

Microcontroller Based Low Cost Gas Leakage Detector with SMS Alert

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Abstract — Gas leakage is a major problem with industrial sector, residential areas and gas driven vehicles like CNG (Compressed Natural Gas) buses, cars etc. One of the preventive methods to stop accidents related with the gas leakage is to install a gas leakage detection device at permeable places. The aim of this project is to develop such a device that can automatically detect and stop gas leakages in those permeable areas. The system detects the leakage of the LPG (Liquefied Petroleum Gas) using a gas sensor and uses the GSM to alert the person about the gas leakage via SMS. When the LPG concentration in the air exceeds a predetermined level, the gas sensor senses the gas leakage and the output of the sensor goes LOW. This is detected by the microcontroller and the LED and buzzer are turned ON simultaneously. The system then alerts the customer by sending an SMS to the specified mobile-phone.

Keywords— GSM (Global System for Mobile Communications), LPG (Liquefied Petroleum Gas), Gas Sensor MQ-5, LCD (Liquid Crystal Display), LED (Light Emitting Diode)

I. INTRODUCTION

LPG gas is basically a mixture of propane and butane which are highly flammable chemicals. It is odourless gas in its natural state to which Ethyl Mercaptan is added as powerful smelling agent, so that leakage can be easily detected. We can detect the LPG leakage in the cars, industrial sectors and residential areas using an Ideal Gas Sensor. We can easily implement the LPG gas leakage detector unit into a unit that can sound an alarm or give a visual suggestion of the LPG concentration in a 16x2 LCD display. The sensor used in this project has both admirable sensitivity and rapid response time. This sensor can also be used to sense other gases like iso-butane, propane, LNG and even cigarette smoke. The output of the sensor goes LOW as soon as the LPG sensor senses any gas leakage. This is detected by the microcontroller and the LED & buzzer are turned ON. After a delay of few milliseconds, the exhaust fan is also turned ON for throwing the gas out and a “GAS LEAKAGE” message is sent to a pre-defined mobile number using GSM Module.

II. OBJECTIVE OF THE PROJECT

This is used to Detect Gas Leakage (like LPG, Butane, Methane) or any such petroleum based gaseous substance that can be detected using MQ-5 Sensor. To setup an SMS based Alert Mechanism and send 3 SMS (3 alert messages) to 2

specified mobile numbers (input inside the Arduino Program). To produce a alarm sound upon gas leak and stop the alarm once gas leak is under control. Display status in an LCD using a 16x2 LCD module.

III. THEORETICAL STUDY

A. Working principle

The sensing material in gas sensors is metal oxide, mostly SnO_2 . When a metal oxide crystal such as SnO_2 is heated at a certain high temperature in air, oxygen is absorbed on the crystal surface with a negative charge. Then donor electrons in the crystal surface are transferred to the absorbed oxygen, resulting in leaving positive charges in a space charge layer. Thus, electric current flows through the junction parts of SnO_2 micro crystals. Grain boundary surface potential acts as a potential barrier against the electron flow. The electrical resistance of the sensor is imposed to this potential barrier. In the presence of a deoxidizing gas, the surface density of the negatively charged oxygen decreases. Consequently the barrier height in the grain boundary is reduced. As a result, the reduced barrier height decreases sensor resistance.

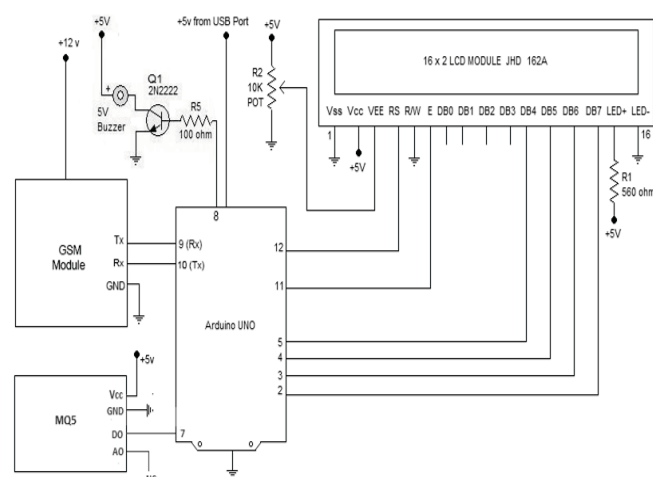


Fig. 1. GSM based gas Leakage Detection System using Arduino

Working Model Working Regulated power supply is fed to MCLR Pin of PIC16F877 Microcontroller which is also

