Group-5 Engineering Design II

LPG Leakage Detector

Project Report

Group-7

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Motivation and Summary of Work done in ED-I

As per the ADSI-2019 report, there were 11,037 fire accidents reported across the country in 2019. These are only the data of which we have a record but there are many cases like an explosion in household LPG gas cylinders, fire accidents due to LPG cylinders, etc., newspapers are flooded with this type of news. Gas leakage is a serious problem, which is neglected by many of us. Due to this we lost many lives and livelihood. The death rate is increasing due to the explosion of LPG gas cylinders. Everyone knows about the disastrous consequences of the Bhopal gas tragedy and the styrene gas release in Vizag recently.

Basically, LPG is made up of hydrocarbons like propane and butane which are highly inflammable which can catch fire at a distance also. But we can't stop using LPG as it has its own perks. LPG is used as fuel in our homes, hotels, factories and many places as it has desirable properties like less smoke, almost no soot and high calorific value which make it the most valuable and important fuel.

So, we have to think about an alternative, rather than replacing the fuel, we can stop the fire accidents by detecting the leakage of gas within the proper time. So, our project is also based on this approach that how can we detect the leakage of gas and alert the user. The main aim of this project is to detect the presence of LPG leakage as a safety system like a fire alarm. Our project will be of great help in minimizing fire accidents due to leakage in gas cylinders.

In Engineering Design-I, we have completed the software part of our project without use of the GSM module. We have presented a tinkercad simulation for the same.
In Engineering Design-II, our target was to make our project prototype with the addition of a GSM module, so that we can also send alert messages to the user and make it a reality from virtual simulations.

Work Description of Engineering Design-II

Aim: - To make a complete working prototype for LPG detection using Arduino and GSM module.

The work to be done in Engineering Design-II was divided on the basis of a timeline as shown below:

Timeline of Our Group

Date	Task
17 Aug - 7 Sept	Coding & Online Simulation
8 Sept - 21 Sept	Material Purchase
21 Sept - 5 Oct	Code Implementation
6 Oct - 30 Oct	Testing and Analysis Errors & Efficiency
1 Nov - 16 Nov	Assemble the Model with GSM and Final presentation
16 Nov - 30 Nov	Final Working & Final Report

So, according to the timeline, firstly, we have to do some coding and make a virtual simulation of our prototype with the GSM module. After that we move forward to material purchasing. We ordered an Arduino Uno board, breadboard, MQ-6 gas sensor, SIM900A GSM module, buzzer, LEDs and Jumper wires. After receiving the items, we started making physical circuitry and tried to implement the code with them. We faced errors, but we sorted them out patiently with the help of technical staff from the electrical and chemistry lab.

Then, we do the testing and analysis of our model with different situations. Analysed the observations very carefully and tried to increase the efficiency of our model.In the end, we assembled the model with GSM and tested it, which was successful. Hence, our prototype is ready and working very well.

Analysis of Design

Our model LPG gas detection with Arduino and GSM module contains the following components:

(i) Arduino Uno

(ii) SIM900A GSM module

(iii) Buzzer

(iv) MQ-6 Gas Sensor

(v) LED

- Arduino Uno:

Arduino can read inputs such as light on a sensor, a finger on a button, etc. and turn it into an output -activating a motor, turning on an LED, etc. which is satisfying all the requirements of the project.

- Buzzer:

Its output is sound warning in the form of a continuous or intermittent buzzing or beeping sound. In our circuit one terminal of Buzzer is connected to Arduino and other terminal to ground, which produces beeping sound when gas level crosses threshold value.

- SIM900A GSM module:

SIM900A GSM module is used to send or receive messages and calls with the help of some Arduino code, which is used to send alert messages to the user in our project.

- MQ-6 Gas Sensor:

MQ-6 Gas Sensor is the most advanced gas detector sensor having a range of 200-10000 ppm and can detect LPG gas, smoke, etc. It is very sensitive to LPG gas.

