KITCHEN SAFETY SYSTEM

PROJECT REPORT
for
ELECTIVE PROJECT AND COMPUTATION - I

DEPARTMENT OF ELECTRICAL ENGINEERING
JADAVPUR UNIVERSITY

Name	Roll
KAZI GHALIB MURTAZA	001910801135
SAMARPAN BANDYOPADHYAY	001910801143
SHEJUTI *K*ARMAKAR	001910801145
MD DANISH ALAM	001910801155
NEHA AGARWAL	001910801156

UNDER THE GUIDANCE OF

Prof. Suparna Kar Choudhury
and
Prof. Debashish Chatterjee

PROBLEM STATEMENT:

In countries like India due to extreme negligence towards safety, thousands of people die due to accidents every year, both inside and outside their homes. A leading cause of accidents in homes is fire due to LPG gas leakage from cooking cylinders.

Gas knobs are sometimes accidentally left open, or there are cracks in the gas pipe that often go undetected.
Elevated temperatures or sparks from nearby circuitry can set this gas on fire, which leads to explosion of the gas cylinder.

Exploding cooking gas cylinders accounted for nearly one-sixth of all deaths from accidental fires between 2010 to 2014, with a total of 19,491 deaths and thousands of severe burn victims.

Hence, it's important to address this issue and develop an economicallyfeasible solution to prevent these accidents.

PROPOSED SOLUTION:

Our system aims to prevent gas leakage accidents by:

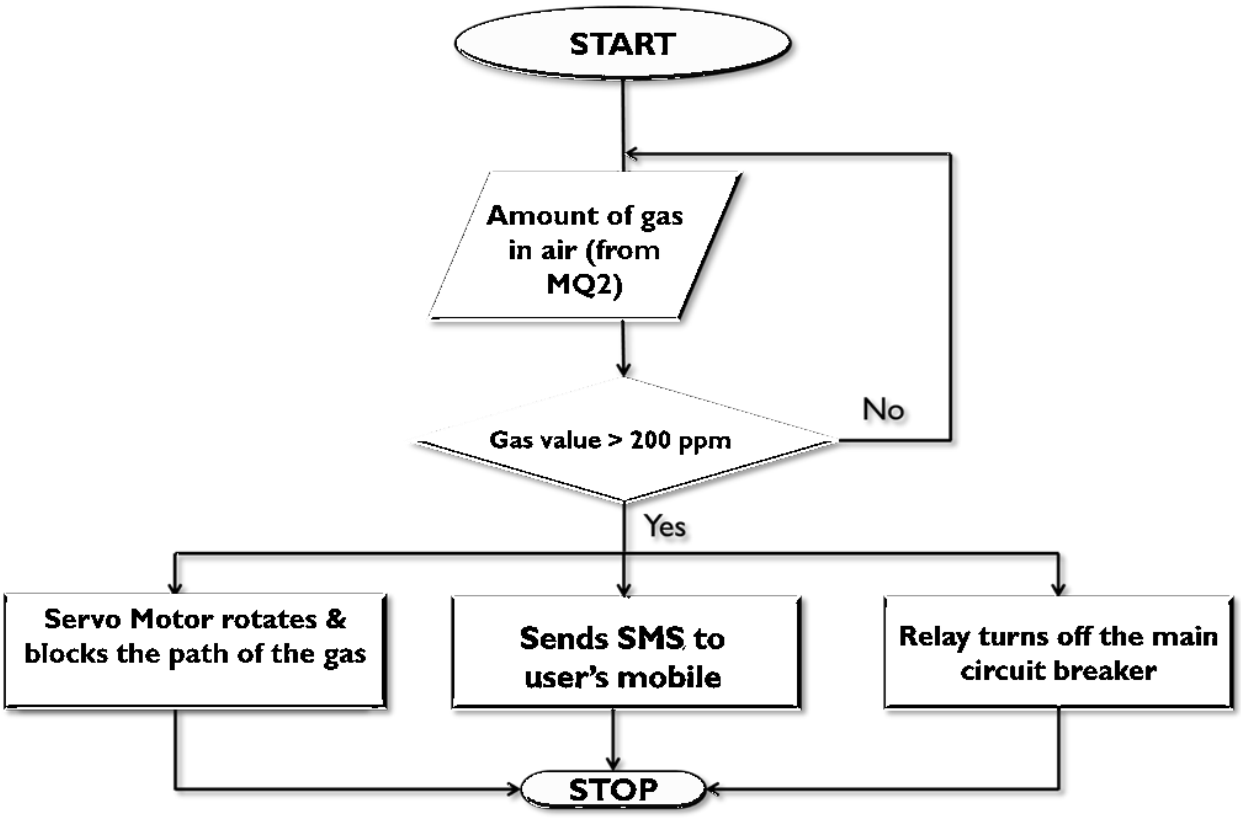
▪ detecting the gas leaks with the help of an MQ-2 gas sensor module compatible with Arduino (Microcontroller Atmega328p).

