ135,LM35 , buzzer, GSM modem, Exhaust fan, LED , 16x2 LCD display are connected to the arduino. Each gas sensor analog pins are connected to the arduino analog inputs. LM35 temperature sensor output pin is connected to the arduino. VCC and ground pins of all sensors are connected to the 5V & ground pins of arduino respectively. I2C module is connected between LCD display and arduino, I2C module converts the series input to the parallel output. Gas sensors and temperature sensor continuously sense the gas & temperature levels, if the sensed gas levels is normal then it will updated to the cloud by the use of IOT module. The sensed values are displays in LCD display. While the sensed gas levels are abnormal then the buzzer sounds, then it is updated in cloud. Like this the temperature is also sensed by sensor, if it abnormal then the buzzer sounds and the data stored in cloud for future use.

CHAPTER 8

CONCLUSION AND FUTURE SCOPE

8.1 CONCLUSION :

The design of a sensor-based automatic gas leakage detector with an alert and control system has been proposed and discussed in this project. This is a low-cost, low power, lightweight, portable, safe, user friendly, efficient, multi featured and simple system device for detecting gas. Gas leakage detection will not only provide us with significance in the health department but it will also lead to raise our economy, because when gas leaks it not only contaminates the atmosphere but also wastage of gases will hurt our economy. In the open literatures it is noticed that much work has not been done for a smart gas detection system. In future, more advanced features will be integrated with this system which will provide users with more safety and relaxation. The proliferation of handheld devices has led to developments in the field of smart gas sensors, which has considerably widened their scope of application. The need for ensuring safety in workplaces is expected to be the key driving force for the market over the coming years.

8.2 FUTURE SCOPE :

Overall, software and hardware parts of the systems have been developed and tested by introducing a small amount of LPG near gas sensor module.One of the notable future functions of this system is to add a sub system where wastage of gas and the uses of gas can be monitored using this system. The system is flexible as a greater number of sensors and relays can be added to it according to the whole LPG supply setup in those premises. Adding more software based intelligent functions with this system. This is an automatic gas detection, control and alert system. In future this system will have a feature where it can notify the emergency services if any accidents happen. A mobile app and web-based app for real time monitoring also will be added. In the user app for this system many smart features will be added. The overall features will make the system more safe for the users. The system will be optimized for use in many places like the car, the home, industries and many other places. After designing the final prototype with smart multifunctional features, the system will be implemented in real life scenarios as a pilot project. A survey will be done soon before using the system and another one will be done after implementing the system to discover the KPI. Summarizing all the results, finding and analysing a research article will be done .In the future paper the features of this final product will be compared with the available gas detector systems.

APPENDIX (SAMPLE CODE)

Integrating SMS alerts and call notifications into an Arduino project involves interfacing with a GSM module.

cpp

```
#include <LiquidCrystal.h>

#include <SoftwareSerial.h>

LiquidCrystal lcd(5, 6, 8, 9, 10, 11);

SoftwareSerial gsmSerial(7, 12);

int redled = 2;

int greenled = 3;

int buzzer = 4;

int sensor = A0;

int sensorThresh = 400;

String phoneNumber = "+1234567890";


void setup()

{

  pinMode(redled, OUTPUT);

  pinMode(greenled, OUTPUT);

  pinMode(buzzer, OUTPUT);
```

```
  pinMode(sensor, INPUT);
  Serial.begin(9600);
  gsmSerial.begin(9600);
  lcd.begin(16, 2);
}

void sendSMS(String message)
{
  gsmSerial.println("AT+CMGF=1");
  delay(1000);
  gsmSerial.print("AT+CMGS=\"");
  gsmSerial.print(phoneNumber);
  gsmSerial.println("\"");
  delay(1000);
  gsmSerial.println(message);
  delay(1000);
  gsmSerial.write(26);
  delay(1000);
}
```

```
void makeCall()
{
  gsmSerial.println("ATD" + phoneNumber + ";");
  delay(1000);
}

void loop()
{
  int analogValue = analogRead(sensor);
  Serial.print(analogValue);
  if (analogValue > sensorThresh)
  {
    digitalWrite(redled, HIGH);
    digitalWrite(greenled, LOW);
    tone(buzzer, 1000, 10000);
    lcd.clear();
    lcd.setCursor(0, 1);
    lcd.print("ALERT");
    delay(1000);
    lcd.clear();
    lcd.setCursor(0, 1);
    lcd.print("EVACUATE");
```

```
    delay(1000);
    sendSMS("Hazardous gas detected! Evacuate immediately.");
    makeCall();
  }
  else
  {
    digitalWrite(greenled, HIGH);
    digitalWrite(redled, LOW);
    noTone(buzzer);
    lcd.clear();
    lcd.setCursor(0, 0);
    lcd.print("SAFE");
    delay(1000);
    lcd.clear();
    lcd.setCursor(0, 1);
    lcd.print("ALL CLEAR");
    delay(1000);
  }
}
```

REFERENCES

1) A. M. Anika, M. N. Akter, M. N. Hasan, J. F. Shoma and A. Sattar, **"Gas Leakage with Auto Ventilation and Smart Management System Using IoT"**, 2021 International Conference on Artificial Intelligence and Smart Systems (ICAIS), pp. 1411-1415, 2021.
2) R. K. Kodali, R. N. V. Greeshma, K. P. Nimmanapalli and Y. K. Y. Borra, **"IOT Based Industrial Plant Safety Gas Leakage Detection System"**, 2018 4th International Conference on Computing Communication and Automation (ICCCA), pp. 1-5, 2018.
3) N.K. Jumaa, Y.M. Abdulkhaleq, M.A. Nadhim and T.A. Abbas, loT Based Gas Leakage Detection and Alarming System using Blynk platforms, 2022.
4) O. Flores-Cortez, R. Cortez and B. Gonzalez, **"Design and Implementation of an loT Based LPG and CO Gases Monitoring System"**, ArXiv preprint, 2021.
5) M.A. Subramanian, N. Selvam, S. Rajkumar, R. Mahalakshmi and J. Ramprabhakar, **"Gas Leakage Detection System using loT with integrated notifications using Pushbullet-A Review"**, 2020 Fourth International Conference on Inventive Systems and Control (ICISC), pp. 359-362, 2020, January.
6) A. Varma, Prabhakar Sand and K. Jayavel**, "Gas Leakage Detection and Smart Alerting and prediction using loT"**, 2017 2nd International Conference on Computing and Communications Technologies (ICCCT), pp. 327-333, 2017.