PROBLEM NAME:

MONITORING THE LEAKAGE OF THE GASES IN STORAGE AREA.

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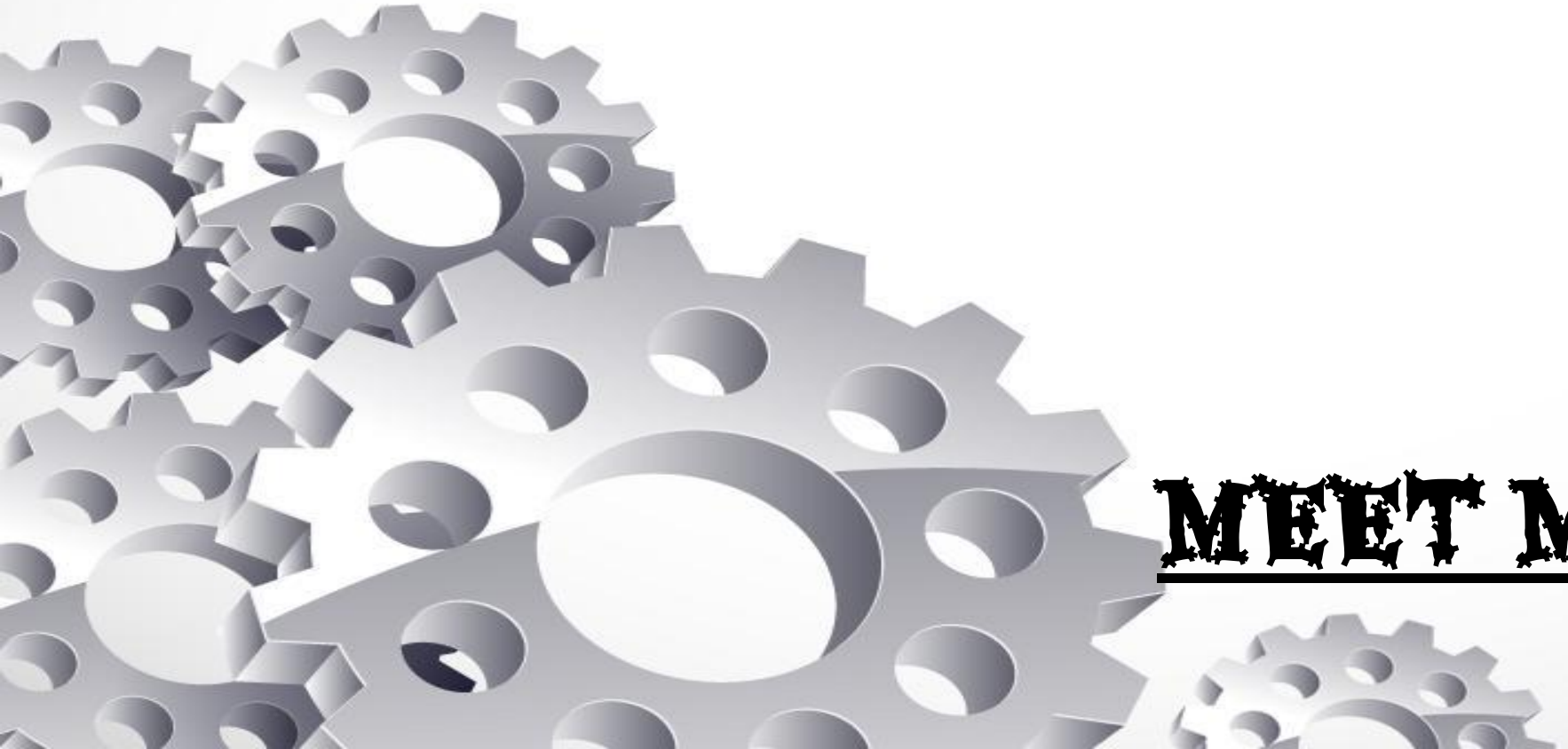
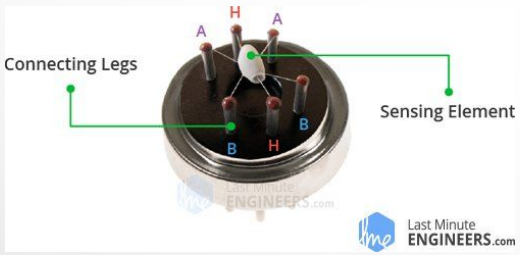


MEET MY "AIROBOT"

MQ2 SENSOR WORKING PRINCIPLE.

