# Autonomous Gas Monitoring System

(CO (carbon monoxide),Combustible gases(Methane ,Propane ,LPG)

**Subject**: Microprocessor Lab

**Involvements**: 1) Danavath Kiran Naik(110260024)

2)Neeraj Ranjan (11d260005)

3)Ajay Boyat(100260028)

**Project summary:**

**Abstract :**

Proposal describes the design of Ambient air quality monitoring system that can continuously track certain environmental parameters. This project mainly focus on the CO (It is toxic to humans and animals when encountered in higher concentrations, although it is also produced in normal animal metabolism in low quantities, and is thought to have some normal biological functions) and combustible gases, since these days quantity (ppm)of these gases are increased due to large exhaust from automobiles .And also to detect the leakage of the Household gases (LPG)(pre indication to the leakage of huge LPG gas ).

**Data input –Out Put**:

At the location of sensor, the Gas sensors will measure the concentration of Gas at that point. MCU(micro controller unit) over there will process the voltage output and return a string containing the information about the concentration of different gases.

In the initial phase of our project, gas sensor is calibrated to the normal atmospheric conditions (i.e to the optimum gas quality which is present in the atmosphere and can't be harmful .).As the concentration of these gases exceed optimum level then the corresponding Led will glow in order to represent which gas has increased and it's corresponding level. As the gas sensor will give the analog value of the corresponding gas ,the levels of gases are calibrated accordingly .

We also have a plan of sending this data to base station by using the most useful feature of GSM protocol i.e. Short Message services (SMS) at regular interval. Server will store this data.

## Working Module:

Phase 1.

1. **Development of sensors**

Monitoring unit and the display unit in laboratory. Following features of sensors used to be taken into account:

**Character**:

* Good sensitivity to CO/Combustible gas.
* High sensitivity to Methane, Propane and CO.
* Long life and low cost.
* Simple drive circuit.

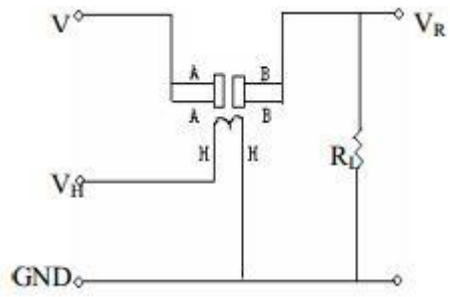
**Application:**

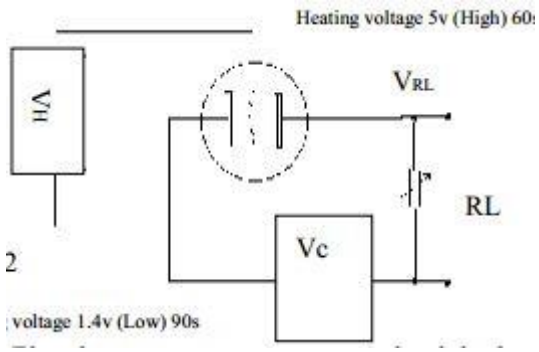
* Domestic gas leakage detector.
* Industrial gas detector.
* Portable gas detector.

For detecting Co and combustible gases we are using **MQ 9** gas sensor .

This will be directly connected to Arduino (ATMEGA 186 microcontroller).

**Circuit diagram:**




The above is basic test circuit of the sensor MQ 9 . The sensor need to be put 2 voltage, heater voltage （VH） and test voltage （VC） . VH used to supply certified working temperature to the sensor, while VC used to detect voltage (VRL) on load resistance （RL） whom is in series with sensor. The sensor has light polarity, Vc need DC power. VC and VH could use same power circuit with precondition to assure performance of sensor. In order to make the sensor with better.

**sensitivity characteristic curve**

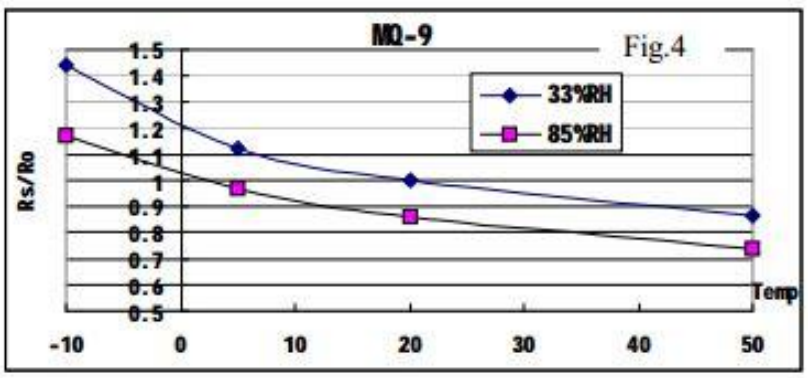



Fig.4 is shows the typical dependence of the MQ-9 on temperature and humidity.
Ro: sensor resistance at 1000ppm LPG in air at 33%RH and 20degree.
Rs: sensor resistance at 1000ppm LPG at different temperatures and humidities.

