

GSM BASED GAS LEAKAGE DETECTION SYSTEM

Rajesh Raikwar¹, Dhruwa Gokhale², Om Dhumal³, Shivani Dhumal⁴, Siddhi Dhumal⁵, Durgesh Dhurve⁶

Department of Engineering, Sciences and Humanities (DESH)
Vishwakarma Institute of Technology, Pune, 411037, Maharashtra, India

Abstract - [1] According to the study of Council on Energy, Environment and Water (CEEW) more than 70% of Indian households use LPG as their primary cooking fuel and around 85% have LPG connections. With this bigger percentage of LPG usage comes a bigger risk of Gas Leakage accidents. Our project is aimed to build and design a device that would help to prevent the disasters caused by these Gas leakages. On detecting Gas Leakage, the designed system uses GSM technology to send an alert message to the user's mobile phone as well as it simultaneously turns on a buzzer and a red LED to alert him. In case if the user is not at home, he can reply with a message "ALERT" which will allow the device to send alert messages to the predefined contact numbers of his neighbors.

Key Words: Gas Detection system, Alert messages, Arduino Uno, MQ-2 Gas sensor, audio-visual alarm

1. INTRODUCTION

Till now India has experienced thousands of accidents/disasters due to gas leakages. In 1984, around 20,000 people lost their lives in the *Bhopal gas tragedy* which is regarded as one of the world's worst industrial disasters. The main reason for such a huge number of deaths is because the people living nearby these areas were not informed to evacuate as soon as possible. Not only Industrial disasters but each year India also experiences hundreds of domestic gas cylinder explosions. According to reports, in 2017 around 309 domestic Gas Cylinder explosions took place which resulted in the death of around 300 people. These accidents could have been prevented easily if those people were informed sooner. So, we are working on a device to inform people about any gas leakage as soon as possible through messages and buzzers. *Arduino Uno* which comes with an atmega 328P microcontroller, *MQ-2 Gas sensor* which detects the presence of combustible gases like propane, butane, and LPG, *GSM 900A Module* which is capable of sending, receiving messages as well as sending voice calls and, a buzzer are the main components of the designed system.

2. Literature Survey

In ref. [2], "A Wireless Home Safety Gas Leakage Detection System", Luay Fraiwan, Khaldon Lweesy, Aya Bani-Salma, Nour Mani, Jordan University of Science & Technology. Luay along with his research partners proposed a wireless safety

device for gas leakage detection. Their system design consists of two main modules: detection-transmission module and receiving module. The main components of the detection and transmission module are MQ-5 Gas sensor, PIC-16F877A microcontroller, RF transmitter, and buzzer. The main function of this module is to detect changes in gas concentration. If the sensor detects any change in gas concentration, this module activates an audio-visual alarm and transmits a signal to the receiver module. The Receiver module consists of an RF receiver, PIC-16F877A microcontroller, LED, and Buzzer. This module acts as a mobile alarm device to allow mobility within the house premises. This system was tested using LPG and it successfully activated the alarm as a result of gas concentration.

In ref. [3], "A Novel Technique For LPG Gas Leakage Detection and Control For Safety", Neha R. Shahapurkar, Shubham P. Deshpande, M. R. Rajput. This research paper successfully reports a novel technique to build an LPG leakage detector. In this project, the authors have used an 8051 microcontroller, MQ-6 Gas sensor, a dc motor, and a gsm module. This system detects gas concentration and performs the following operation successfully. The system they designed alarms the user with an audio-visual alarm and also sends an alert message on the owner's mobile phone. It as well consists of a dc motor to turn off the regulator valve and start an exhaust fan.

In ref. [4], "Implementation and design of Gas Leakage Detection system using ATmega8 microcontroller", N Evalina and A Azis H. In many countries LPG is widely used for cooking for economic reasons. This paper show implementation and design of gas leakage detection system. The main aim of the project is to build a gas leakage detector using an LPG gas sensor and microcontroller. It develops a security system by providing an early Warning and to give a sign if there is a leakage of gas around there. If this system detects the existence of leakage, then the system will give a signal in form of alarm or buzzer. If there is leakage of gas, system will work and the early warning will be given. The presence of gas, is required on the sensors to work. The MQ-6 is the gas Sensor used to detect diffused gas. The tool is designed to detect gas leaks that are then visible on the LCD screen and alarm. And in certain circumstances, the buzzer will ring. This MQ-6 sensor test is performed by measuring the sensor output with the Atmega8 microcontroller when

the LPG gas is detected and then writes it on the LCD screen. This test was conducted to determine the contribution of the MQ-6 sensor. It becomes essential to protect gas leakage from damage and accident.