- MQ2 gas sensor works according to the change in current/resistance in the sensing element when the Gas comes in contact with the material.
- higher the concentration of gas detected: higher will be the current flowing in the sensor and lower will be the resistance of the sensing material.
- The analog output of the sensor changes in proportional to the concentration of smoke/gas.
- The greater the gas concentration, the higher is the output, while lesser gas concentration results in low output .
- MQ2 sensor can detect LPG, Smoke, Alcohol, Propane, Hydrogen, Methane and Carbon Monoxide concentrations anywhere from 200 to 10000 ppm.



IDEA

- Building a bot with a gas sensor.
- The gas sensor will detect the gases in the surrounding and will give an output accordingly(the output will vary according to the concentration of the gases coming in contact with the sensing material of the sensor).
- When the sensor will come in contact with the gases , green LED would “turn on” provided, the concentration<threshold value.
- When the concentration reaches the threshold value, red LED would “turn on”(Green LED off).
- Concentration of each gas would be displayed each time on LCD screen.
- along with turning on the red LED ,on reaching the threshold value, a buzzer alarm would ring and valve of the pipeline using the motor would get closed.

Here we would be considering three gases and their respective thresholds are mentioned below:

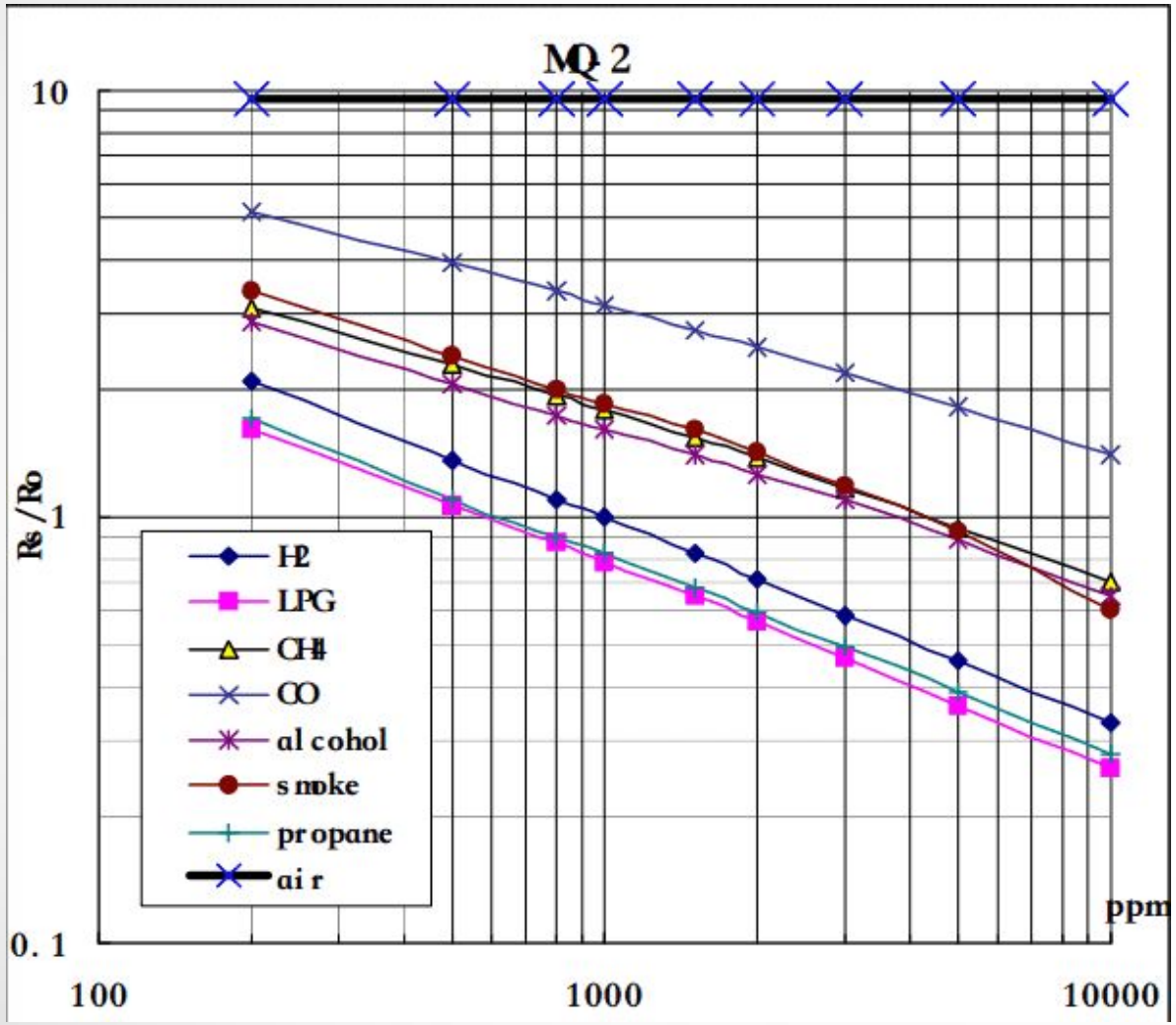
GAS	THRESHOLD VALUE(PPM)
CO Gas	200 ppm
Smoke	350 ppm
LPG	800 ppm

