

AN ENGINEERING PROJECT REPORT

On

Gas Leakage Detection System

Submitted By

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Submitted to

The Department of IT and Computer Engineering

**In Partial fulfillment of requirement for the degree of
Bachelor of Engineering in Electronics and Communication**



**Cosmos College of Management & Technology
(Affiliated to Pokhara University)**

Tutepani, Lalitpur, Nepal

September 16, 2023

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Under the Supervision of

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Yours Sincerely,

Abhidha Pokharel

Anuj Chaudhary

Sachin Paneru

Saurabh Basnet

Abstract

The aim of our project is to develop a comprehensive system to detect gas leaks, provide immediate alerts and automatically activate a fan mechanism for gas dispersion. The objective of the project is to enhance safety measures in environments where gas leaks can pose a significant risk.

The project utilizes MQ-6 gas sensor to detect the presence of gas leaks and interfaces them with an Arduino Uno for data processing and system control. Upon detecting a gas leak the system triggers an alert system comprising audio and visual indicators such as buzzers, LED lights, and a GSM module ensuring immediate notification to user. Additionally, an automatic fan mechanism is integrated into the system to disperse the gas.

The methodology employed in the project includes component selection, circuit design, programming, sensor integration, alert system development, prototype assembly, testing and validation. Testing is conducted to validate the system's functionality and accuracy in detecting gas leaks and alerting about leaks including both buzzers and GSM module.

The Gas Leakage Detection System project contributes to enhancing safety measures in various environments prone to gas leaks, including residential areas, industries, and commercial areas. By providing immediate alerts and activating a fan mechanism, the system helps mitigate potential hazards and ensures the safety of the users.

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List of abbreviations

GSM = Global System for Mobile Communication

LPG = Liquefied petroleum gas

GPRS= General Packet Radio Service

EDGE= Enhanced Data for Global Evolution

SSR= Solid State Relay

1. Introduction

1.1 Background

In context of Nepal, Gas leakage is a major problem within the industrial sector and residential premises. Since last few years there is a hike in the demands of liquefied petroleum gas (LPG) and natural gas. To meet this excess amount of demand for energy and replace oil or coal due to their environmental disadvantage, LPG and natural gas are preferred. These gases are mostly used on a large scale in industries and home appliances. Leakage of gas can be quite dangerous as it increases the risk of explosion. For this purpose, an odorant such as ethanol is added to LPG, so that a leakage can be detected by anyone. However, some people cannot rely on this safety mechanism as they may have a reduced sense of smell. The issue of Liquefied Petroleum Gas leakage has been so disastrous that it has resulted in serious harm, including the loss of life and property worth millions of dollars around the world. According to the Nepal police headquarter, in the fiscal year 2021-2022, three people were killed and 10 got injured in 10 cases of LPG gas explosions. And there are uncountable case of death and injuries due to gas leakage accident which were not reported.

The scope of this project is to design and develop a gas leakage detection with an alert system and automatic fan. The gas sensor will detect the presence of gas, and the GSM module will send an alert message to the user's phone in case of gas leakage. The project will also include the development of an automatic fan that will turn on in case of gas leakage to ventilate the area and prevent the gas from accumulating.

1.2 Project objectives

Main objective: To develop a gas leakage detector that comes with an SMS alert and automatic fan system to prevent accidents caused by gas leakage.

Specific objectives:

- i. To develop an Arduino-based control system that can process the sensor data.
- ii. To integrate Gas sensor to detect the concentration of gas and GSM module with the system to send an SMS alert to the owner's phone in case of a gas leak.

To integrate a fan to ventilate the area and prevent the gas from accumulating and minimize the risks.