Electric parameter measurement circuit is shown as Fig.2

E. Sensitivity characteristic curve

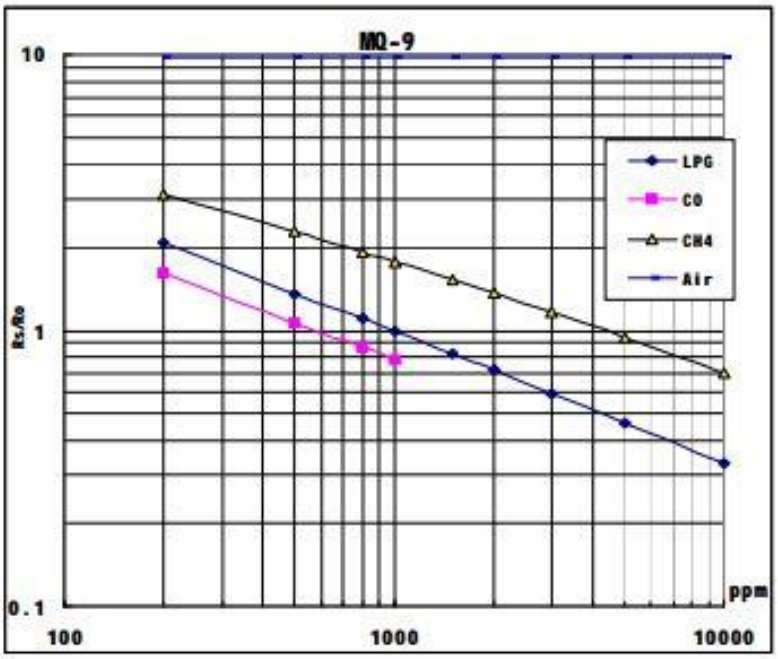



Fig.3 sensitivity characteristics of the MQ-9

Fig.3 is shows the typical sensitivity characteristics of the MQ-9 for several gases.

in their: Temp: 20℃、

Humidity: 65%、

$O_2$ concentration 21%

RL=10k Ω

Ro: sensor resistance at 1000ppm LPG in the clean air.

Rs: sensor resistance at various concentrations of gases.

**OPERATION PRINCIPLE**

The surface resistance of the sensor Rs is obtained through effected voltage signal output of the load resistance RL which series-wound. The relationship between them is described:

Rs\RL = (Vc-VRL) / VRL

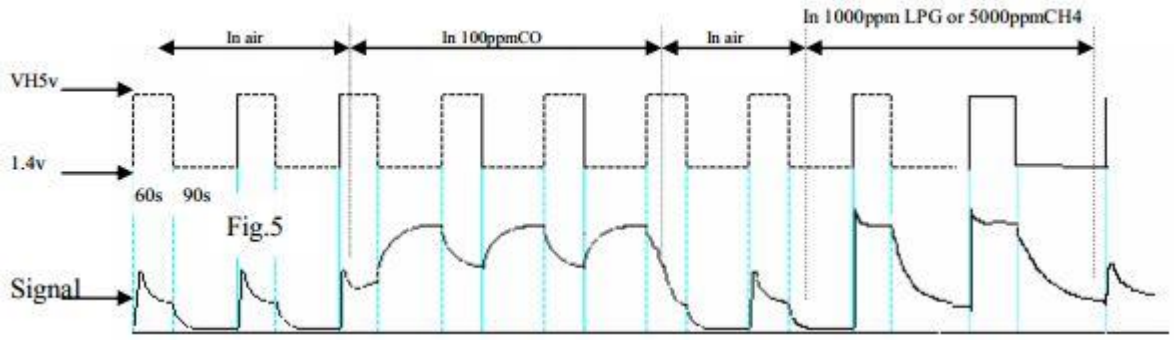



Fig.5

Fig. 5 shows alterable situation of RL signal output measured by using Fig. 2 circuit output signal when the sensor is shifted from clean air to carbon monoxide (CO) or CH4, output signal measurement is made within one or two complete heating period (2.5 minute from high voltage to low voltage ). Sensitive layer of MQ-9 gas sensitive components is made of SnO2 with stability, So, it has excellent long term stability. Its service life can reach 5 years under using condition.