▪ sealing off the gas source with the help of a servo motor.

▪ alerting the owner about the leak via SMS that requires no internet connectivity.

▪ turning off the main switch using a circuit breaker with the help of a protective relay.

WORKFLOW:



WORKING PRINCIPLE:

The **MQ-2 gas sensor module** which is a **chemiresistor** has been used to detect the leakage of the LPG gas.
The sensing element of the sensor is mainly **aluminum-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 generates 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.

Generally, at a *concentration of 2000 ppm the LPG gas is considered to be dangerous due to risk of explosion*.

The module detects a concentration of **300-10000 ppm** of combustible gas and it requires a power source of **4.5V to 5V** DC and can be directly powered from the Arduino board. For the circuit we have kept the leakage detection threshold as 1.95V. The output value of the sensor has been sent as an input to the microcontroller; therefore, as soon as the value of combustible gas in air goes above the threshold the microcontroller sends signals three units:

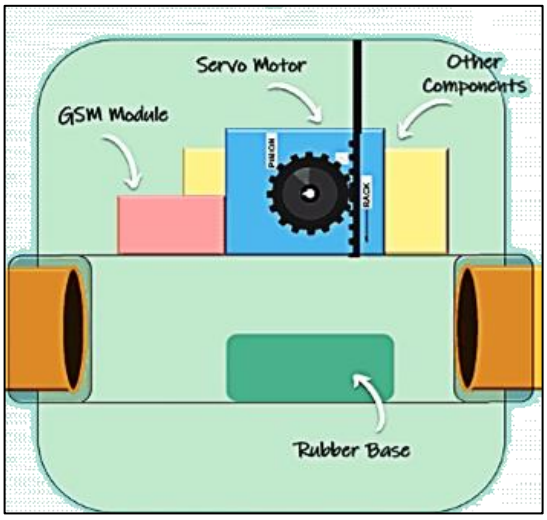
- to the *servo motor* to close and shut off the supply of the gas through *the connector*,
- to the *gsm module* to send an alert SMS to the users' mobile phone and
- to the *relay switch* to turn off the main switch using a circuit breaker.

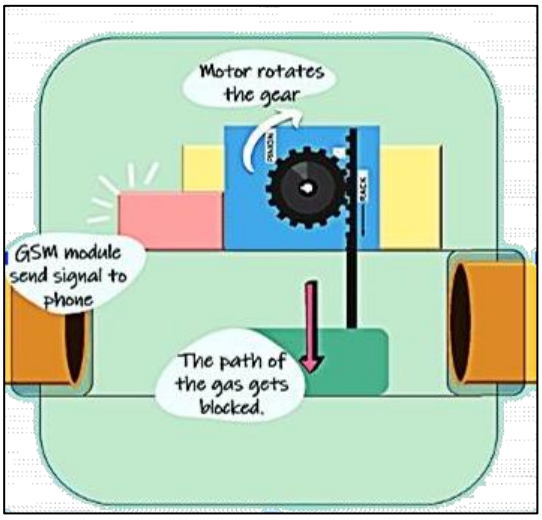
For better safety and to avoid any mishaps we have used two gas sensors one outside the cylinder cabinet (to detect gas leakage from the stove) and one inside to detect internal gas leakage (Leakage in pipe).

Working Principle of the output units are as follows:

- **Servo Motor and Connector:**

The servo motor is connected to a "**Rack and Pinion**" type system. When the sensor detects gas, the Arduino sends a signal to the servo motor to rotate. As the motor rotates the rack and pinion system closes the path of the gas in the connector and thus any further leakage is stopped. Servo motor is also powered by the Arduino 5V pin.