::if any one the gas has a concentration greater than its threshold value, leakage would be detected and certain measures would be taken.

APPROACH

- MQ2 gas sensor will be used here.
- the output from the sensor would be taken at different concentration levels of gases in analog form.
- The analog output obtained from the sensor each time will be converted to the ppm concentration, which would be different for different gases.The ppm value for each gas will be then displayed on LCD screen each time.
- After getting the ppm value of the gases, these will be compared with their respective threshold value.
- if concentration of all gases does not exceeds their respective threshold, Green LED will turn on and concentration of each gas will be displayed on LCD.
- if the concentration of any gas exceeds its limit(threshold) then, red LED will turn on, buzzer will ring , warning message and concentrations will be displayed on LCD and the valve of the pipeline will be closed on rotating servo by 180 degrees.
- Upon dilution of air in surrounding(after leakage), if for all gases, concentration < threshold, the valve will be opened again, green LED will turn on(red LED off) , buzzer will stop ringing.

CONVERTING ANALOG SIGNAL OUTPUT BY SENSOR TO PPM VALUE.



- This is a MQ2 sensitivity graph.
- The scale of this graph is log-log.
- The graph tells us the concentration of a gas in part per million (ppm) according to the resistance ratio of the sensor (RS/R0).

- Rs = Sensor resistance in displayed gases at various concentrations .
- Ro = Sensor resistance in fresh air.

- using this graph the analog output reading of sensor can be converted to ppm concentration.

- Based on the graph MQ2, the derivation of ppm formula will be:
- **y = mx + c**

Where:

y: Rs/Ro value

x: ppm value

m: Slope of the line for a particular gas.

b: Y intercept

For a log-log scale, the formula looks like this:

- log(y) = m*log(x) + b
- **log(RS/RO)=m*log(ppm)+b**

(taking the points(coordinates) from the graph value of “b” and “m” can be calculated for each individual gas.)

Hence, an equation will be obtained for each individual gas in terms of RS/RO and ppm.

Taking the analog output value from the sensor, we can calculate RS/RO and using the above equation we can get ppm value for each gas at a given analogread value.

CALCULATION OF RS AND RO

To calculate Rs:

- **Rs=(Vin-Vout)/Vout**

  where,

  Vin=Vcc=5V(from arduino)

  Vout= sensor value in voltage(analog output in voltage form)

Using the above formula Rs can be obtained at different analog output value.

To calculate Ro:

calculate Rs for fresh air, using above formula.

From the graph we get,

- **Rs/Ro=9.8**.(for fresh air)
- Hence Ro=Rs/9.8

Analog output read out by sensor has to be converted to analog voltage form:

sensor value in voltage(Vout)=(analog output)*5/1023

.