- LEDs:

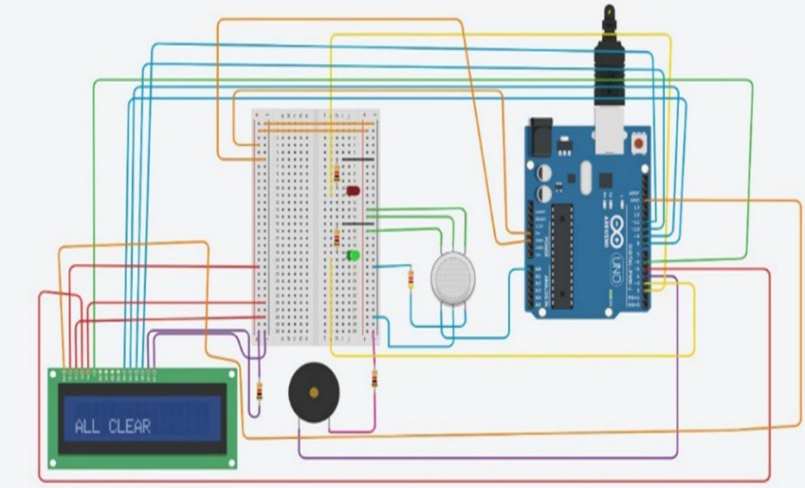
Red and green LEDs are used for signal purposes. If the gas level crosses the threshold value, then Red LED will glow, otherwise in normal state green LED will glow.

We tested our model design around 3-5 times and it was working very well, whenever the gas level crosses a bare minimum value even though by small amounts the buzzer starts buzzing, red LEDs start glowing and the user also receives an alert message for the same. Hence, it is in well working condition.

Modelling and Simulation

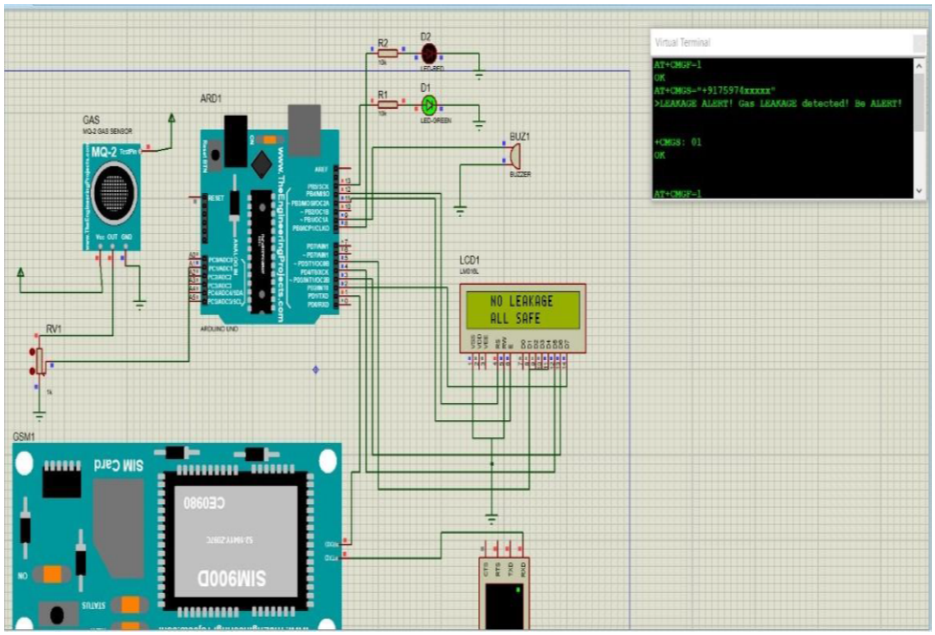
We prepared our model simulation in Proteus 8 Professional software as other software like TinkerCad were not providing GSM module components.The circuitry of our model simulation is presented below (without GSM):

Tinkercad Link:
https://www.tinkercad.com/login?next=%2Fthings%2FdwzoDr0b7yl-lpg-gas-detector-ed-project-group-7%2Feditel%3Fsharecode%3DvTcdMZxb2eXciQsRF_KTEVqmFkQTb23F5pBVQb9r5yY



This circuit was working fine but to send SMS we need GSM also but this component was not available in TinkerCad software, so for simulation of our model with GSM we shifted to Proteus 8 Professional Software which is the most advanced electrical simulator software contains all most every electrical component.

The circuitry with GSM module in Proteus software:



In this we also added a virtual screen for receiving the alert message. This simulation was just perfect which verified all our code and connections virtually. Now, we just have to make connections physically with real components.

Dimensioning and Material Selection

Material Selection:

- Arduino Uno R3 was selected as a microcontroller in our model, as it satisfies all the needs of our model and also cost effective as compared to other Arduino boards like mega, nano, etc.
- MQ-6 Gas Sensor is the most efficient gas sensor which can detect both smoke and LPG very efficiently and it is very sensitive to LPG gas. It can detect gas levels ranging from 200-10000 ppm. So, that's why it was selected.
- SIM900A GSM module was selected because it was cost effective when compared to other GSM modules.
- Other components are normal like LEDs, Buzzer and wires.