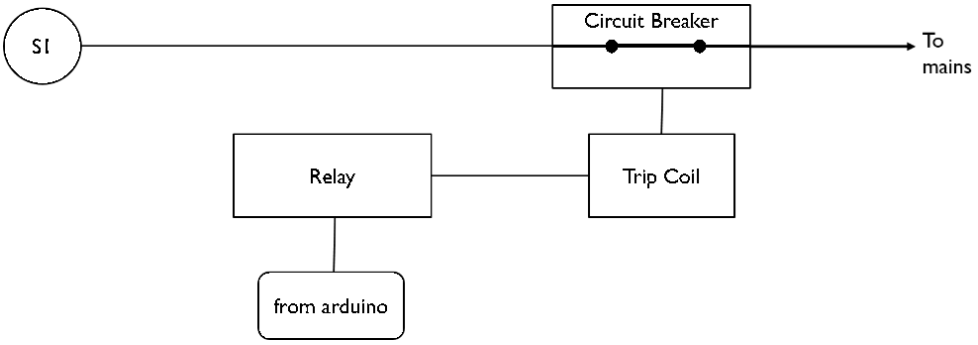


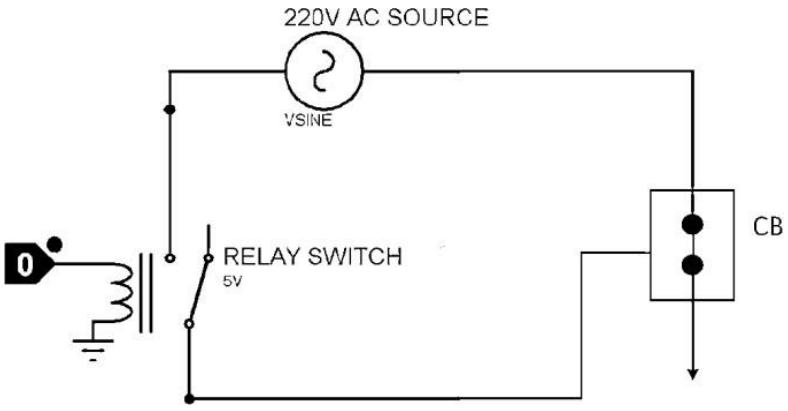
- **GSM Module:**

The SIM 900 series of the available GSM Modules has been used. These modules require a maximum of 2A of current with a DC supply voltage of 3.4V to 4.5V while sending an SMS or calling. A 5V-12V supply can be used with a linear voltage divider. Rechargeable Li-on cells are used to power the module as well as the whole setup, to supply high current. The SIM 900 modules are very easy to use and after placing the SIM and connecting with the Arduino board the configuration can directly be done when the code runs. After the detection of the gas the Arduino sends commands to the SIM Module to send SMS to the user. It takes the module **3 to 5 seconds** to send an SMS to the user.

- **Relay switch and Circuit Breaker:**

A single channel 5V relay switch with Max Switching voltage of 250V and max switching current of 10 ampere has been used. The relay switch requires an input voltage of 5V and a few mill amperes and can be directly powered by the Arduino. The relay switch is connected with the Trip Coil of Circuit Breaker. Upon receiving signal from circuit breaker, the relay will trip the circuit breaker (CB), as shown by the following schematic and circuit diagram:





COMPARISON WITH EXISTING COMMERCIAL SYSTEMS:

Pros:

▪ comes at an **affordable** price

▪ **Easy** to install. Does not require a lot of changes in the existing system for setting up.

▪ Works on batteries and uses minimal wires, has a **hassle-free** compact design