COMPONENTS REQUIRED

- MQ2 gas sensor 1

- LCD(16X2) 1

- Breadboard 1

- Jumper Wire

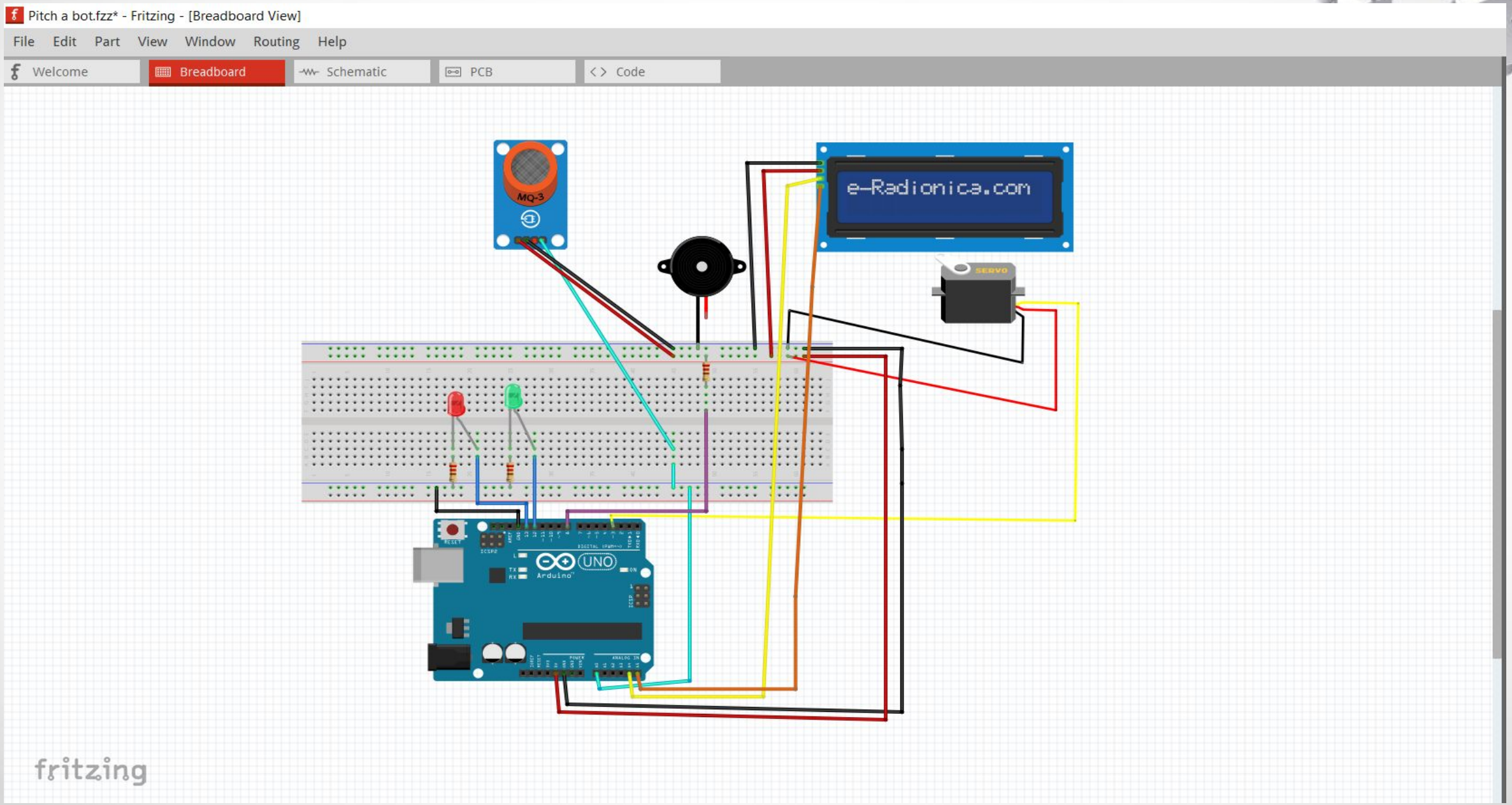
- Servo motor 1

- Red LED , Green LED

- Buzzer 1

- Arduino UNO 1

CONNECTIONS AND CIRCUIT DIAGRAM



CODE

```
#include <LiquidCrystal_I2C.h>  // adding packages
#include <Servo.h>
#include<wire.h>

servo myservo:
LiquidCrystal_I2C lcd(0x27,16,2);
int redLED=13;     // pin set to 13
int greenLED=12;   // pin set to 12
int buzzer=8;      // pin set to 8
int smokeA0=A0;    // pin set to A0
int angle=0;       // position of servo
int sensorvalue=0;
float voltageoutput;
float Rs;
float Ro;
int b1,b2,b3,m1,m2,m3; // b and m represent constant and slopes of gases.
int threshold ;

void setup()
{
   myservo.attach(3); // servo attached to pin 3 of arduino
   lcd.init();
   lcd.backlight();
   lcd.print("Gas Detector")
   pinmode(redLED,OUTPUT);  // setting the signal type (output or input)
   pinmode(greenLED,OUTPUT);
   pinmode(buzzer,OUTPUT);
   pinmode(smokeA0,INPUT);
   serial.begin(9600); // serial communication begins at 9600 bits per second.

   sensorvalue=analogRead(smokeA0);
   voltageoutput= sensorvalue*(5/1023); // converting analog output in voltage form.
   Rs= (5-voltageoutput)/voltageoutput ;
   Ro= Rs/9.8 ;           // calculation of Ro
   serial.begin(9600);
}

void loop()
{
  sensorvalue=analogread(smokeA0);
  voltageoutput= sensorvalue*(5/1023); // converting analog output in voltage form.
  Rs= (5-voltageoutput)/voltageoutput;
  float ratio = Rs/Ro; // same for all gases
  float calc= log10(ratio);
  float a=10.0;
  double ppm1= pow(a, ((calc-b1)/m1)) // b1 and m1 are the constant and slope of CO.    (ppm1 is of CO)
  double ppm2= pow(a,((calc-b2)/m2)) // b2 and m2 are the constant and slope of smoke.  (ppm2 is of smoke)
  double ppm3= pow(a,((calc-b3)/m3)) // b3 and m3 are the constant and slope of LPG.    (ppm3 is of LPG)