supplied with crystal oscillator frequency (i.e.) from OSC 1 and OSC 2 for the working of the microcontroller. With the help of step down transformer of 230V AC primary to 0-12V, 500mA secondary power supply is taken from main supply. Full-wave rectifier and a capacitor filter provide the output voltage and then fed to 5-volt regulator (LM7805) whose output is used as power supply for IC's and microcontroller. Furthermore, temperature sensor and gas sensor is connected to the microcontroller. The Complete Connection Diagram consists of the Microcontroller Circuit, GSM Module, Power Supply, GAS Sensor Module and Exhaust Fan. The Power Supply is fed to the GSM Module. The output of the sensor goes low as soon as the MQ-5 Gas Sensor senses any gas leakage from the storage. This is detected by the microcontroller and the LED & buzzer are turned ON. After the delay of a few milliseconds, the exhaust fan is also turned ON for throwing the gas out and the microcontroller continues sending message as "GAS LEAKAGE" to a pre-defined mobile number using GSM Module.

B. Flow chart

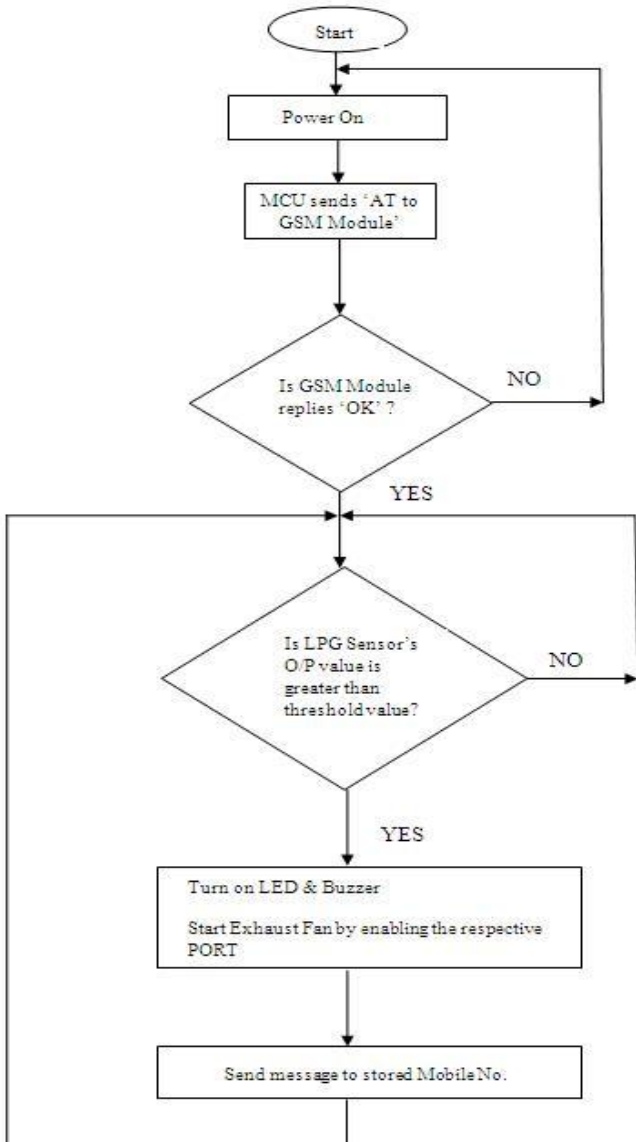


Fig. 2. Flow Chart GSM based gas Leakage Detection System using Arduino

C. ArduinoUno Programming

```
#include <SoftwareSerial.h>
```

```
#include <LiquidCrystal.h>
LiquidCrystal lcd(12, 11, 5, 4, 3, 2);
SoftwareSerial mySerial(9, 10);
int sensor=7;
int speaker=8;
int gas_value,Gas_alert_val, Gas_shut_val;
int Gas_Leak_Status;
int sms_count=0;
void setup()
{
  pinMode(sensor,INPUT);
  pinMode(speaker,OUTPUT);
  mySerial.begin(9600);
  Serial.begin(9600);
  lcd.begin(16,2);
  delay(500);
}
void loop()
{
  CheckGas();
  CheckShutDown();
}
void CheckGas()
{
  lcd.setCursor(0,0);
  lcd.print("Gas Scan - ON");
  Gas_alert_val=ScanGasLevel();
  if(Gas_alert_val==LOW)
  {
    SetAlert(); // Function to send SMS Alerts
  }
}
int ScanGasLevel()
{
  gas_value=digitalRead(sensor); // reads the sensor output (Vout of LM35)
  return gas_value; // returns temperature value in degree celsius
}
void SetAlert()
{
  digitalWrite(speaker,HIGH);
  while(sms_count<3) //Number of SMS Alerts to be sent
  {
    SendTextMessage(); // Function to send AT Commands to GSM module
  }
  Gas_Leak_Status=1;
  lcd.setCursor(0,1);
  lcd.print("Gas Alert! SMS Sent!");
}
void CheckShutDown()
{
  if(Gas_Leak_Status==1)
  {
    Gas_shut_val=ScanGasLevel();
    if(Gas_shut_val==HIGH)
    {
      lcd.setCursor(0,1);
      lcd.print("No Gas Leaking");
      digitalWrite(speaker,LOW);
      sms_count=0;
      Gas_Leak_Status=0;
    }
  }
}
```

```

void SendTextMessage()
{
mySerial.println("AT+CMGF=1"); //To send SMS in Text
Mode
delay(1000);
mySerial.println("AT+CMGS=\"+919495xxxxx\""); //
change to the phone number you using
delay(1000);
mySerial.println("Gas Leaking!");//the content of the
message
delay(200);
mySerial.println((char)26);//the stopping character
delay(1000);
mySerial.println("AT+CMGS=\"+918113xxxxx\""); //
change to the phone number you using
delay(1000);
