LPG Gas Detector and Alert System Using Arduino

B.Sc. (Engineering) PROJECT

A project submitted to the Department of Information and Communication Engineering. Faculty of Engineering, University of rajshahi in partial fulfillment of the Degree of Bachelor of Science in Information and Communication Engineering.

SUBMITTED BY

Roll No: 1710577146

Registration No: 1710577146

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DEPARTMENT OF INFORMATION AND COMMUNICATION ENGINEERING

University of Rajshahi

ABSTRACT

Liquefied Petroleum Gas (LPG) is a main source of fuel, especially in urban areas because it is clean compared to firewood and charcoal. Gas leakage is a major problem in the industrial sector, residential premises, etc. Nowadays, home security has become a major issue because of increasing gas leakage. Gas leakage is a source of great anxiety with ateliers, residential areas and vehicles like Compressed Natural Gas (CNG), buses, and cars which are run on gas power. One of the preventive methods to stop accidents associated with the gas leakage is to install a gas leakage detection kit at vulnerable places. The aim of this paper is to propose and discuss a design of a gas leakage detection system that can automatically detect and alert gas leakage. This proposed system also includes an alerting system for the users. The system is based on a sensor that easily detects a gas leakage.

Individual Contribution of Group Members

This is a combine project. The whole project is completed by two person whose roll no are 1710577146 and 1711177141. It was started at September in 2021 and finished at March in 2022.

Contribution of Roll 1710577146:

1. Main circuit design and ideas.
2. Control and navigation algorithm and coding.
3. Project paper composition related these topics.
4. Future development ideas and conclusion.

Contribution of Roll 1711177141:

1. Circuit design implementation and setup.
2. Hardware components and setup.
3. Project paper composition related to these topics.
4. Information collection and references.

CONTENTS

CHAPTER ONE

Introduction

1.1 Introduction

Gas leakage leads to various accidents resulting in both material loss and human injuries. The risk of explosion, firing, suffocation are based on their physical properties such toxicity, flammability, etc. The number of deaths due to explosion of gas cylinders has been increasing in recent years. The reason for such explosion is due to substandard cylinders, old valves, worn out regulators and lack of awareness in handling gas cylinders. The LPG or propane is a flammable mixture of hydrocarbon gases used as fuel in many applications like homes, hostels, industries, automobiles, vehicles because of its desirable properties which include high calorific value, less smoke, less soot, and meager harm to the environment.[1] Due to the explosion of LPG, the number of deaths has been increased in recent years. To avoid this problem there is a need for a system to detect the leakage of LPG. Gas leak detection is the process of identifying potentially hazardous gas leaks by means of various sensors [2]. Several designs of LPG detection and alert system have been proposed in the literature. Apeh et al. designed kitchen gas leakage detection and automatic gas shut off system [3]. T.Soundaryaet al. presented the cylinder LPG gas leakage detection system [4]. Wireless and GSM technology [5] based gas detectors have also been proposed.

1.2 Gas Detector Evolution

While mining was the pioneering industry to spearhead gas detection innovation, other industries also had a need for gas safety. The flame safety light was not a ‘one size fits all’ approach for all industries; their specific gas and atmosphere detection requirements were too diverse.

The catalytic sensor was the first gas detector that resembles modern technology. The sensors work on the principle that when a gas oxides, it produces heat. The catalytic sensor works by detecting a temperature change, which is proportional to the concentration of gas.[13]

1.3 LPG Accident in Bangladesh

The safety aspects are becoming a big concern as the accidents initiate from LPG cylinders increased as well. There is no single regulatory body to monitor and regulate the safety aspects of LPG use. The Department of Explosives only inspects the cylinders and the valve. There is none to monitor the other accessories like regulator, hose pipes that are used.

According to the data from Bangladesh Fire Service and Civil Defense (BFSCD), some 852 accidents took place in 2017 where 81 people died and 1,295 were injured. In 2018, 15 people were died and 249 were injured in 662 accidents. Though officials of BFSCD said the casualty number is not the exact figure as they only includes the spot casualty in the database.[14]

1.4 Gas Detector

An LPG gas detector is a one kind of device which is used to sense the presence of a hazardous LPG gas leak in service station, cars, storage tanks and homes. This sensor is attached to an alarm circuit to give an alert to the operators through a buzzer sound in the area where the gas leak is occurring.

1.5 Problems with gas detector

There are many factors in the workplace that can cause a gas detector to fail.

1. Environmental

Dirt, dust and water impact. These physical affects can block gases and vapors from entering the sensor chamber preventing detection of the gases. This can be either within the sensor area, sampling pump or sample lines.

2. Physical Affects

Dropping and other abuse can damage the instrument from working properly or at the least change the ability of the detector from measuring accurately.

3. Gas Exposure

High gas exposure will change the calibration curve of the sensors causing false or inaccurate readings. Extremely high concentrations can kill the sensor's ability to measure gas. Further, many sensors can fail but not provide a warning that they have failed.

4. Temperature Affect

Storing instruments in environment which is either too cold or too hot can affect the ability of the sensors to measure accurately. [15]

1.6 Objectives

Gas detectors can be used to detect combustible, flammable and toxic gases, and oxygen depletion. This type of device is used widely in industry and can be found in locations, such as on oil rigs, to monitor manufacturing processes and emerging technologies such as photovoltaic. They may be used in firefighting.[10]

CHAPTER TWO

Hardware Components

2.1 List of Hardware Components

The entire System consists of the following components.

1. Arduino Uno Board
2. MQ-2 Flammable Gas and Smoke Sensor
3. SIM800L GSM Module
4. 1 Channel 5V Relay Module
5. Buzzer
6. LEDs
7. Brushless Fan
8. Batteries
9. Breadboard
10. Connecting Wires

2.2 Arduino Uno Board

Arduino is a microcontroller kit that designed with a verity of microprocessors and microcontroller. Arduino is a prototype platform (open-source) based on an easy to use hardware and software. It consists of a circuit board, which can be programmed and a ready-made software called Arduino IDE (Integrated Development Environment), which is Liced to write and upload the computer code to physical board. Various kinds of Arduino boards are available depending on different micro-controller used. However, all Arduino hoards have one thing in common: they are programmed through the Arduino IDE. The differences are based on the number of inputs and outputs, speed, operating voltage, form factor etc.[6]

Arduino Uno is an open-source microcontroller board based on the Almega320 microcontroller. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a type B USB connection port, power input jack, an ICSP header and a reset button. It can be powered through USB or connecting battery to the DC input port.