  lcd.clear();
  lcd.setcursor(0,0); // setting row,column where text is to obatined on LCD
  lcd.print("CO");
  lcd.setcursor(3,0):
  lcd.print("smoke");
```

```
lcd.print(ppm1);
lcd.setcursor(4,1);
lcd.print(ppm2);
lcd.setcursor(9,1);
lcd.print(ppm3);
delay(100);

if (ppm1>=200 || ppm2>=350 || ppm3>=800)    // conditions

{
   digitalWrite(redLED, HIGH); // redLED on
   digitalWrite(greenLED, LOW);
   tone(buzzer,1000);   // buzzer sound on
   if (angle==0)
   {
      for(angle = 0; angle <= 180; angle++)
      {
        myservo.write(angle);   // servo rotates
        delay(15);
      }
   }
}
delay(1000);


else
{
  digitalWrite(greenLED, HIGH); // greenLED on
  digitalWrite(redLED, LOW);
  noTone(buzzer);   // no buzzer sound
  if (angle!=0)
  {
    for(angle = 180; angle >= 0; angle--)
    {
      myservo.write(angle);   // servo rotates
      delay(15);
    }
  }
}
delay(1000);
```

TAKE AWAY AND RESOURCES

- This project made me learn many new things like working of sensor and about other components as well.
- This gave an idea how technology can make inspections easier and safer for industries.Creating a basic one in this task was fun.
- In this issue given,in addition to the measures taken we could use different kinds of buzzer sounds for different gases when leaked, this would help us to know from distant which gas leaked. Using other sensors,we could make the bot to detect the leakage locations as well.A mobile bot would be an awesome idea.
- Writing arduino code was a new task but got through it under the guidance of mentors.

- https://www.arduino.cc/reference/en/
- https://lastminuteengineers.com/mq2-gas-senser-arduino-tutorial/
- https://maker.pro/arduino/tutorial/how-to-control-a-servo-with-an-arduino-and-mpu6050
- https://create.arduino.cc/projecthub/akshayjoseph666/interface-i2c-16x2-lcd-with-arduino-uno-just-4-wires-273b24

Thank You