



## DESIGN AND IMPLEMENTATION OF FACTORY SECURITY SYSTEM

\*Jinan Nsaif Shehab

Assistant Lecturer., Communication Engineering Department, Diyala University, Diyala, Iraq.

**Abstract:** Security is a prime concern in our life. Security of factory is almost standardized nowadays. Safety from leaking of gas and fire are the most important requirements of home and factory security system for people. A conventional security system gives the signals in terms of alarm. Whereas, the proposed system uses GSM (Global System for Mobile communications) to alert about the gas leakage and flame via calling and higher alarm sound. When the proposed system detects the leaking of gas or flame in the air then it immediately alert by higher alarm sound (Buzzer) or by making calling to specified mobile phone. This system is built with open source hardware (Arduino uno 328) and Micro C language for programming microcontroller (Arduino uno 328). The advantage of this proposed detection and alerting system over the conventional method is that it gives fast response time and accurate detection of an emergency and in turn leading faster diffusion of the critical situation via calling to specified number for the system and higher alarm sound.

**Keywords:** *Arduino Uno 328, GSM, Gas sensor, flame sensor.*

### تصميم وتنفيذ نظام الأمن للمصنع

**الخلاصة:** ان الحماية هو موضوع مهم في حياتنا العملية. نظام حماية المصانع مهمة في الوقت الحاضر. السلامة من تسرب الغاز والنار هي أهم متطلبات نظام الحماية للناس. نظام الحماية التقليدي يعطي إشارات للتنبيه. لكن، يستخدم النظام المقترح ( GSM النظام العالمي للاتصالات المتنقلة) للتنبيه عن تسرب للغاز واللهب من خلال الاتصال والانذار بصوت عالي. عندما يكشف النظام المقترح تسريب الغاز او اللهب في الهواء فإنه في حالة تأهب على الفور فيصدر صوت عالي للتنبيه (الطنان) أو عن طريق الدعوة إلى الهاتف المحمول المحدد. تم بناء هذا النظام عمليا باستخدام الأجهزة مفتوحة المصدر (اردوينو أونو 328). حيث تم استخدام لغة مايكرو C في برمجة ( اردوينو أونو 328). ان من فوائد النظام المقترح لكشف تسرب الغاز والتنبيه عنه عن الانظمة التقليدية القديمة هو أنه يقدم وقت استجابة سريع وكشف دقيق لحالة الطوارئ عن طريق الانذار بصوت عالي واجراء اتصال بالرقم المحدد للنظام.

### 1. Introduction

Gas leakage and fire are a common problem in homes and industries [1]. A classical system for gas leakage can only senses a leakage and alerts an alarm. Whereas, Design of factory security system depending on GSM overtures many more benefits. This work mainly focuses on protecting industries and home against risks ( danger and damage ) based on Propane gas (MQ-6) and flame leakage detection system, there are two cases to warn; The first case( without mobile phone) to issue a warning aerobically by sound .

\* [eng\\_jinan83@yahoo.com](mailto:eng_jinan83@yahoo.com)

and the second case (with mobile phone and Arduino) will be sent a warning (calling) directly to the user through GSM networks.

## 2. Related Work

In 2012, V.Ramya and B. Palaniappan, design PIC (Peripheral Interface Controller) 16F877 microcontroller based toxic gas detecting and alerting system. The dangerous gases like LPG and propane were sensed and displayed each and every second in the LCD display. If these gases exceed the usual level, then an alarm is generated immediately and also an alert message SMS (Short Message Service) is sent to the certified person through the GSM [1].

In 2013, Selvapriya et.al, designed a gas leakage detection system contains LPG (Liquefied Petroleum Gas) gas sensor for sensing the leakage and produce the result in audio and visual formats besides alerts human via SMS [2].

In 2014, Nandeesh G S et.al, designed a GSM GPS (Global Position System) based home and industry security system and tested with the mobile network. in this system GPS and GSM were used [3].

In 2015, Pushkar Yelave et.al, proposed technique of security system for oilfield industries using GSM and Zigbee. The system was able to receive all the oil parameters like the current oil level, temperature of oil, leakage of gas [4].

In 2016, Md Iftekharul Mobin et.al, proposed a full fire protection system to prevent fire from extending and does all necessary activities. This system takes input signals from various sensors placed in different position of the monitored area, and combines integrated fuzzy logic to recognize fire breakout locations and severity [5].

This proposed system introduces a new design to alert about the gas leakage and flame via calling by programming microcontroller Arduino with MQ-6 gas sensor and flame sensor and this is the difference between the proposed system and the others system in alert about gas leakage and flame.