In ref. [5], "Gsm Based Gas Leakage Detection System", Ashish Shrivastava, Ratnesh Prabhaker, Rajeev Kumar, Rahul Verma. This paper states that: - The aim of this paper is to present such a design that can automatically detect and stop gas leakage in vulnerable premises. In particular gas sensor has been used which has high sensitivity for propane (C3H8) and butane (C4H10). Gas leakage system consists of GSM module, which warns by sending SMS. However, the former gas leakage system cannot react in time. This paper provides the design approach on both software and hardware.

In ref. [6], " IOT Based Industrial Plant Safety Gas Leakage Detection System", Ravi Kishore Kodali, Greeshma R. N. V., Kusum, Yatish. Most of the fire- breakouts in businesses are due to gas leaks. These cause terrible damage to the equipment, human life leading to injuries, deaths, and (surrounding conditions). Now available leakage detectors warn the people around using on- site alarms. So, this project proposes a leakage detector which sends the warning to the concerned people through SMS. This detector senses the presence of harmful gases especially, LPG, Methane and Benzene. LPG and Methane gases catch fire easily resulting in blasts. Benzene is (cancer- causing thing) producing/making happen the health of workers, if inhaled in higher concentrations. Because of this, detection of these gases is very important. This low-cost project includes MQ6, MQ4 and MQ135 gas sensors which detect LPG, Methane and Benzene gas leaks (match up each pair of items in order) and uses ESP-32 as a Wi-Fi module. The concentration levels of the above talked about/said gases are uploaded in the UBIDOTS cloud and the login details are included in the alert message so that the user can check, if needed. The early model of the proposed system creates a sound alert using buzzer on detection of a dangerous leakage and sends an SMS to the concerned person using IFTTT web service. Different color LEDs are used to specify the gas leaked for example, RED LED points to/shows the presence of LPG.

3. METHODOLOGY

3.1 Components

1. MQ-2 Gas Sensor:

This project focusses on detecting LPG as it is the most commonly used gas in domestic households and hence for this we have used a MQ-2 gas sensor which is one of the best available sensors used to detect LPG. [7] MQ-2 is one of the commonly used gas sensors in MQ sensor series. It is a Metal Oxide Semiconductor (MOS) type Gas Sensor known as Chemiresistors as the detection is based upon change of resistance of the sensing material when the Gas comes in contact with the material. Using a simple voltage divider

network, concentrations of ga can be detected . MQ-2 Gas sensor works on 5V DC and draws around 800mW. It can detect LPG, Smoke, Alcohol, Propane, Hydrogen, Methane and Carbon Monoxide concentrations anywhere from 200 to 10000 ppm.

2. GSM 900A Module:

We have used a GSM900A module to enable SMS communication between the proposed system and the user's mobile phone during an emergency. [8] GSM SIM900A is a dual-band GSM/GPRS engine that works on frequencies EGSM 900MHz and DCS 1800MHz. It features GPRS multi-slot class 10/ class 8 and supports the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4. It is a 68-terminal device.