1.3 Problem Statement

Gas leakage is a serious concern in many households and industries, as it can lead to potential health hazards and even fatal accidents. To ensure the safety of people and property, it is important to detect gas leakage at an early stage and act appropriately to prevent any mishap. From our research we found that most of the gas detection systems just detect the change in concentration of the gas and sound the buzzer to alert the user. But this is not effective as in the modern era, most of the time the house remains empty as the parents go to their job and children go to school. If any gas leaks at this time, then there will be no one to hear the buzzer's sound to call the professional to fix it. Some of the gas detection systems use GSM module to notify the user but they lack a system that can reduce the concentration of accumulated gas by the time the owners arrive, or the professional arrives to fix the leakage.

Therefore, we are going to build a system that will not only detect gas leakage and notify the user but also turn on an exhaust fan automatically using Arduino uno, GSM module, gas sensor, relay, and fan. The system will continuously monitor the air quality and detect any gas leakage in the environment. Upon detection of gas leakage, the system will send an SMS alert to the user's mobile phone, notifying them of the potential risk. Additionally, the system will automatically turn on a fan to ventilate the area and mitigate the risk.

2. Literature Review

We did research into the possible sources that we could access. In our exploration, we did find the Authors of [1] proposed system defines that detection and monitoring of the LPG gas is sensed using MQ 5 sensors. In the system, when the leakage of gas is detected, the buzzer will be on, along with that the alert message will be displayed in the LCD. And while monitoring of gas based on the cylinder weight, which is measured using the load sensor, it will send the message to the owner of the application or system.

Another author of [2] proposed to detect gas with a sensor. This gas sensor senses the concentration of gas. Upon detection of a change, it activates the buzzer and shows the concentration of gas on the LCD display.

Another author of [3] proposed a smart gas leakage detection system using an Arduino Uno board, an MQ-2 gas sensor, and a GSM module. The system can detect the presence of LPG, methane, and propane gas leaks. When a gas leak is detected, the system will sound an alarm, send a notification to a user's smartphone, and send an SMS message to a user's phone number.

Another author of [4] proposed an IoT-based gas leakage detection system using an Arduino Uno board, an ESP8266 Wi-Fi module, and an MQ-2 gas sensor. The system can detect the presence of LPG, methane, and propane gas leaks. When a gas leak is detected, the system will send a notification to a user's smartphone and to a cloud server.

Many similar systems have been proposed earlier by different authors and researchers and that has helped us to improve the gas safety issue in our day to day lives. But there were no steps taken to prevent the accident in case of leakage like an exhaust fan. A lot of people would prefer to go with the quote 'prevention is better than cure'. Our system uses MQ-6 gas sensor to detect LPG gas leakage. When gas leakage is detected, our system will inform the user by sending an alert message and turn on automatic fan to ventilate the area and prevent the gas from accumulating and prevent any accidents from occurring.