Dimensions:

- Arduino Uno R3:

LENGTH	68.6 mm
WIDTH	53.4 mm
WEIGHT	25 g

- SIM900A GSM module:

LENGTH	49 mm
WIDTH	47 mm
WEIGHT	38 g

- Breadboard:

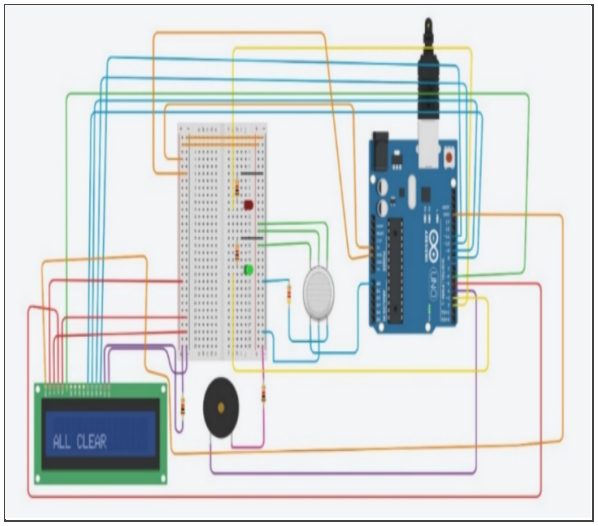
LENGTH	17 cm
WIDTH	5.5 cm
WEIGHT	79 g

- MQ-6 Gas Sensor:

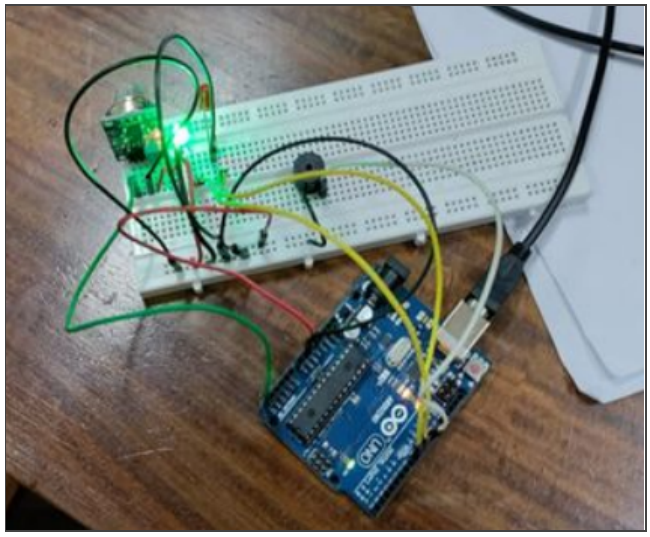
LENGTH	32 mm
WIDTH	20 mm
WEIGHT	7 g
HEIGHT	22 mm

Prototyping and Refinement

A first or preliminary version of our project model was created on 28 Sept. 2021. This model was a physical implementation of an earlier developed simulation on “Tinkercad” software in the Engineering Design-I course.



Tinkercad simulation



Physical Implementation

This gas sensor has a threshold value (the threshold value is around the amount of L.P.G. leaked) in that if it goes above it starts alerting people in the vicinity. The output of the gas sensor is given to Aurdino Uno where it is compared with the threshold value for gas density which is set using preset potentiometers and amplified.. As a result, the LED will glow and the buzzer starts to produce an alarm sound. We tested the model for two different threshold values i.e. 225 ppm and 550ppm because our Gas Sensor MQ 6 has a range of 200 ppm to 10000 ppm.

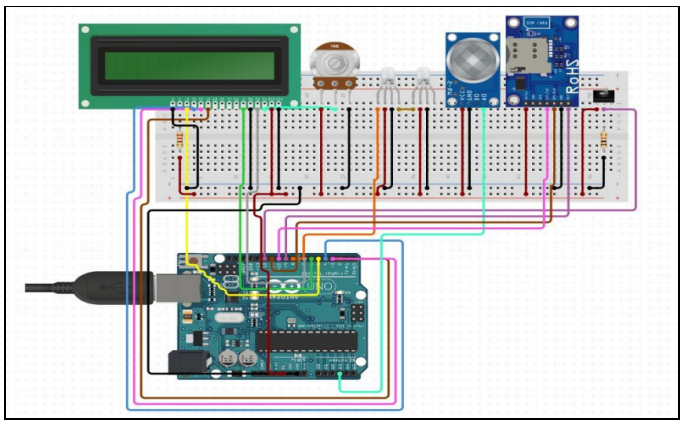
```
#include <LiquidCrystal.h>
LiquidCrystal lcd(5,6,8,9,10,11);

int redled = 2;
int greenled = 3;
int buzzer = 4;
int sensor = A0;
int sensorThresh = 550;

void setup()
{
pinMode(redled, OUTPUT);
pinMode(greenled,OUTPUT);
pinMode(buzzer,OUTPUT);
pinMode(sensor,INPUT);
Serial.begin(9600);
lcd.begin(16,2);
}

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

Threshold value 550 ppm