## 3. General Description of Equipment

The equipment that used in this work are:

### 3.1. Arduino

It's an open-source physical computing display place based on a simple microcontroller board involves an ATmega328 microcontroller and a development environment for writing soft-ware for the board. Arduino can be used to develop communicating objects, taking inputs from a selection of switches or sensors and controlling a selection of lights, motors and other physical outputs. Arduino projects can be fulfilled-alone, or they can be communicating with software running on your computer (e.g. Flash, Processing, Proteus and MaxMSP) [6,7].

Arduino Uno is microcontroller board and based on the Atmel's ATmega328 microcontroller. "Uno" means one in Italian and the uno board is the latest in a series of

USB (Universal Serial Bus) .The Arduino Uno board has a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, a reset button, 6 analog inputs and 14 digital input/output pins (of which 6 can be used as PWM outputs). The board has 32 KB flash memory of which 0.5 KB is used by boot-loader, 2 KB of SRAM, 1 KB of EEPROM and 16 MHz clock speed. Arduino Uno board is shown in "Fig. 1" [8].

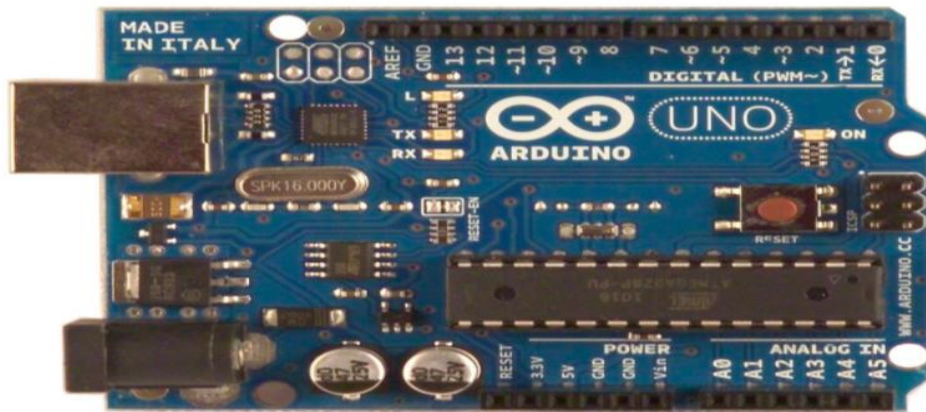


Figure 1. Arduino Uno Board

### 3.2. MQ-6 GAS Sensor

It is a standard gas sensor which detects the gas leakage. The responsive material of MQ-6 is (SnO<sub>2</sub>). It has very low conductivity in fresh air. MQ-6 gas sensor has high sensitivity to Propane, Butane and, also respond to Natural gas. This sensor could be used to detect different combustible gas, especially Methane, it is with low cost and suitable for different application. The concentration range of MQ-6 gas sensor is 300-10000ppm. This sensor has 6 pins package, out of which 4 pins are used for fetching the signals and other 2 pins are used for providing heating. The power need by the sensor is 5V. "Fig. 2" shows MQ-6 gas sensor [9].



Figure 2. Propane Gas Sensor.

### 3.3. Flame Sensor

A flame detector is a sensor designed for detecting and responding to the existence of a flame or fire. It further can detect ordinary light source in the range of a wavelength 760nm-1100 nm. The distance of detection is up to 100 cm. A flame detector can usually respond faster and more accurately than a smoke or heat detector owing to the mechanisms it uses to detect the flame. The Flame sensor can product digital or analog

signal. It can be used as a flame alarm or in firefighting robots. "Fig. 3" shows flame sensor [5].

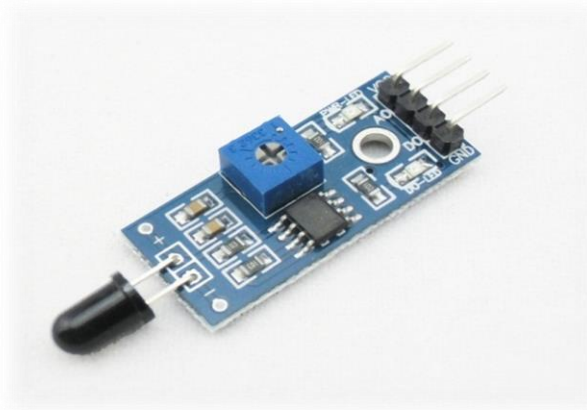


Figure 3. Flame Sensor.