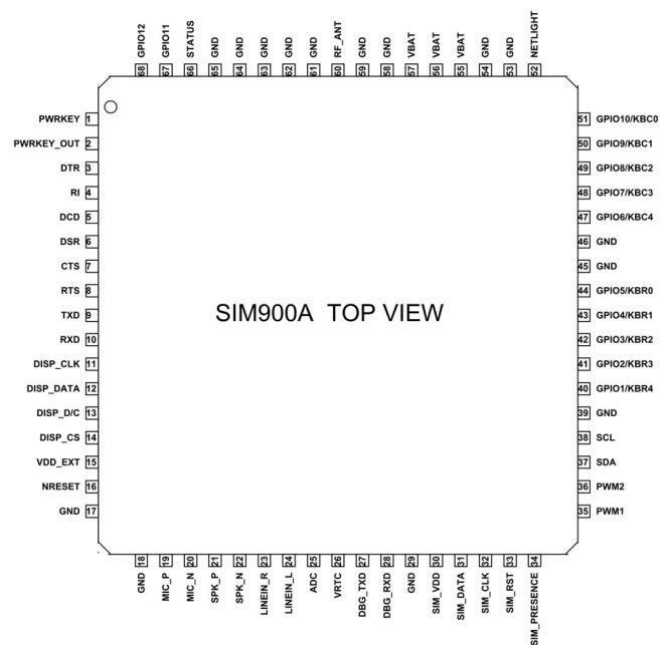


Fig -1: Pinout diagram of SIM900A

3. Arduino Uno:

Arduino Uno is a microcontroller board based on the ATmega 328P. It has 14 digital input/output pins out of which 6 can be used as PWM outputs, 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, power jack, an ICSP header and a reset button. This microcontroller board can be easily programmed using Arduino IDE which is an open-source project.

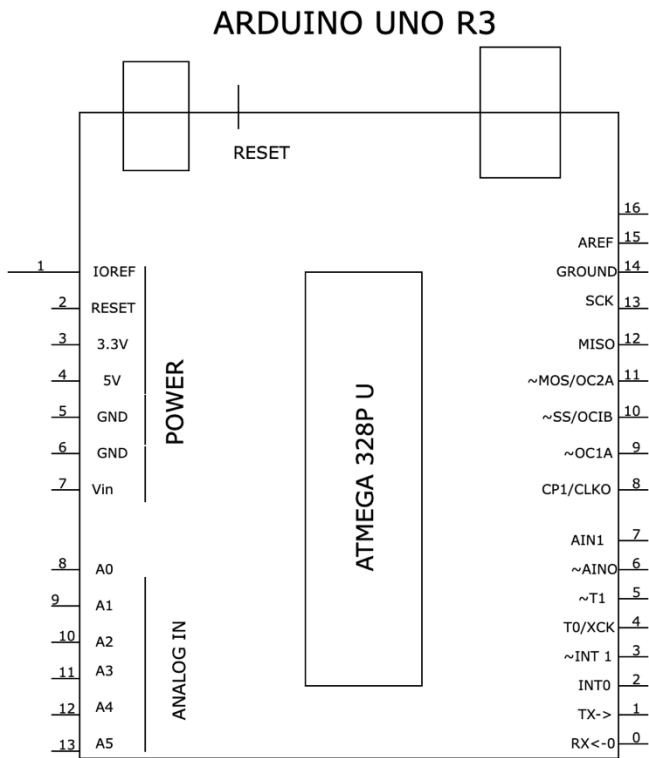


Fig -2: Pinout diagram of Arduino Uno.

4. Buzzer:

A buzzer is an audio signaling device. There are two main type of buzzers ,i.e, Active and Passive. An active buzzer has additional circuitry in it which makes it easier to use but limits the buzzer to only making one type of tone. A passive buzzer can make different tones. A passive buzzer module is used in this designed system to notify the user about gas leakage.

5. LED:

A light-emitting-diode (LED) is a semiconductor device that emits light when an electric current flow through it. In this designed system, tow LEDs of Red and Green color respectively are used. If the output from the sensor is below the set threshold value (i.e Gas concentration is LOW) then the Green LED will glow. Incase if the output is above the set threshold value (i.e Gas concentration is high), then the Red LED will glow.

3.2 Block Diagram

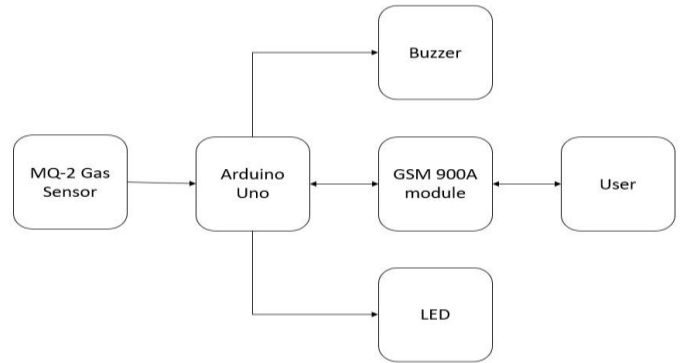


Fig -3: Workflow of the proposed system.