"Uno" means "one" in Italian and was chosen to mark the initial release of Arduino Software. The Uno board is the first in a series of USB-based Arduino boards. The Uno board and version 1.0 of Arduino IDE were the reference version of Arduino, now evolved to newer releases. The ATmega328 on the board comes programmed with a bootloader that allows uploading new code to it without the use of an external hardware programmer.

Each of the 14 digital pins and 6 analog pins on the Uno can be used as input or output under software control (using pinMode(), digitalWrite(), and digitalRead() functions). They operate at 5 volts. Each pin can provide or receive 20 mA as the recommended operating condition and has an internal pull-up resistor (disconnected by default) of 20-50K ohm. A maximum of 40mA must not be exceeded on any I/O pin to avoid permanent damage to the microcontroller. The Uno has 6 analog inputs, labeled AO through A5; each provides 10 bits of resolution (i.e. 1024 different values). By default, they measure from ground to 5 volt, though it is possible to change the upper end of the range using the AREF pin and the analogReference() function. [7]

In addition, some pins have specialized functions.

Serial/UART: pins 0 (RX) and pin 1(TX). Used to receive and transmit TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL serial chip.

External interrupts: pins 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in chip.

PWM: pins 3,5,6,9,10 and 11. Can provide 8-bit PWM output with the analogWrite() function.

Spl (Serial Peripheral Interface): pins 10(SS), 11(MOSI), 12(MOSI), 13(SCK). These pins support SPl communication using the SPI library.

TWI (Two-wire interface): pins SDA (A4) and pin SCL (A5). Support TWI communication using the wire library.

AREF (analog reference): Reference voltage for the analog inputs

Fig 2.1: Arduino Uno R3

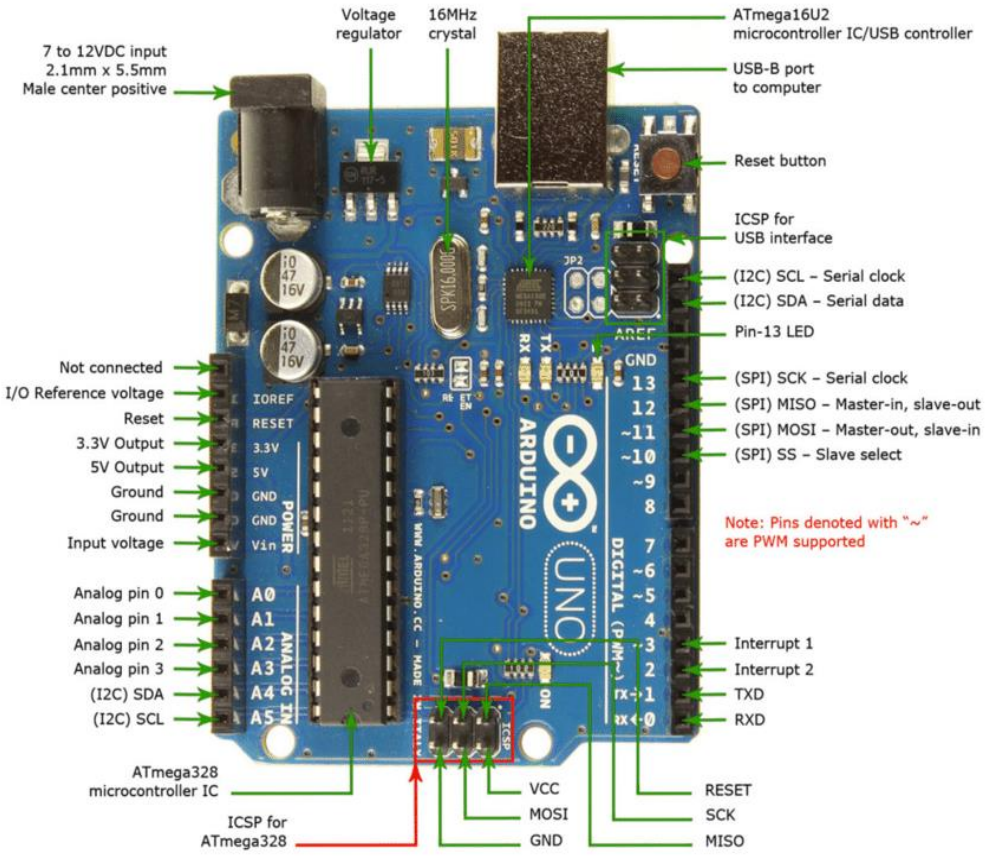

Fig 2.2: Arduino Uno Pin Description

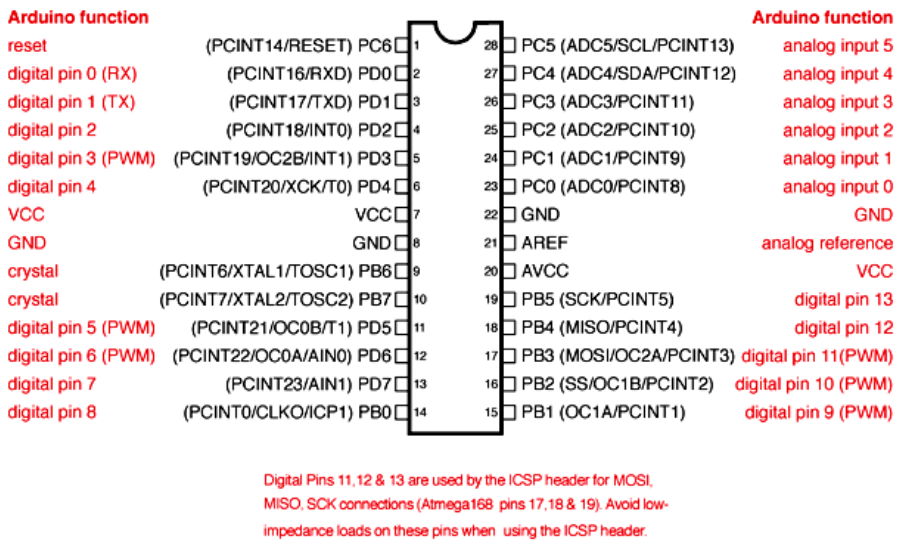

Fig 2.3: Pin Configuration of ATmeaga328P Microcontroller

2.2.1 Technical Specification:

- Microcontroller: Microchip ATmega328P
- Operating Voltage: 5 volts
- Input Voltage: 7 to 20 Volts
- Digital I/O Pins: 14(of which 6 can provide PWM output)
- Analog Input Pins: 6
- DC Current per I/O pin: 20 mA
- DC Current for 3.3V Pin: 50 mA
- Flash Memory: 32 KB of which 0.5 KB used by bootloader
- SRAM: 2KB
- EEPROM: 1 KB
- Clock Speed: 16 MHz
- Length: 68.6 mm
- Width: 53.4 mm
- Weight: 25 g