3. Methodology

3.1 Block diagram of the project

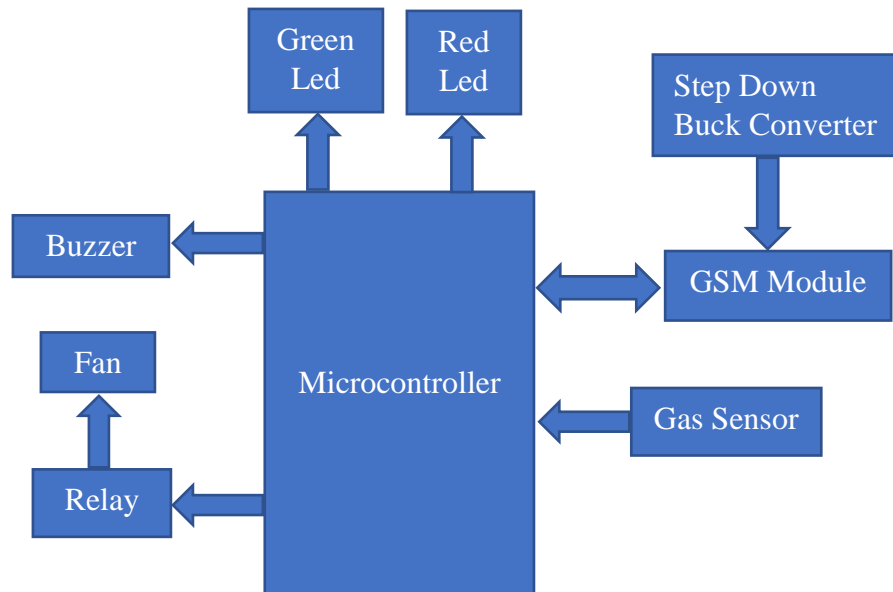


Fig. 3.1. Block Diagram of the project

3.2. Flow diagram of the project

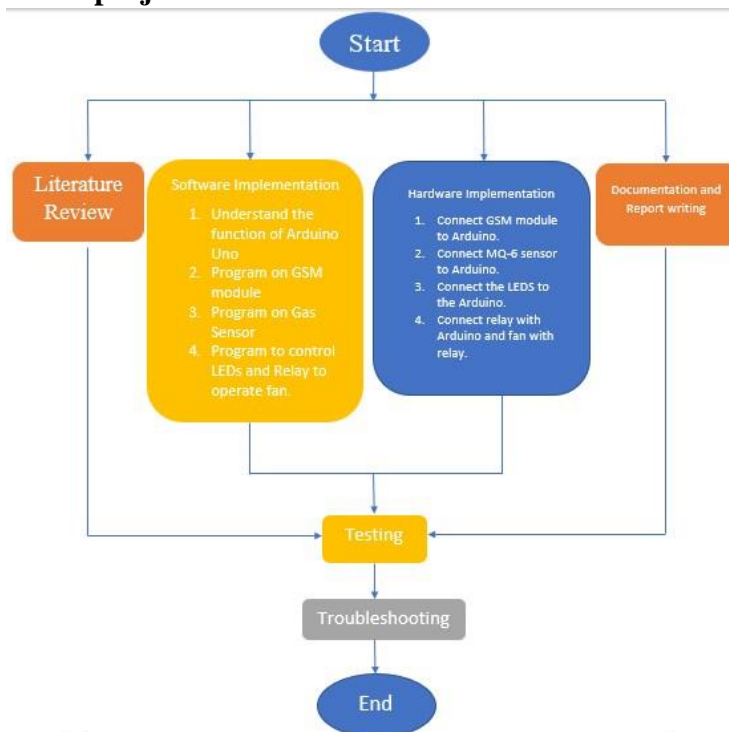


Fig 3.2 Flow diagram of the project

3.3 Circuit diagram

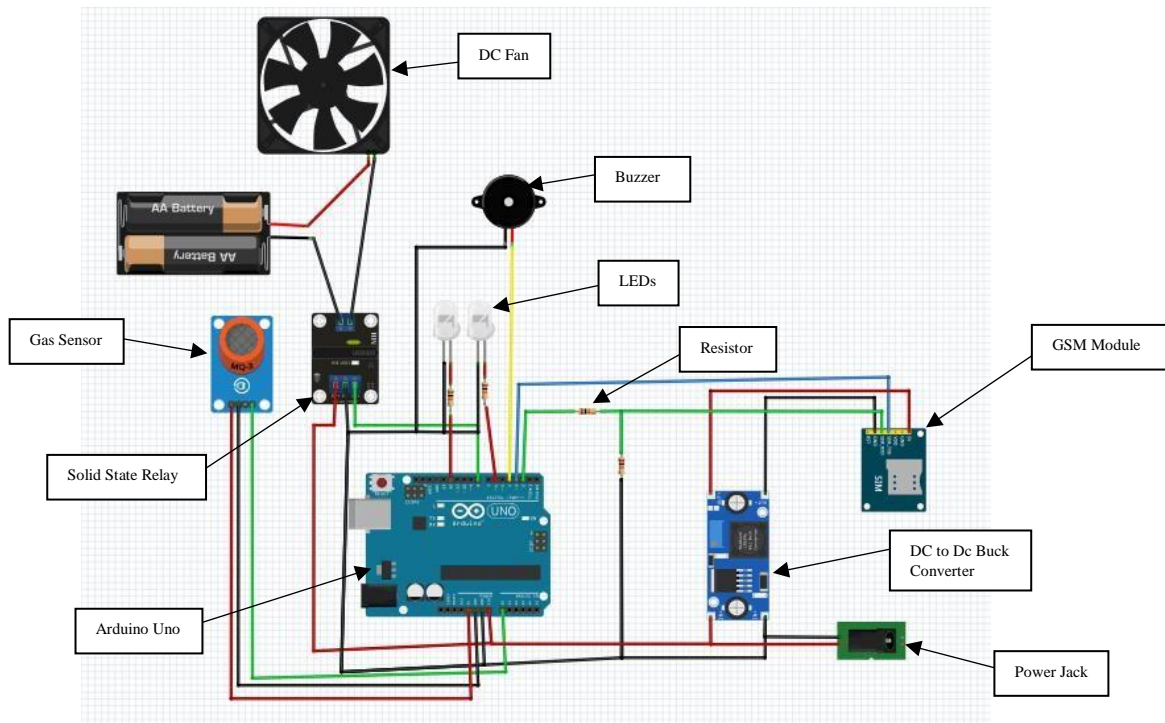


Fig.3.3. Circuit diagram of the project

In our project we used a 12V, 1A adapter to convert the ac to dc from the power supply. Then this 12V was connected to dc-to-dc buck converter which converts 12V, 1A to 4V, 2A suitable for the operation of sim800l module as it requires 2A current to connect to the network and send message and the 4V, 2A from the buck converter was connected to Vin pin of sim800l. We also used 12V to power the Arduino through Vin pin. Then we used 10k and 20k resistors to make a voltage divider circuit as shown in circuit to convert 5V from Arduino pin 2 to 3.3V as the sim800l was not capable of tolerating 5V. After that we used the MQ-6 sensor that was connected to analog pin A0 to get the concentration of gas accumulated in the room. We also used a relay module connected to pin 5 to turn on the Ac fan (exhaust fan) to reduce the concentration of accumulated gas. Also we used a buzzer connected to pin 4 to alert the user. The user could also turn on the exhaust fan and get the concentration of gas accumulated in the room by sending message to sim800l as “fanof”, “fanon” and “gas”. We also used the two led to indicate if the sim was registered to the network and could send and receive messages and make calls. If it was connected to the network the green led was turned on or else the red led was turned.