### 3.4. Relay

The relay is an electromagnetic device, which consist of solenoid, moving contacts (switch) and restoring spring and consumes relatively large amount of power. It is used for the function of isolating the controlling and the controlled device. Hence it is possible for the interface IC to control the relay contentedly. To enable this, a driver circuitry, which will operate as a dielectric circuit, is to be combine between them. The driver circuitry senses the presence of a “high” level at the input and drives the relay from another voltage source. Therefore, the relay is used to switch the electrical supply to the appliances [10]. Relay module; is an electrically operated switch, it is used to allow the opening and closing the circuit depending on the voltage or/and current to ensure the safety device in the event that the voltage or current is greater than the ability of Arduino to handle and thus the fundamental function protect each part of the circuit separately as shown in "Fig. 4".



Figure 4. Relay for switching

### 3.5. GSM Modem

GSM modem in this system is a mobile phone (Nokia 6670 in transmitter and any mobile phone in receiver). Nokia 6670 is connected with Arduino through a relay

module to control it. In this work, alerting the person by way of calling when any sensor activated the microcontroller control the relay module to send an active signal to other outwardly connected devices.

#### 4. Proposed System

The Proposed System consists of two cases: The first case (without mobile phone) to issue a warning aerobically by sound. The proposed system in this case consists sensors, microcontroller and speaker as shown in the "Fig. 4". When the flame or gas sensor work the Arduino activate the buzzer. The proper alarm point for the gas detector should be determined after considering the temperature and humidity influence for accurately measuring." Fig. 6" shows the typical sensitivity characteristics of the MQ-6 for several gases under 20°C temperature and 55% humidity [11].

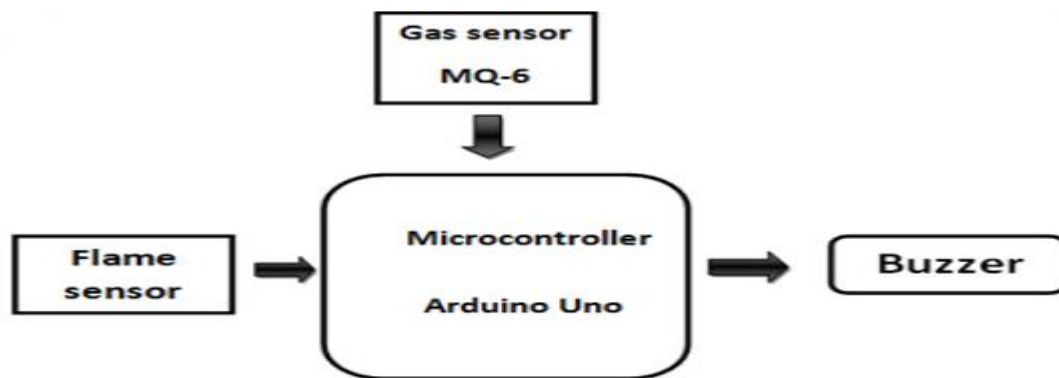


Figure 5. Relay for Block Diagram of gas leakage and flame detection security system by alarm

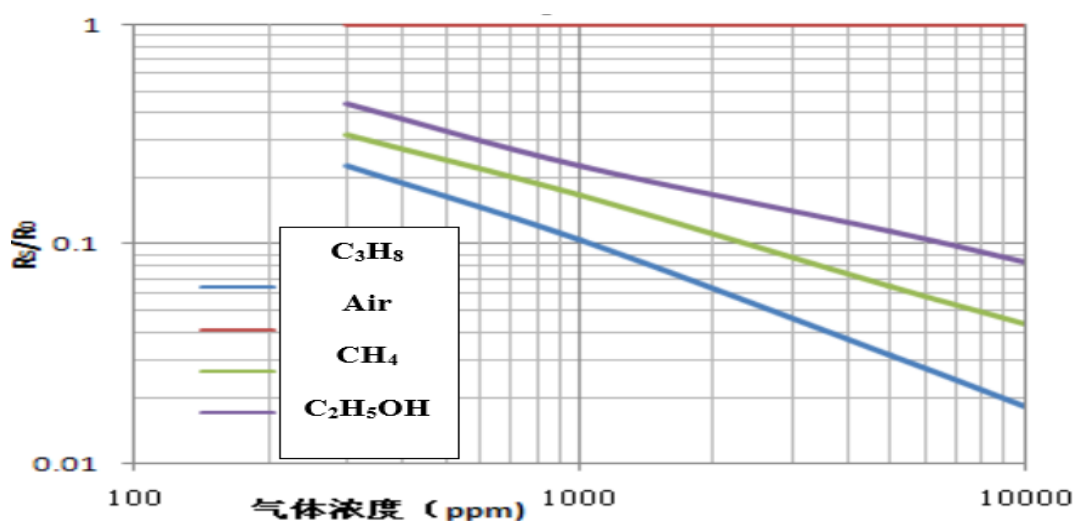


Figure 6. Typical sensitivity characteristics of the MQ-6 for several gases

The second case (with mobile phone and Arduino), will be sent a warning (calling) directly to the user through GSM Networks. When a gas leak or fire occurs, the owner receives a call from a registered number in the mobile device that was placed in the protection device for the purpose of the alarm to take necessary actions. The block diagram of building GSM Security System Alert Person by make call is shown in "Fig. 7".