```
#include <LiquidCrystal.h>
LiquidCrystal lcd(5,6,8,9,10,11);

int redled = 2;
int greenled = 3;
int buzzer = 4;
int sensor = A0;
int sensorThresh = 225;

void setup()
{
pinMode(redled, OUTPUT);
pinMode(greenled,OUTPUT);
pinMode(buzzer,OUTPUT);
pinMode(sensor,INPUT);
Serial.begin(9600);
lcd.begin(16,2);
}

void loop()
{
  int analogValue = analogRead(sensor);
  Serial.print(analogValue);
  if(analogValue>sensorThresh)
  {
    digitalWrite(redled,HIGH);
    digitalWrite(greenled,LOW);
    tone(buzzer,1000,10000);
```

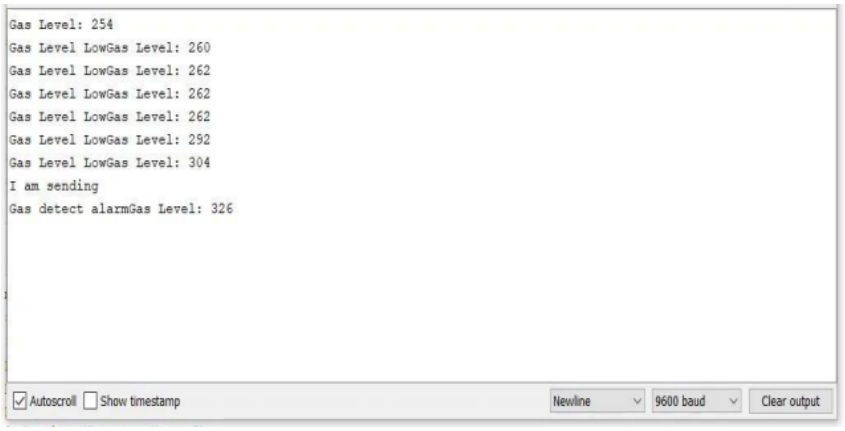
Threshold value 550 ppm

The second model was developed later in this course which was a physical implementation of the stimulation of the model created in the proteus and circuit.io software. This model includes the GSM module which helped in altering the user with the help of a S.M.S. message, whenever the user is away from the vicinity of gas leakage.



Software simulation with GSM

The threshold value used for this model was 300 ppm so that model neither takes more time to alert users about leakage nor does it alert users with an insignificant amount of gas present in the vicinity. Also, we used a 2G sim for proper functioning of our GSM 900 device in our model. A SIM900 GSM module is a circuit that will be used to establish communication between a mobile phone or a Gas Leakage detector. After detecting a gas with more than 300 ppm in the vicinity of the experiment, a S.M.S. was sent to the user's phone by GSM 900. The working of the arduino, gas sensor and GSM is depicted in the figure below:

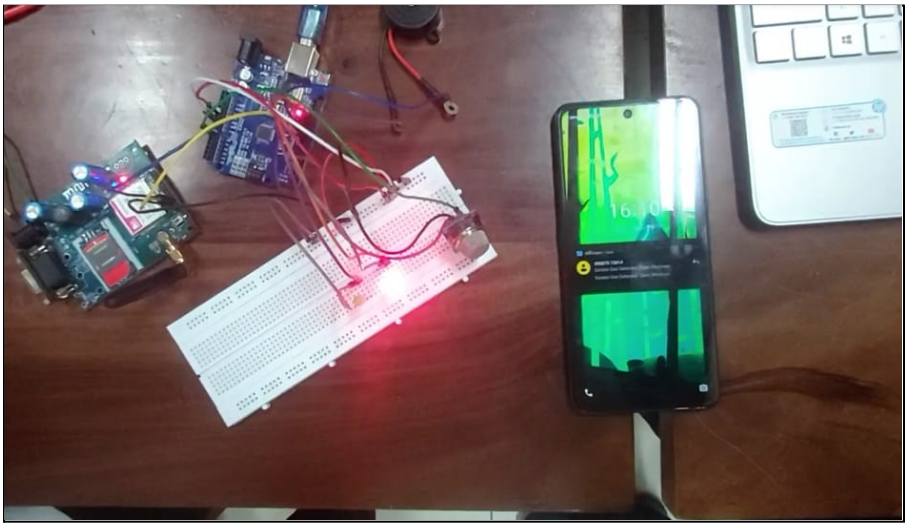


INTEGRATING ELECTRICAL AND MECHANICAL ELEMENTS

There is a little less work of integration of electrical and mechanical elements in our project but we can see integration of electrical and mechanical elements in the form of connection of our whole circuit with the laptop and the arduino cc software. Arduino is in itself an integrated circuit of a lot of electronic components like microcontrollers , a lot of small chips and wires. We also connected the sim card mechanically to the phone which is also an example of integration of electrical and mechanical components.

Arduino Uno

Demonstration of the Final Design



The final design of our model is shown above and is working according to theoretical expectation. The threshold value for the gas sensor used for final design is 300 ppm. Code of our final model:

```
#include <SoftwareSerial.h>
SoftwareSerial mySerial(9, 10);

const int BuzzerPin = 11;
int ledPin = 13;
int ledPin2 = 12;
int gasValue = A0;
int data = 0;

void setup()
{
randomSeed(analogRead(0));
mySerial.begin(9600); // Setting th
Serial.begin(9600); // Setting the

pinMode(gasValue, INPUT);
pinMode(ledPin, OUTPUT);
pinMode(ledPin2, OUTPUT);
pinMode(BuzzerPin, OUTPUT);
}

void loop()
{

data = analogRead(gasValue);

Serial.print("Gas Level: ");
Serial.println(data);
delay(1000);

if ( data > 300) //
{
SendMessage();
Serial.print("Gas detect alarm");
delay(1000);
```

```
tone(BuzzerPin, 50);
digitalWrite(ledPin2, HIGH);
digitalWrite(ledPin, LOW);
}
else
{
Serial.print("Gas Level Low");
delay(1000);
digitalWrite(ledPin, HIGH);
digitalWrite(ledPin2, LOW);
noTone(BuzzerPin);
}

}

void SendMessage()
{
Serial.println("Sending alert message");
mySerial.println("AT+CMGF=1"); //Sets the GSM Module in
delay(1000);
mySerial.println("AT+CMGS=\"+91XXXXXXXXXX\"\r"); // Rep
delay(1000);
mySerial.println("Excess Gas Detected. Open windows.");
delay(100);
mySerial.println((char)26);// ASCII code of CTRL+Z
delay(1000);
}
```

CONTRIBUTION OF EACH GROUP MEMBER:

Jai's Contribution:

Basically, his role in this project is as team leader and I had managed the overall working of our team for this project. Also, performed material selection and purchase and tested the model without GSM at the chemistry lab in the institute.

Hemant's Contribution:

In this course he has contributed as an integrator of more than half of the circuit in which he has made all the connections except connecting gsm to circuit and connecting gsm to sim card and making it possible for sending the message.

Yash's Contribution:

He made Proteus circuit simulation with GSM and virtual screen and also contributed in coding part of the model for GSM module (For SMS alert). He also contributed in making physical connection of GSM and tested it successfully by sending an alert message

Sumit's Contribution:

He contributed as a coordinator while testing and also helped in testing and connection of GSM and Arduino and worked on efficiency of our model and researched on the different parameters that can affect our model's accuracy.

ANNEXURE

Hemant’s Contribution

In this course I have contributed as an integrator of more than half of the circuit in which I have made all the connections except connecting gsm to circuit and connecting gsm to sim card and making it possible for sending the message . I have connected the breadboard and smoke detecting sensor with our first made model on the incense stick due to the lack of the lpg gas and presented the first prototype in the class . I have also contributed to the making of ppt for the class and actively participated in group meetings for the completion of this project to the best of our ability. I have also taken part in the class when our group name has been called to answer sir questions as per best of my knowledge. I have also taken up the leds for our project from the basic lab building. I also act as a team motivator in the end when our circuit is completely working with arduino and showing alert messages on screen but not sending messages to the sim card by saying that “Let's give it one more try and make it possible” and finally we will make it best as per our capability.