3.4 Components

Arduino

Arduino is an open-source electronics platform that consists of hardware and software designed to enable users to create and develop interactive electronic projects. The Arduino hardware is based on a microcontroller, which is a small computer on a single integrated circuit. The Arduino software includes a programming language and development environment that enables users to write and upload code to the microcontroller board. The Uno uses the ATmega328P microcontroller, which operates at 16 MHz and has 32KB of flash memory for storing the program code, 2KB of SRAM for data storage, and 1KB of EEPROM for non-volatile storage .

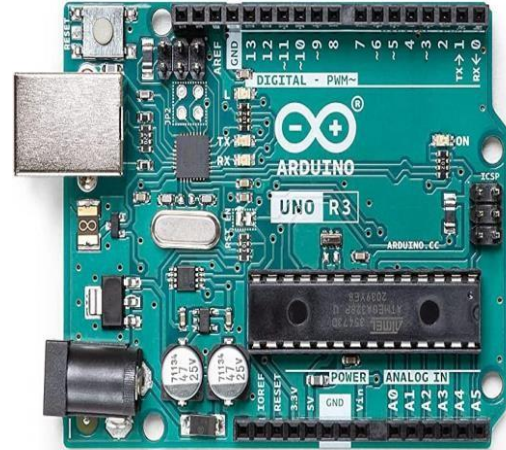


Fig.3.4.1. Arduino

Gas Sensor (MQ-6)

The MQ-6 gas sensor is a commonly used gas sensor module that is designed to detect the presence of LPG (liquefied petroleum gas), such as propane and butane. It is often used in applications where gas leakage detection and safety are critical, such as in homes, gas-powered vehicles, and industrial environments. The MQ-6 gas sensor module operates based on the principle of semiconductor gas sensing. It contains a tin dioxide (SnO_2) sensing element that detects the target gas by changes in its conductivity when it encounters the gas molecules. It has high sensitivity to LPG gas and can detect concentrations in the range of 200 to 10000 parts per million (ppm). However, it is important to note that the actual sensitivity can vary depending on factors such as temperature, humidity, and other gases present in the environment.