2.3 MQ6 Flammable Gas And Smoke Sensor

Sensors are the electronic devices used for interaction with the outer environment. There are various types of sensors available that can detect light, noise, smoke, proximity etc. With the advent in technology, these are available as both analog and digital forms. Besides forming a communication with the outer environment, sensors are also a crucial part of safety systems. Fire sensors are used to detect the fire and take appropriate precautions on time. For smooth functioning of control systems and sensitive electronics, humidity sensors are used for maintaining humidity in the unit. One of such sensor used in safety systems to detect harmful gases is MQ6 Gas sensor.

MQ6 gas sensor is an electronic sensor used for sensing the concentration of gases in the air such as LPG, propane, methane, hydrogen, alcohol, smoke and carbon monoxide.[8]

MQ6 gas sensor is also known as chemiresistor. It contains a sensing material whose resistance changes when it comes in contact with the gas. This change in the value of resistance is used for the detection of gas.

MQ6 is a metal oxide semiconductor type gas sensor. Concentrations of gas in the gas is measured using a voltage divider network present in the sensor. This sensor works on 5V DC voltage. It can detect gases in the concentration of range 200 to 10000ppm.[9]

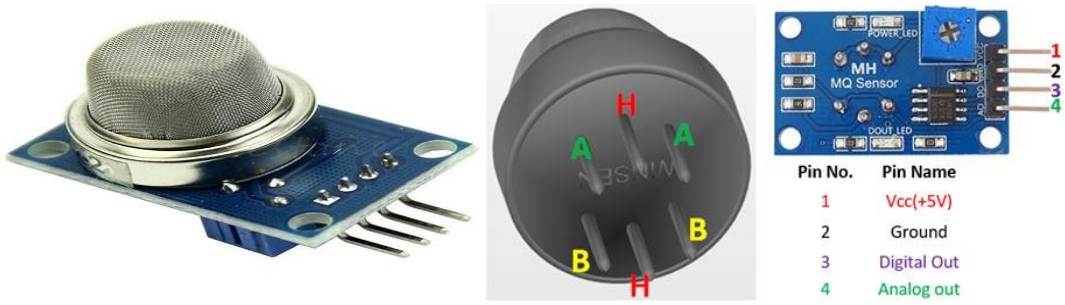

Fig 2.4: MQ-6 Gas Sensor

2.3.1 Working Principle

This sensor contains a sensing element, mainly aluminium-oxide based ceramic, coated with Tin dioxide, enclosed in a stainless steel mesh. Sensing element has six connecting legs attached to it. Two leads are responsible for heating the sensing element, the other four are used for output signals.

Oxygen gets adsorbed on the surface of sensing material when it is heated in air at high temperature. Then donor electrons present in tin oxide are attracted towards this oxygen, thus preventing the current flow.

When reducing gases are present, these oxygen atoms react with the reducing gases thereby decreasing the surface density of the adsorbed oxygen. Now current can flow through the sensor, which generated analog voltage values.

These voltage values are measured to know the concentration of gas. Voltage values are higher when the concentration of gas is high.

2.3.2 Applications

These sensors are used to detect the presence of gases in the air such as methane, butane, LPG and smoke but they are unable to distinguish between gases. Thus, they cannot tell which gas it is.

Module version of this sensor can be used without interfacing to any microcontroller and is useful when detecting only one particular gas. This can only detect the gas. But if ppm has to be calculated then the sensor should be used without module.
This sensor is also used for Air quality monitoring, Gas leak alarm and for maintaining environmental standards in hospitals. In industries, these are used to detect the leakage of harmful gases.

Some of the alternatives of the MQ6 gas sensor are MQ-2, M-306A, AQ-3 sensors.

2.4 SIM800L GSM Module

SIM800L GSM/GPRS module is a miniature GSM modem, which can be integrated into a great number of IoT projects. You can use this module to accomplish almost anything a normal cell phone can; SMS text messages, Make or receive phone calls, connecting to internet through GPRS, TCP/IP, and more! To top it off, the module supports quad-band GSM/GPRS network, meaning it works pretty much anywhere in the world.[12]

At the heart of the module is a SIM800L GSM cellular chip from SimCom. The operating voltage of the chip is from 3.4V to 4.4V, which makes it an ideal candidate for direct LiPo battery supply. This makes it a good choice for embedding into projects without a lot of space.

Fig 2.5: SIM800l GSM Module

All the necessary data pins of SIM800L GSM chip are broken out to a 0.1″ pitch headers. This includes pins required for communication with a microcontroller over UART. The module supports baud rate from 1200bps to 115200bps with Auto-Baud detection.

The module needs an external antenna to connect to a network. The module usually comes with a Helical Antenna and solders directly to NET pin on PCB. The board also has a U.FL connector facility in case you want to keep the antenna away from the board.

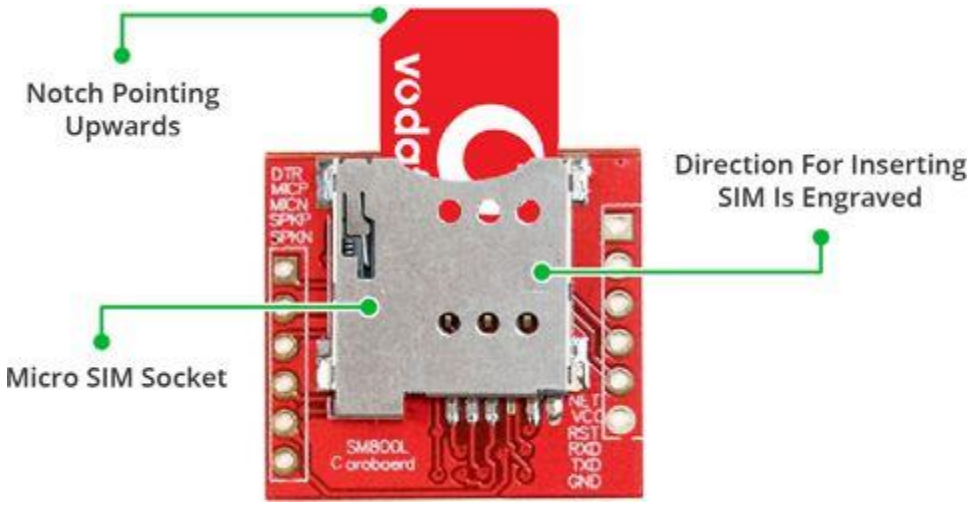

Fig 2.6: Insurting SIM into Module

There's a SIM socket on the back! Any activated, 2G micro SIM card would work perfectly. Correct direction for inserting SIM card is normally engraved on the surface of the SIM socket.