3.3 Schematic Diagram

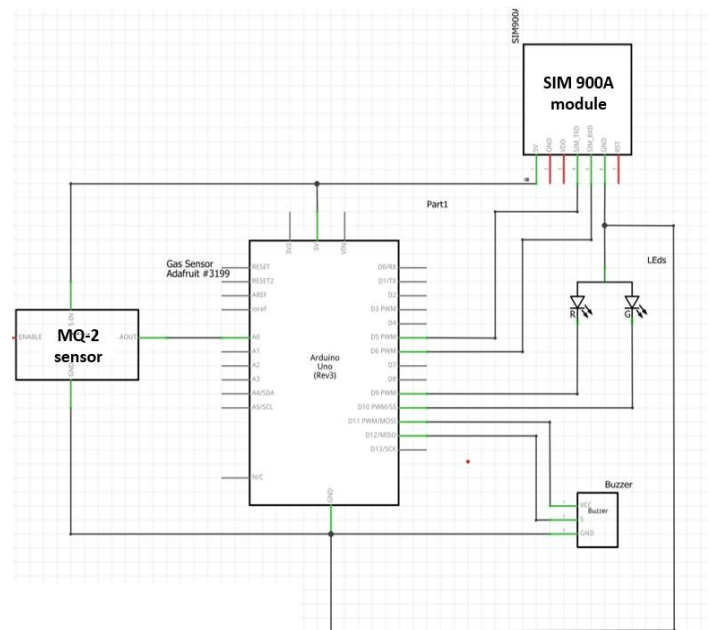


Fig -4: Schematic Circuit Diagram of Proposed System

3.4 Construction and Working

The whole system is constructed and arranged on a breadboard. Figure 4 shows the system design, connection of Arduino Uno pins with the various components used like GSM module, Gas Sensor, buzzer, LED, and power supply. The pin connection configuration of the system are as follow:- The positive and negative terminal of power supply is connected to the *vin* and *ground* pin of the Arduino uno respectively. The 5v, Tx(transmitter), Rx(Receiver), and ground pin of the SIM900A module are connected to the 5v output, digital pin 5, digital pin 6, and ground of the Arduino uno respectively. The anode of Red and Green LED are connected to the digital pin 9 and 10 of Arduino uno repectively and the cathodes are connected to the ground of Arduino uno. The vcc, tone, and ground of the passive buzzer

module are connected to the digital pin 11 , digital pin 12 and ground of Arduino Uno. The MQ-2 Gas Sensor has four terminal, 5v vcc, ground, AO(analog output) and DO (digital output). For these project Analog pin is used which is connected to the A0 analog pin of Arduino Uno. The 5v vcc and ground are connected to the 5v output and ground of Arduino Uno.

The working of the Gas Leakage detection system is as follow:- The MQ-2 Gas sensor senses the concentration of combustible gas such as butane, methane, LPG, etc in the surrounding and outputs the data to the microcontroller board. The output ranges from 0 units (0v) to 1024 units (5v). A threshold value (300 unit) is set to distinguish between safe and dangerous (low and high) concentration of gas. If the sensor output goes above the threshold value, the microcontroller board perform three main operations. It activates the buzzer, switches on the Red Led and sends an alert message to the user’s phone using GSM module. If the owner replies to the GSM module with a message “ALERT”, the microcontroller will send the same alert message to his neighbors. This was done so that incase if the owner is not at home, his neighbors could take appropriate actions.

In case if the sensor output is below the threshold value, the microcontroller will deactivate the buzzer and switch on Green Led and switch off the Red LED. GSM module has no role in this case. Figure 5 shows the flowchart of this process.