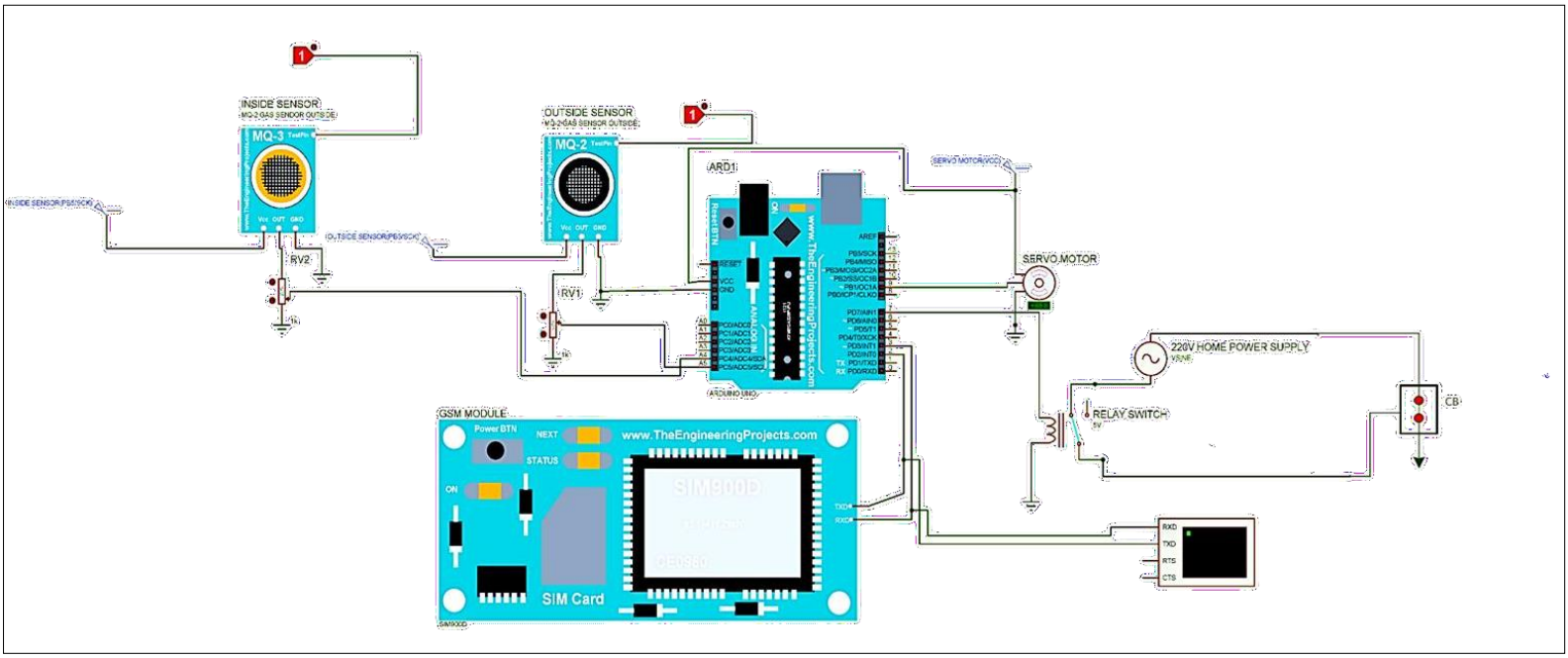
▪ Microcontroller based and is more reliable as compared to existing gas leakage detection system.

▪ Sends alert via **SMS** and hence internet connection isn't required.

Cons:

- Other commercially existing systems serve only the purpose of alerting, using an LED or buzzer which is only useful if the user is near the system. Our system can send SMS and alert the user, no matter where he is.
- Existing systems perform only one function which is to alert the user, whereas our system not only alerts the user but also prevents the accident by **1) blocking the path of the gas** thereby stopping further leakage, **2) switching off other electrical appliances** preventing fire hazard from electrical sparks
- Most existing systems use MQ-6 sensors which can't differentiate between smoke and inflammable gases and may lead to false alert if smoky food is cooked. We have used the **sensitive MQ-2 gas sensor** which can detect reducing gases in air from 200-10000 ppm. The sensor is very sensitive and has a fast response.
- Commercially available systems use the concept of pressure to jam the knob but are not very reliant.

HARDWARE:



HARDWARE COST ESTIMATION:

COMPONENT	QUANTITY	COST PER PIECE	AMOUNT
MQ-2 Sensor	2	170	340
Servo Motor	1	240	240
Arduino	1	1240	1240
SIM-800L GSM Module	1	350	350
9V battery	1	140	140
Relay Switch	1	170	170
Jumper Wires, Resistors, Capacitors	---	---	400
Safety Connector	1	120	120
Total			3000

SOFTWARE:

```
#include <Servo.h>
#include<SoftwareSerial.h>
Servo gas_servo;
SoftwareSerial gsm(2,3);
//Sets the digital pin 2 and 3 as RXD and TXD respectively

int LPG_sense1 = A5;
int LPG_sense2 = A4;
int sensorThres = 400;
int flag=1;


void setup()
{
    pinMode(LPG_sense1, INPUT);
    pinMode(LPG_sense2, INPUT);

    Serial.begin(9600);
    gsm.begin(9600);
    gas_servo.attach(9);

    pinMode(7, OUTPUT);
}


void loop()
{
    int analogSensor1 = analogRead(LPG_sense1);
    int analogSensor2 = analogRead(LPG_sense2);

    if ((analogSensor1> sensorThres)||(analogSensor2 > sensorThres))
        {
            if (flag==1)
            {
                gas_servo.write(360);
                digitalWrite(7,HIGH);

                gsm.println("AT+CMGF=1");
                delay(1000);

                gsm.println("AT+CMGS=\"+919735207239\"\r");
                delay(1000);

                gsm.println("Gas leakage detected in the kitchen!! ");
                delay(100);

                gsm.println((char)26); flag=0;
            }

        }

}
```

Fin