This module measures only 1 inch² but packs a surprising amount of features into its little frame. Some of them are listed below:

- Supports Quad-band: GSM850, EGSM900, DCS1800 and PCS1900
- Connect onto any global GSM network with any 2G SIM
- Make and receive voice calls using an external 8Ω speaker & electret microphone
- Send and receive SMS messages
- Send and receive GPRS data (TCP/IP, HTTP, etc.)
- Scan and receive FM radio broadcasts
- Transmit Power:
- Class 4 (2W) for GSM850
- Class 1 (1W) for DCS1800
- Serial-based AT Command Set
- FL connectors for cell antennae
- Accepts Micro SIM Card

2.4.1 LED Status Indicators

There is an LED on the top right side of the SIM800L Cellular Module which indicates the status of your cellular network. It'll blink at various rates to show what state it's in:

Blink every 1s

The module is running but hasn't made connection to the cellular network yet.

Blink every 2s

The GPRS data connection you requested is active.

Blink every 3s

The module has made contact with the cellular network & can send/receive voice and SMS.

2.4.2 Selecting Antenna

An antenna is required to use the module for any kind of voice or data communications as well as some SIM commands. So, selecting an antenna could be a crucial thing. There are two ways you can add an antenna to your SIM800L module.

The first one is a Helical GSM antenna which usually comes with the module and solders directly to NET pin on PCB. This antenna is very useful for projects that need to save space but struggles in getting connectivity especially if your project is indoors.

Fig 2.9: Connecting Helical Antenna to Module

The second one is any 3dBi GSM antenna along with a U.FL to SMA adapter which can be obtained online for less than $3. You can snap-fit this antenna to small u.fl connector located on the top-left corner of the module. This type of antenna has a better performance and allows putting your module inside a metal case – as long the antenna is outside.

Fig 2.10: Connecting 3dbi Antenna to Module

2.4.3 Supplying Power for SIM800L module

One of the most important parts of getting the SIM800L module working is supplying it with enough power.

Depending on which state it's in, the SIM800L can be a relatively power-hungry device. The maximum current draw of the module is around 2A during transmission burst. It usually won't pull that much, but may require around 216mA during phone calls or 80mA during network transmissions.

2.4.4 SIM800L GSM Module Pinout

The SIM800L module has total 12 pins that interface it to the outside world. The connections are as follows:

Fig 2.11: Pin Status of SIM800L

NET is a pin where you can solder Helical Antenna provided along with the module.

VCC supplies power for the module. This can be anywhere from 3.4V to 4.4 volts. Remember connecting it to 5V pin will likely destroy your module! It doesn't even run on 3.3 V! An external power source like Li-Po battery or DC-DC buck converters rated 3.7V 2A would work.

RST(Reset) is a hard reset pin. If you absolutely got the module in a bad space, pull this pin low for 100ms to perform a hard reset.

RxD(Reciever) pin is used for serial communication.

TxD(Transmitter) pin is used for serial communication.

GND is the Ground Pin and needs to be connected to GND pin on the Arduino.

RING pin acts as a Ring Indicator. It is basically the 'interrupt' out pin from the module. It is by default high and will pulse low for 120ms when a call is received. It can also be configured to pulse when an SMS is received.

DTR pin activates/deactivates sleep mode. Pulling it HIGH will put module in sleep mode, disabling serial communication. Pulling it LOW will wake the module up.

MIC± is a differential microphone input. The two microphone pins can be connected directly to these pins.

SPK± is a differential speaker interface. The two pins of a speaker can be tied directly to these two pins.

2.5 5V Relay Module

The single Channel Relay Module is a convenient board which can be used to control high voltage, high current load such as motor, solenoid valves, lamps and AC load. It is designed to interface with microcontroller such as Arduino, PIC and etc. The relays terminal (COM,NO and NC) is being brought out with screw terminal. It also comes with a LED to indicate the status of relay.[11]

2.5.1 Specification:

- Digital output controllable
- Compatible with any 5V microcontroller such as Arduino.
- Rated through-current: 10A (NO) 5A (NC)
- Control signal: TTL level
- Max. switching voltage 250VAC/30VDC
- Max. switching current 10A
- Operating time: 10ms
- Release time: 5 ms

Fig 2.12: 5V Relay Module

One of the most useful things can be done with an Arduino is control higher voltage (120-250V) devices like fans, lights, heaters, and other household appliances. Since the Arduino operates at 5V it can't control these higher voltage device control these higher voltage devices directly, but you can use a 5V relay to switch the 120-250V current and use the Arduino to control the relay.

2.5.2 How The 5V Relay Works

The SRD-O5VDC-SL-C relay has three high voltage terminals (NC, C, and NO) which connect to the device you want to control. The other side has three low voltage pins (Ground, and Signal) which connect to the Arduino. The one terminal of the load is connected to the NO terminal of the relay and the other terminal of the load is connected to the Common terminal of the relay. When the relay is triggered the circuit is completed hence turning on the load.

2.5.3 5V Relay Module Terminals and Pins

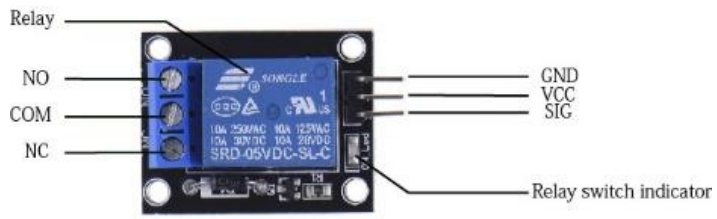

Fig 2.13: Pin Status of Relay Module

2.5.4 Pin Description

- Ground: connects to the ground pin on Arduino
- 5V VCC: connects to the Arduino's 5V pin
- Signal: Carries the trigger signal from the Arduino that activates the relay
- Common: common terminal is connected to one end of the load that is to be controlled.
- NC: Normally connected terminal. The other end of the load is either connected to NO or NC. If connected to NC the load remains connected before trigger.
- NO: Normally open terminal. The other end of the load is either connected to NO or NC. If connected to NO the load is connected after trigger.