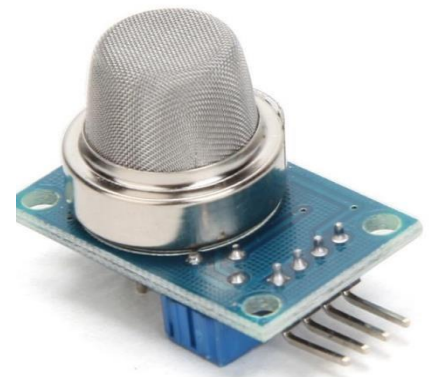


Fig.3.4.2. MQ-6 gas sensor

GSM module (SIM800L)

The GSM module SIM800L is a widely used module for enabling GSM (Global System for Mobile Communications) connectivity in various electronic projects. It provides the ability to send and receive SMS messages, make, and receive calls, and connect to the internet using GPRS (General Packet Radio Service) data transmission. This quad-band GSM/GPRS module is designed to work on the four global GSM frequency bands (850/900/1800/1900MHz), making it compatible with most cellular networks around the world. The SIM800L module operates based on the GSM network,

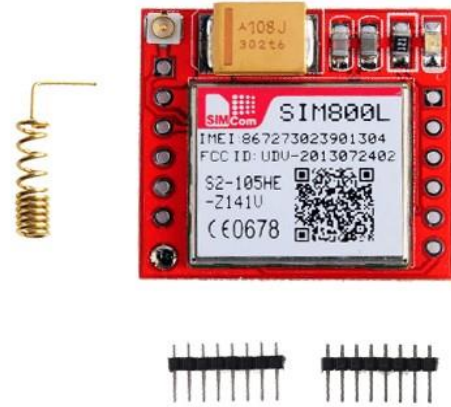


Fig.3.4.3. Sim800l

which is a widely adopted standard for mobile communication worldwide. It supports 2G networks, including GSM and GPRS. It communicates with external devices, such as microcontrollers or computers, using UART (Universal Asynchronous Receiver-Transmitter) serial communication. To interact with the SIM800L module, we send AT commands through the UART interface. Additionally, it has GPIO (General Purpose Input/Output) pins that can be used for interfacing with other electronic components. The module operates on a low voltage range, typically between 3.4V and 4.4V. It is important to provide a stable and sufficient power supply to ensure reliable operation. A separate power supply or voltage regulator may be needed to power the module.

Solid State Relay(SSR)

A Solid State Relay (SSR) is an electronic switching device that is used to control the flow of electrical current without the use of mechanical components such as traditional relays with moving parts. Instead, SSRs rely on semiconductor devices like thyristors or triacs to perform the switching action. SSRs offer several advantages over their mechanical counterparts, including faster switching speeds, longer lifespan, reduced electromagnetic interference, and silent operation.



Fig.3.4.4. Solid State Relay

4. Outcomes

- An Arduino based system that is able to detect gas leakage.
- The system can send SMS alerts in case of gas leakage.
- The system can turn on a relay that was able to turn on fan to ventilate the area.
- The user can get gas concentration value by sending message.