mySerial.println("Gas Leaking!");//the content of the
message
delay(200);
mySerial.println((char)26);//the message stopping character
delay(1000);
sms_count++;
}

```

IV. ADVANTAGES AND DISADVANTAGES

There are some advantages as well as disadvantages of microcontroller based gas leakage detector . Advantages are low cost, low power consumption, high accuracy. It also detects alcohol so it is used as liquor tester. The sensor has excellent sensitivity combined with a quick response time. Disadvantages are no prevention of fires is possible with kit. Applicable only as an indicator or alarming device. It works only when 5v power supply is given. Its sensitivity depends on humidity and temperature. It is a little sensitive to smoke.

V. APPLICATIONS

Domestic gas leakage detector, Industrial Combustible gas Detector, Portable Gas Detector, Homes, Hotels, Factories, LPG Storage, Gas driven Cars etc.

VI. COST ANALYSIS

TABLE I. COST ANALYSIS OF GAS LEAKAGE DETECTOR

Sl. No.	Description	Qty.	Price
01	Arduino UNO Board	01	1120.00
02	GSM Module	01	850.00
03	MQ-5 Sensor	01	150.00
04	Resistor	02	20.00
05	Capacitor	02	18.00
06	Diode	02	20.00
07	LED	03	160.00
08	Step Down Transformer	01	90.00
09	Temperature Sensor	01	145.00
10	Vero Board	01	150.00
11	Wires		30.00
	Total		2753.00

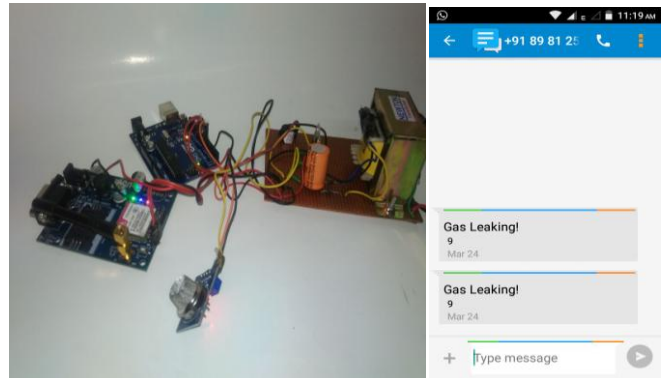


Fig. 3. Microcontroller Based Low Cost Gas Leakage Detector with SMS Alert

VII. CONCLUSION

Finally, we conclude in recent households, the use of LPG is taking a big roll, from the use of cylinder up to the use of petroleum pipelines. The biggest trouble in using this kind of technology is security problem, and our project will strike it out for households and industries. Although the market price is quite high of this device, yet we have tried to limit this high price within. The leak detecting techniques are categorised into various ways for gas pipelines. Some techniques have been improved since their invention and some new ones were designed resulting in advancement of sensor manufacturing and computing power. Leak detection techniques in each category hold some advantages and disadvantages. For example, all external detection technique is done from outside of the pipelines. It not only detects the leakage but the leakage location also. But the detection of this leakage location is very long. Mathematical model based detection of the pipe shows good results at high flow rates while for low flow rates a mass balance based detection system would be more suitable. Hybrid systems take the advantage of the real-time detection capability of a software based method. The high localization accuracy of a hardware based technique, along with other specific advantages is supposed to be the future trend in gas leak detection. Between these ample varieties of commercial solutions available is ultimately an action that has to be taken after evaluating the needs of the system in which gas leak detection is required.

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