2.5.5 Application of Relay

- Commonly used in switching circuits.
- For home automation projects to switch AC loads.
- To control (On/Off) heavy loads at a pre-determined time/condition.
- Used in safety circuits to disconnect the load from supply in event of failure
- Used in automobiles electronics for controlling indicators glass motors etc.

2.6 Buzzer

A buzzer or beeper is an audio signaling device or component which may be mechanical, electromechanical, or piezoelectric (piezo as short form). Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.

The electric buzzer was invented in 1831 by Joseph Henry. They were mainly used in early doorbells until they were phased out in the early 1930s in favor of musical chimes, which had a softer tone.

Piezoelectric buzzers, or piezo buzzers, as they are sometimes called, were invented by Japanese manufacturers and fitted into a wide array of products during the 19705 to 1900. This advancement mainly came about because of cooperative efforts by Japanese manufacturing companies. In 1951, they established the Barium Titanate Application Research Committee, which allowed the companies to be "competitively cooperative" and bring about several piezoelectric innovations and inventions.

Fig 2.14: Peizo Buzzer

2.7 LEDs

A light-emitting diode (LED) is a semiconductor device that emits light when an electric current flows through it. When current passes through an LED, the electrons recombine with holes emitting light in the process. LEDs allow the current to flow in the forward direction and blocks the current in the reverse direction.

Light-emitting diodes are heavily doped p-n junctions. Based on the semiconductor material used and the amount of doping, an LED will emit a coloured light at a particular spectral wavelength when forward biased. As shown in the figure, an LED is encapsulated with a transparent cover so that emitted light can come out.

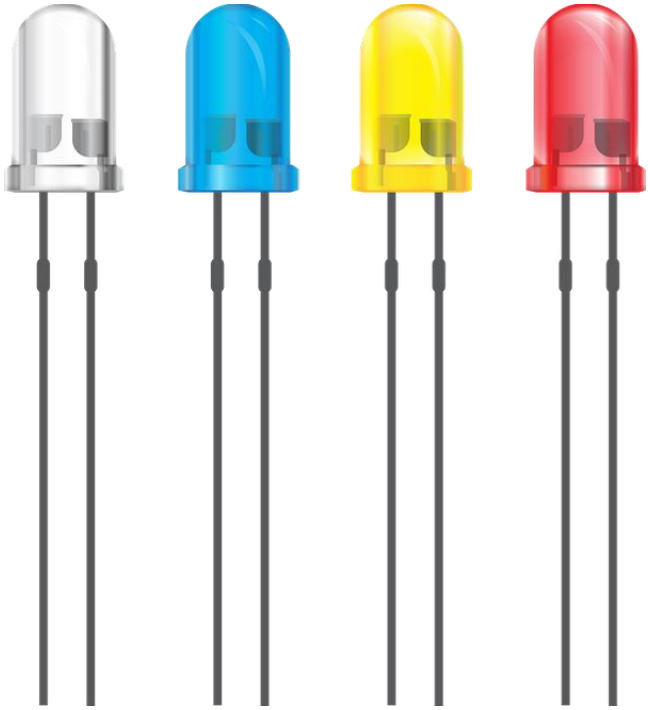

Fig 2.15: LED

2.8 Brushless Exhausted Fan

An exhausted fan is a fan which is used to control the interior environment by venting out smoke, moisture, and other contaminants which may be present in the air. This fan can also be integrated into a heating and cooling system. When smoke or gas is detected fan automatically turn on and venting out gas. After venting out smoke or gas it's turn off automatically.

Fig 2.16: Exhausted Fan

2.9 Batteries

Since SIM800L module doesn't come with onboard voltage regulator, an external power supply adjusted to voltage between 3.4V to 4.4V (Ideal 4.1V) is required. The power supply should also be able to source 2A of surge current, otherwise the module will keep shutting down. Here are some options you can consider to correctly power your GSM module.

2.9.1 3.7v Li-Po Battery

One of the cool things about Li-Po batteries is that their voltage is generally in the range of 3.7V – 4.2V, perfect for SIM800L Module. Any 1200mAh or larger sized Lithium ion/polymer battery is best since it can provide the correct voltage range even during 2 Amp spikes.[12]

Fig 2.17: 3.7V Li-Po Battery

2.9.2 3.7V Lithium ION Rechargeable Battery

The ICR 1200mAh is a high powered li-ion battery that is perfect for demanding electronics such as tactical LED flashlights. These batteries feature 3.7 Volts of power and a top of the line 1200mAh capacity that will keep high drain electronics running longer than competing power sources. Combined with reliable manufacturing quality and bulk value pricing, the ICR is one of the best deals when it comes to li-ion power.

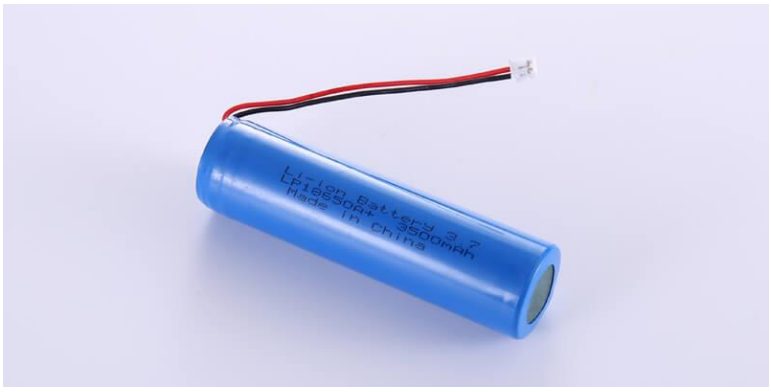

Fig 2.18: 3.7V lithium-ion Battery

2.10 Breadboard

A breadboard is a solderless device for temporary prototype with electronics and test circuit designs. Most electronic components in electronic circuits can be interconnected by inserting their leads or terminals into the holes and then making connections through wires where appropriate. The breadboard has strips of metal underneath the board and connect the holes on the top of the board. The metal strips are laid out as shown below. Note that the top and bottom rows of holes are connected horizontally and split in the middle while the remaining holes are connected vertically.