5. Budget Structure

Name	Quantity	Price (Rs)
1. Arduino Uno	1	1250
2. GSM module (SIM800l)	1	1000
3. Gas sensor (MQ-6)	1	500
4. Fan	1	500
5. Relay	1	200
6. Lm2596	1	250
7. Battery	1	2000
8. Miscellaneous	-	1000
Total		6700

Total estimated cost is Rs.7000

6. Working Schedule

The project will be completed within the following timeline:

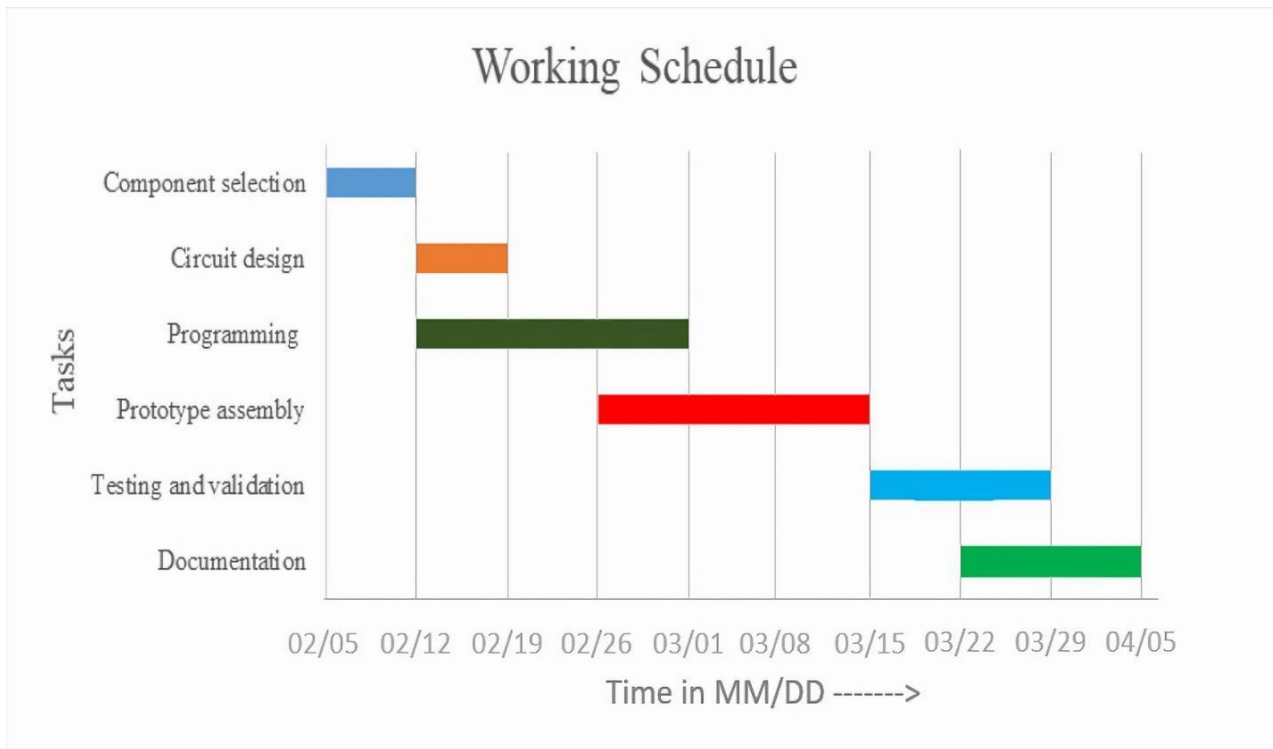


Fig 6.1. Working schedule

7. References

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8.Conclusion:

In conclusion the Gas Leakage Detection System project has been a success. Our project have been designed, implemented, and thoroughly tested. And as a result reliable system that can effectively detect gas leaks in real-time has been obtained. This system with its user friendly interface and reliable alert system hold promise for enhancing safety in various environments including industries and households. Moving forward further improvements can be made that can highly increase the working and safety mechanism of the system. However as of the completion of this project we have achieved our primary objectives and provided a solid foundation for future improvement and enhancement. Also this system stands as a testament to our commitment to safety and innovation, and we believe it has the potential to make a significant impact on gas leak prevention.