**SENSITVITY ADJUSTMENT**

Resistance value of MQ-9 is difference to various kinds and various concentration gases. So, When using this components, sensitivity adjustment is very necessary. we recommend that you calibrate the detector for 200ppm and 5000ppm CH4 or 1000ppm LPG concentration in air and use value of Load resistance that( RL) about 20 KΩ(10KΩ to 47 KΩ). When accurately measuring, the proper alarm point for the gas detector should be determined after considering the temperature and humidity influence. The sensitivity adjusting program:

a. Connect the sensor to the application circuit.
b. Turn on the power, keep time of preheating through electricity is over 48 hours.
c. Adjust the load resistance RL until you get a signal value which is respond to a certain carbon monoxide concentration at the end point of 90 seconds.
d. Adjust the another load resistance RL until you get a signal value which is respond to a CH4 or LPG concentration at the end point of 60 seconds .
connections to micro controller

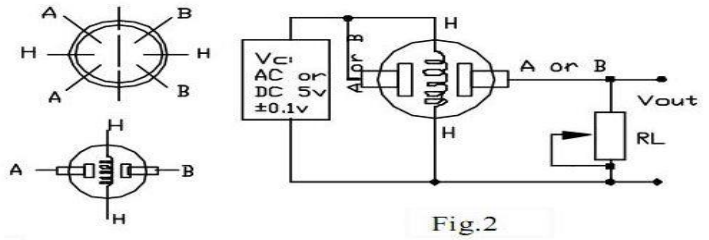



Fig.2

In the picture, the heater is for +5V and is connected to both 'A' pins. This is only possible if the heater needs a fixed +5V voltage.

// The MQ9 gas sensor has been brought from outside .The whole project members are involved in fetching the components.

**Result:**
out Put that will be given by the sensor to the microcontroller.r is Vout.
corresponding analog value will be displayed on the monitor .

**Algorithm:**

```
int analogpin=A0;
int ledpin1= 12;
int ledpin2=11;
int ledpin3=10;
void setup()
{
Serial.begin(9600); //Set serial baud rate to 9600 bps
pinMode (analogpin,input);//read the analog value from pin A0
pinMode (ledpin1,OUTPUT);
pinMode (ledpin2,OUTPUT);
pinMode (ledpin3,OUTPUT);

}
void loop()
{
int val;
val=analogRead(0);Read Gas value from analog 0

if (val<=X)//moderate quantity of gas is presentt
{
digitalWrite(ledpin1,HIGH);
}
else if (val>=x&&<=y) //gas concentration in increased but tolerable
{
digitalWrite(ledpin2,HIGH);
}
else if (val>=y&&<=z)  //Gas concentration is highly increased
{
digitalWrite(ledpin3,HIGH);
```

```
}
else {
digitalWrite(ledpin1,LOW);
digitalWrite(ledpin2,LOW);
digitalWrite(ledpin3,LOW);
}
Serial.println(val);//Print the value to serial port
delay(100);
}
```

//Algorithm has been written combinedly during the lab hours

**Working conditions of Program** description**:**

**# MQ9** gas sensor detects CO(carbon Monoxide) when it is heated at 1.5V.
and Combustible gases at 5V.

**#** it will give analog values corresponding to concentration of the gas ,so through calibration the optimum values X,Y,Z and corresponding volume of the gas level will be calculated.

**#** In order to differentiate the combustible gases the corresponding X,Y,Z values should be adjusted through calibration.

**#** Gas sensor must be heated for more than 48 hrs .

3. **Data Transmission:** (add on)

As for our plan, we will be installing the gas sensors at suitable locations,
but will have a single base station with a server to collect data, process and store them and accordingly send appropriate command to a particular unit if needed. To accomplish this, here comes the role of Data communication. In this section we will be mainly using a module: GSM Modem.

**GSM MODEM**

GSM (Global System for Mobile Communications) is the most popular standard for mobile telephone systems in the world. 80% of the global mobile market uses GSM standard. GSM also pioneered low-cost implementation of the short message services (SMS), also called text messaging, which has since been supported on other mobile phone standards as well. We will be using this feature of GSM protocol to transfer the data to and fro from sensor location to the server. At the location of sensor, the Gas sensors will measure the concentration of Gas at that point. MCU over there will process the voltage output and return a string containing the information about the concentration of different gases. In the initial phase of our project, we will send this data to base station by using the most useful feature of GSM protocol i.e. Short Message services (SMS) at regular interval. Server will store this data.

This service can also be used by server to command any one of the unit to do work, other than their normal work. In general there is not much fluctuation in the concentration of the air at anyplace, unless something goes wrong in the surrounding. So, in normal condition we will take the sample of gas at larger intervals to save the energy used. In case the server finds a large change in concentration of the gas from the normal value, it can send overriding command to the sensor to take samples at lower interval of time. We will also provide the facility of providing this valuable information to the general public, so that they can be aware of degrading environment and take step to minimize the pollution at their level. A little contribution from all can help in improving the current or the more worst coming environmental condition. For this they need to send a SMS to a particular number in a particular format, defining the location for which they want the data. Server will look for the data at that location and send back the SMS containing the information about the Gas condition over there.