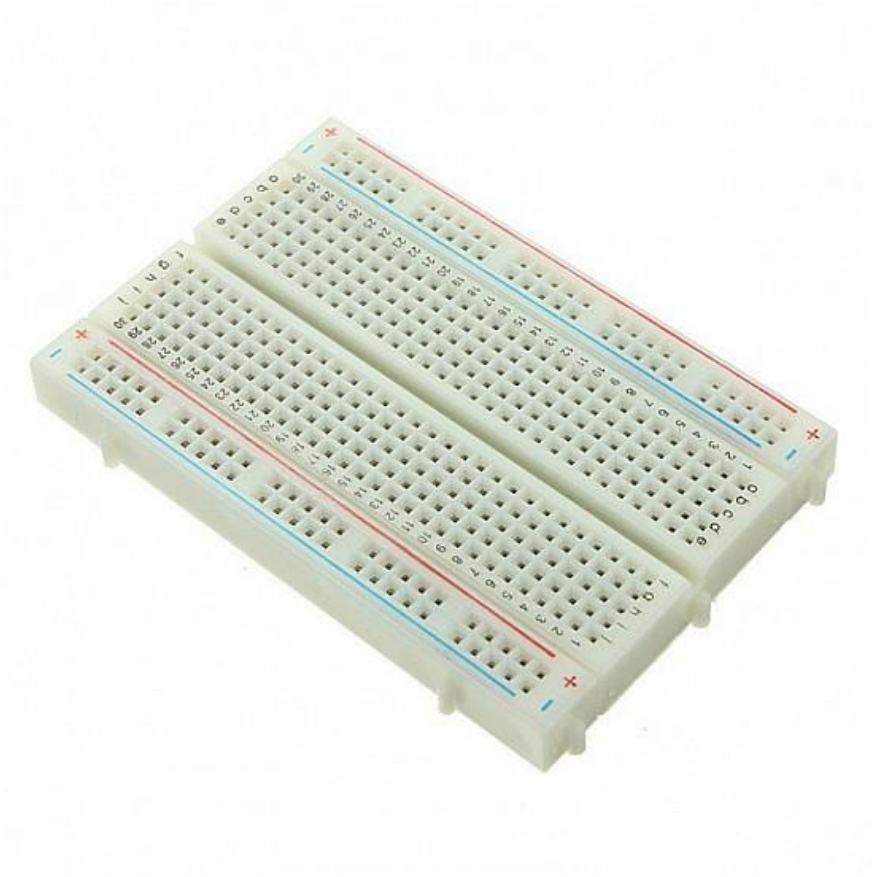

Fig 2.19: Breadboard

2.11 Connecting Wires

Connecting wires allows an electrical current to travel from one point on a circuit to another, because electricity needs a medium through which to move. In a basic circuit, the wire comes from one terminal of a power source, such as a battery. It then connects to a switch that determines whether the circuit is open or closed. The wire then connects to the device that is drawing power, allowing it to draw electricity and perform its task. Finally, the wire connects the load back to the opposite terminal of the power source.