3.5 Flow Chart

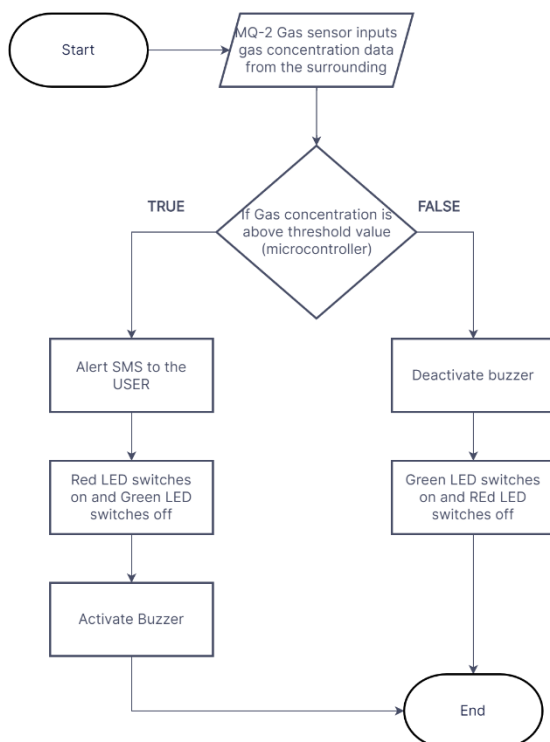


Fig -5: Flow Chart(Runs in Loop)

4. RESULT AND DISCUSSIONS

The proposed Gas Leakage detection system was designed and tested successfully. The MQ-2 Gas sensor can effectively sense the presence of gases like LPG, butane, and methane. The device was tested using butane Gas. The sensor analog output to the microcontroller ranges from 0 to 1024 units (5v). The output was found to be around 100 in normal condition when it wasn’t subjected to any gas concentration. These readings rose to 800 when the sensor was subjected to butane gas. After testing and analyzing these readings, the threshold value was finally set to 300.

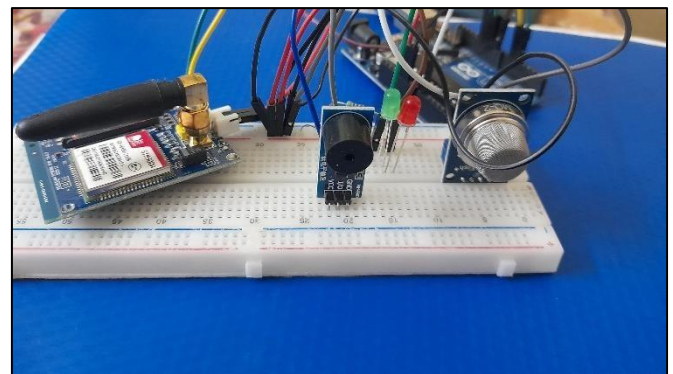


Fig -4: Prototype of proposed system.

5. CONCLUSION

One of the most important things to do during any kind of gas leakage is to inform the people as soon as possible to prevent any loss of life. Our designed system was successfully able to send alert messages to the user’s mobile phone. The user’s phone does not require any application installed to receive these messages. These alert messages are sent using GSM technology. The designed system was as well successful in sending alert messages to the neighbor’s contact number if the user replies with “ALERT” to the alert message sent by the GSM module. This was done to alert the user’s neighbor so that they could take proper actions in case if the user is not at home. The designed system was also successfully able to activate the buzzer and LED when the gas concentration was above the threshold value.

ACKNOWLEDGEMENT

We are extremely grateful to Professor Rajesh Raikwar for his guidance and support from the initial stages till the completion of this project.

REFERENCES

[1] More than 70% of Indian Households Use LPG as Primary Cooking Fuel: CEEW Riddhima Sethi, Mihir Shah <https://www.ceew.in/press-releases/more-70-indian-households-use-lpg-primary-cooking-fuel-ceew>

- [2] Luay F., Khaldon L., Aya Bani-Salma, Nour M.,(2011) "A Wireless Home Safety Gas Leakage Detection System", Jordan University of Science and Technology
- [3] Neha R. Shahapurkar, Shubham P. Deshpande, M. R. Rajput, " A Novel Technique For LPG Gas Leakage Detection and Control For Safety", Volume-7, Issue-3 (Mar-17)
- [4] N Evalina and A Azis H., Implementation and design of Gas Leakage Detection system using ATMega8 microcontroller"
- [5] Ashish Shrivastava, Ratnesh Prabhaker, Rajeev Kumar, Rahul Verma, "Gsm Based Gas Leakage Detection System".
- [6] IOT Based Industrial Plant Safety Gas Leakage Detection System", Ravi Kishore Kodali, Greeshma R. N. V., Kusum, Yatish.
- [7] <https://lastminuteengineers.com/mq2-gas-senser-arduino-tutorial/#:~:text=The%20MQ2%20sensor%20is%20on%20material%20when%20exposed%20to%20gasses>
- [8] <https://components101.com/wireless/sim900a-gsm-module>