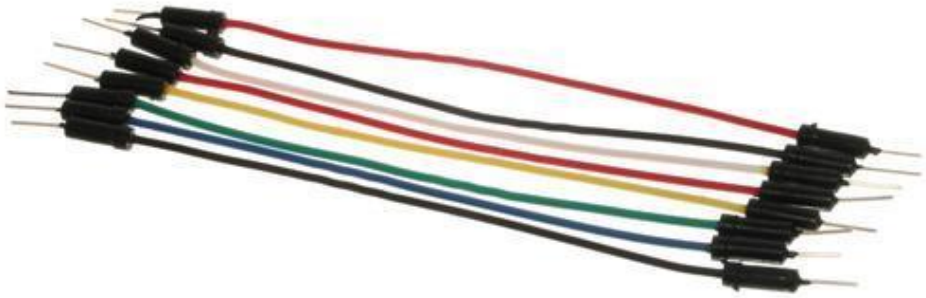

Fig 2.20: Connecting Wires

CHAPTER THREE

Circuit Design and Working Procedure

3.1 Circuit Design

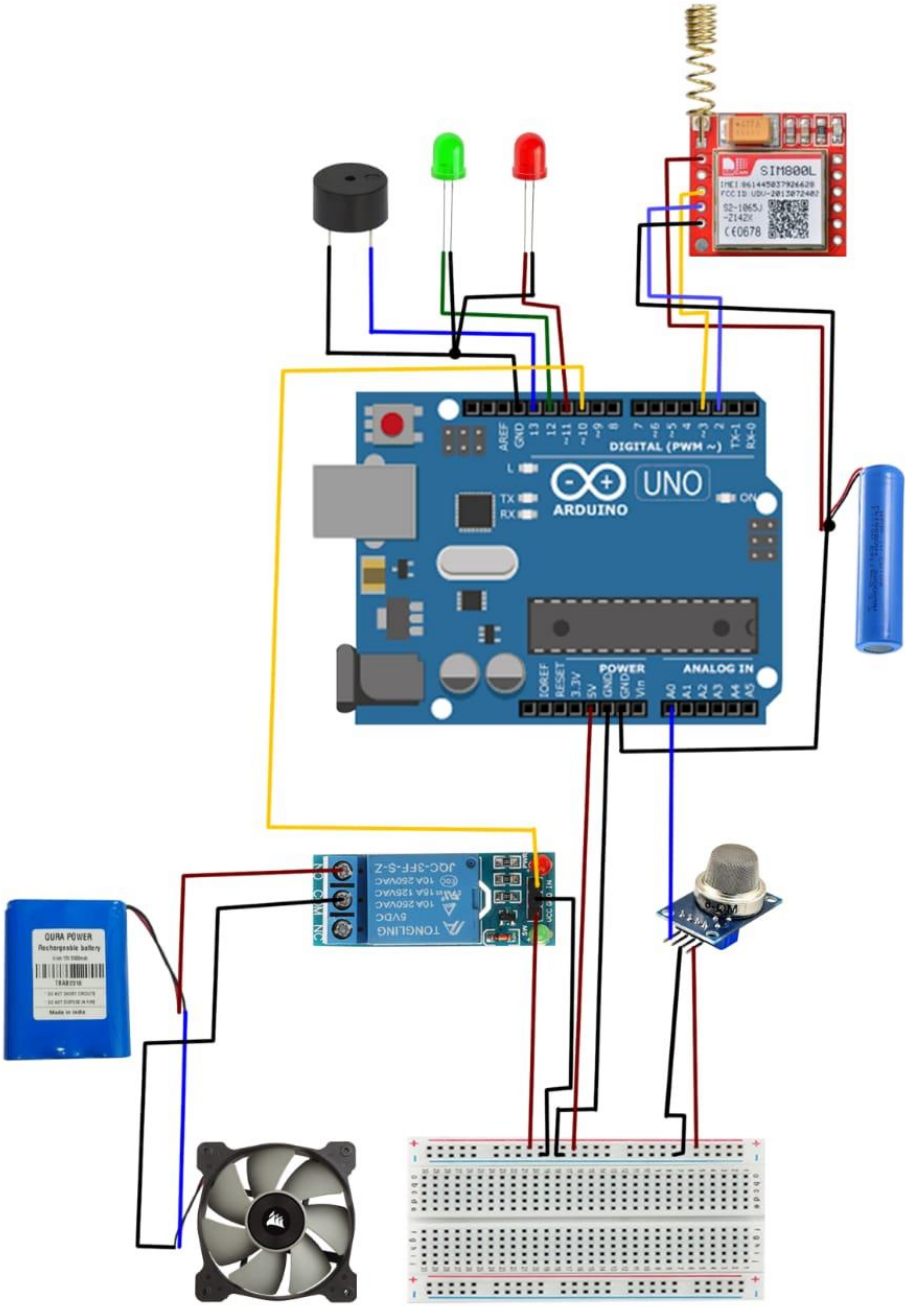

Fig 3.1: Circuit Diagram

3.2 Circuit Setup

The whole circuit diagram of the gas leakage detector and alert system project based on Arduino is shown in the previous page.

1. The MQ-6 gas sensor has four pins which are A0,D0,GND and VCC. A0 pin is connected to the A0 port of Arduino to provide input to the microcontroller, the GND pin is connected to one the GND port of Arduino and finally the VCC pin is connected to 5 volts port of Arduino which provides power to gas sensor. The D0 pin is not used because we will read analog values.
2. The Relay module has three pins which are VCC,GND and IN. The VCC is connected to 5 volts port of Arduino for providing power to the module, GND is connected with the GND port of Arduino and IN pin is connected to digital port 10 of Arduino.
3. In the opposite site of relay, there are three ports which are NO,GND and NC. Positive part of fan is connected with Negative wire of battery and the positive wire of battery is connected with NO port of relay and negative part of fan is connected with GND of relay which is usually a serial connection.
4. Bazar has two wires. Positive wire is connected with port 13 of Arduino and negative wire is connected with GND of Arduino.
5. The green LED has two wires where positive wire is connected with port 12 and negative with GND.
6. The red LED has same connection except it's positive wire is connected with port 11 of Arduino.
7. The GSM module's (SIM800l) VCC pin is connected with an positive wire of external source which supplies 3.7 to 4.2 volts. The GND is made common with GND of Arduino along with the GND of source. The RXD pin is connected with port 3 and TXD with port 2.
8. The Arduino is powered up using a 12 volts power adapter.

3.3 Working Principal

When the Arduino is powered up, the gas sensor takes input and sends the value to microcontroller. If the value exceeds the normal value of gas density, the microcontroller activates port 13,11 and 10. Thus bazar, red LED and fan goes on active mode. The microcontroller also activates the GSM module and sends warning messages to user. Otherwise, microcontroller activates port 12 only which is green LED. To understand working principal properly we need to see the Arduino code.

3.4 Arduino Code

```
#includes<SoftwareSerial.h>

SoftwareSerial mySerial(2,3);

int sensor=A0;

int bazar=13;

int green=12;

int red=11;

int relay=10;

int data;

void setup()

{

  pinMode(bazar,OUTPUT);

  pinMode(green,OUTPUT);

  pinMode(red,OUTPUT);

  pinMode(relay,OUTPUT);

  Serial.begin(9600);

}
```

```
Void loop()
{
  data=analogRead(sensor);
  Serial.println(data);
  If(data>450)
{
  SendMessage();
  digitalWrite(bazar,HIGH);
  digitalWrite(red,HIGH);
  digitalWrite(Green,LOW);
  digitalWrite(relay,LOW);
}
else
{
 digitalWrite(bazar,Low);
 digitalWrite(red,LOW);
 digitalWrite(green,HIGH);
 digitalWrite(relay,HIGH);
}
```

```
SendMessage()
{
  mySerial.println("AT+CMGF=1");
  delay(1000);
  mySerial.println("AT+CMGS=\"+8801590028416\");
  delay(1000);
  mySerial.println("Excess Gas Detected. There is a gas leakage.");
  delay(1000);
  mySerial.prinln((char)26);
  delay(1000);
}
```

3.5 Final Outcome of The Project

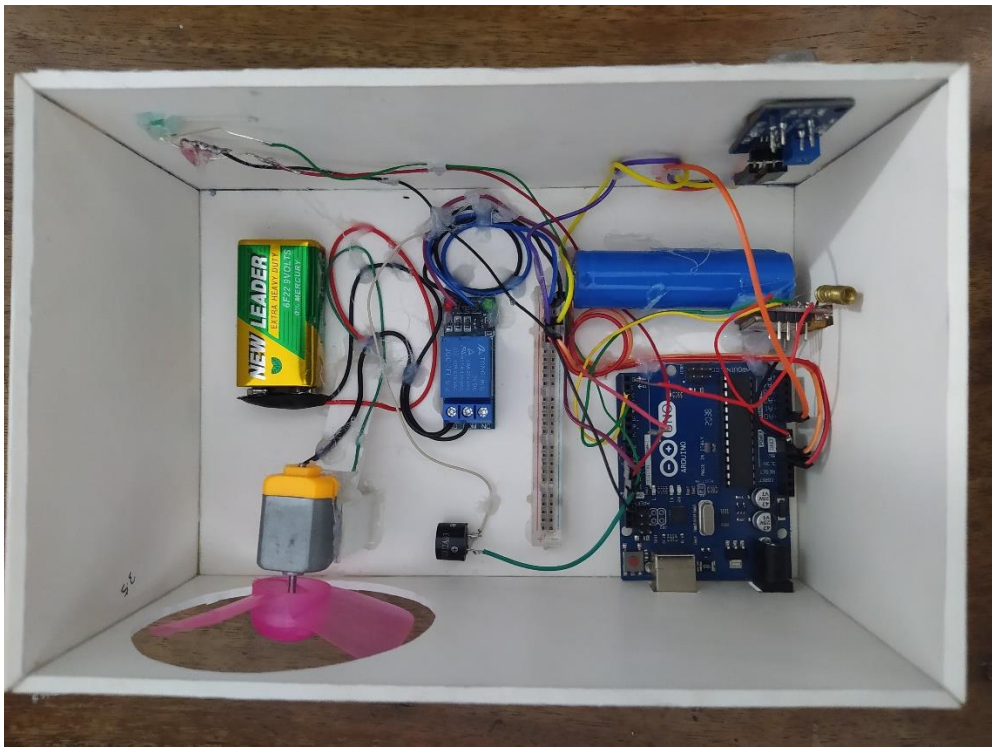

Fig 3.2: Internal View of The Project

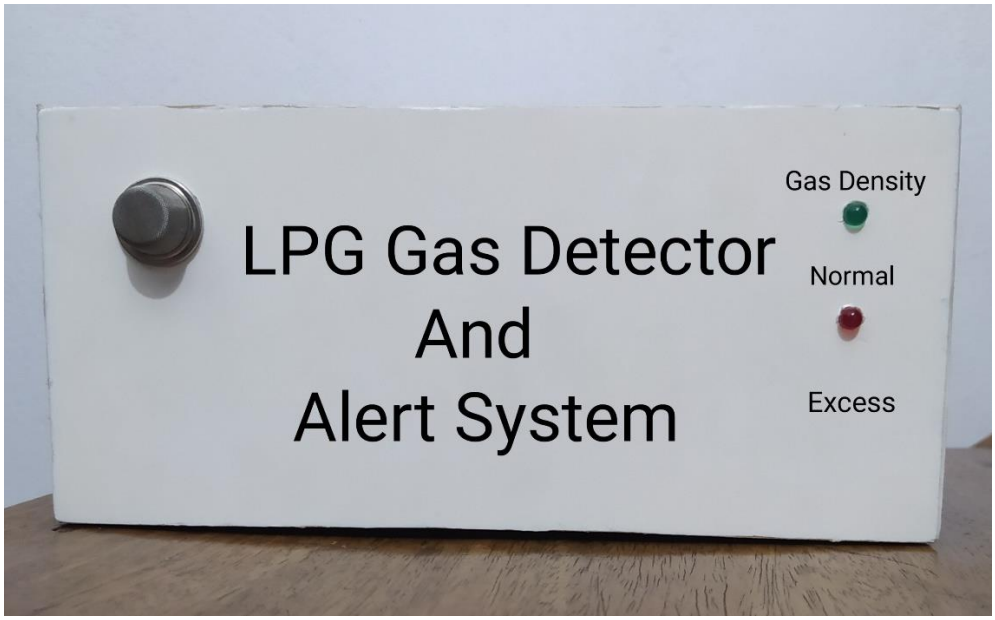

Fig 3.3: External View of The Project

Chapter Four

Conclusion And Recommendation For Future Work

4.1 Conclusion

Gas leakage leads to severe accidents resulting in material losses and human injuries. Gas leakage occurs mainly due to poor maintenance of equipment's and inadequate awareness of the people. Hence, LPG leakage detection is essential to prevent accidents and to save human lives. The design of a sensor-based automatic gas leakage detector with an alert and control system has been proposed and discussed in this paper. 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. Thus the proposed system is very attractive. 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.

4.2 Recommendation For Future Work

Overall, software and hardware parts of the systems have been developed and tested by introducing a small amount of LPG near gas sensor module. The authors of this paper are currently working to include multi functions with this device. 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. The author is 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 analyzing a research article will be done and author has plans to submit it to the MDPI *sensors* journal for review. In the future paper the features of this final product will be compared with the available gas detector systems presented in other articles.

References

1. Mahalingam, A.; Naayagi, R.T.; Mastorakis, N.E. Design and implementation of an economic gas leakage detector. In Proceedings of 6th International Conference on Circuits, Systems and Signals, Athens, Greece, 7–9 March 2012; pp. 20–24.

2. Attia, Hussain A., and Halah Y. Ali. "Electronic Design of Liquefied Petroleum Gas Leakage Monitoring, Alarm, and Protection System Based on Discrete Components." International Journal of Applied Engineering Research, vol. 11, no. 19, pp. 9721-9726, 2016.

3. Apeh, S.T.; Erameh, K.B.; Iruansi, U. Design and Development of Kitchen Gas Leakage Detection and Automatic Gas Shut off System. J. Emerg. Trends Eng. Appl. Sci. 2014, 5, 222–228.

4. Soundarya, T.; Anchitaalagammai, J.V.; Priya, G.D.; Karthickkumar, S.S. C-Leakage: Cylinder LPG Gas Leakage Detection for Home Safety. IOSR J. Electron. Commun. Eng. 2014, 9, 53–58.

5. Shrivastava, A.; Prabhaker, R.; Kumar, R.; Verma, R. GSM based gas leakage detection system. Int. J. Emerg. Trends Electr. Electron. 2013, 3, 42–45.

6. Anurupa, A.; Gunasegaram, M.; Amsaveni, M. Efficient Gas Leakage Detection and Control System using GSM Module. Int. J. Eng. Res. Technol.2015,3, 1–4.

7. All Answers Ltd. GSM Based LPG Detection [Internet]. November 2018. Available online: https://ukdiss.com/examples/gsm-based-lpg-detection.php?vref=1 (accessed on 15 October 2020).

8. Mr. Sameer Jagtap, Prajkta Bhosale, Priyanka Zanzane, Jyoti Ghogare, "LPG Gas Weight and Leakage Detection System Using IoT", International Journal for Research in Applied Science & Engineering Technology", Volume 4, Issue 3, March 2016, Pg – 716 to 720.

9. H. Huang, H. Bainand, S. Zhu, "A Greenhouse Remote Monitoring System Based on GSM", in proceedings of IEEE International Conference on Information Management, 2011, Pg – 357 to 360.

10. https://en.wikipedia.org/wiki/Gas_detector

11. mybotic.com.my/module/relay-module/single-channel-5v-relay-module

12. https://lastminuteengineers.com/sim800l-gsm-module-arduino-tutorial/

13. https://dsasuppliers.com/blog/a-brief-history-of-gas-detection/

14.https://epbd.com/view/details/article/MzIwNQ%3D%3D/title?q=Who+is+Responsible+for+LPG+Accidents%3F

15. https://www.linkedin.com/pulse/top-10-reasons-why-your-gas-detector-working-john-lee