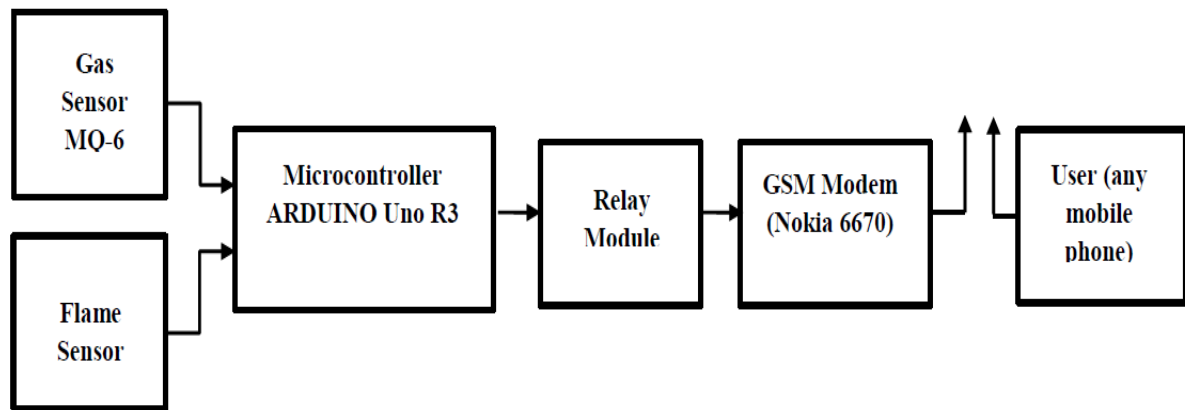


Figure 7. Block Diagram of gas leakage and flame detection security system with GSM

## 5. Experimental Results and Discussions

### 5.1. Security Alarm System (without GSM)

The prototype of leakage system has been tested by sensing a small amount of Propane gas near to the gas sensor and small amount of flame from lighter near to the flame sensor. MQ-6 gas sensor and flame sensor detect the leakage gas and fire consecutively and send a signal to the microcontroller (Arduino Uno 328). After that, microcontroller send an active signal to other externally connected devices. As a result, a buzzer rings and a Light Emitting Diode blinks as shown in "Fig. 8". "Fig. 9" shows the flow chart of this case.

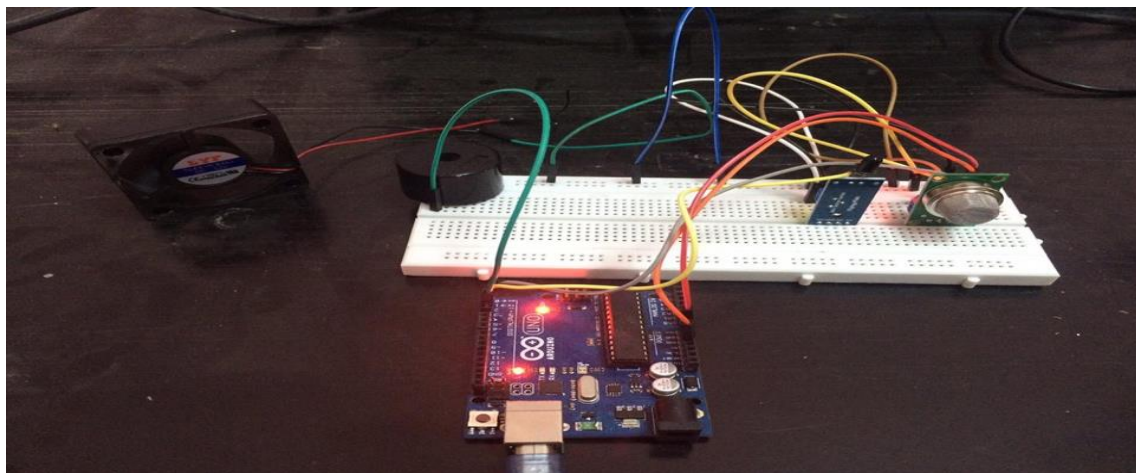


Figure 8. Hardware of Security Alarm System (without GSM)



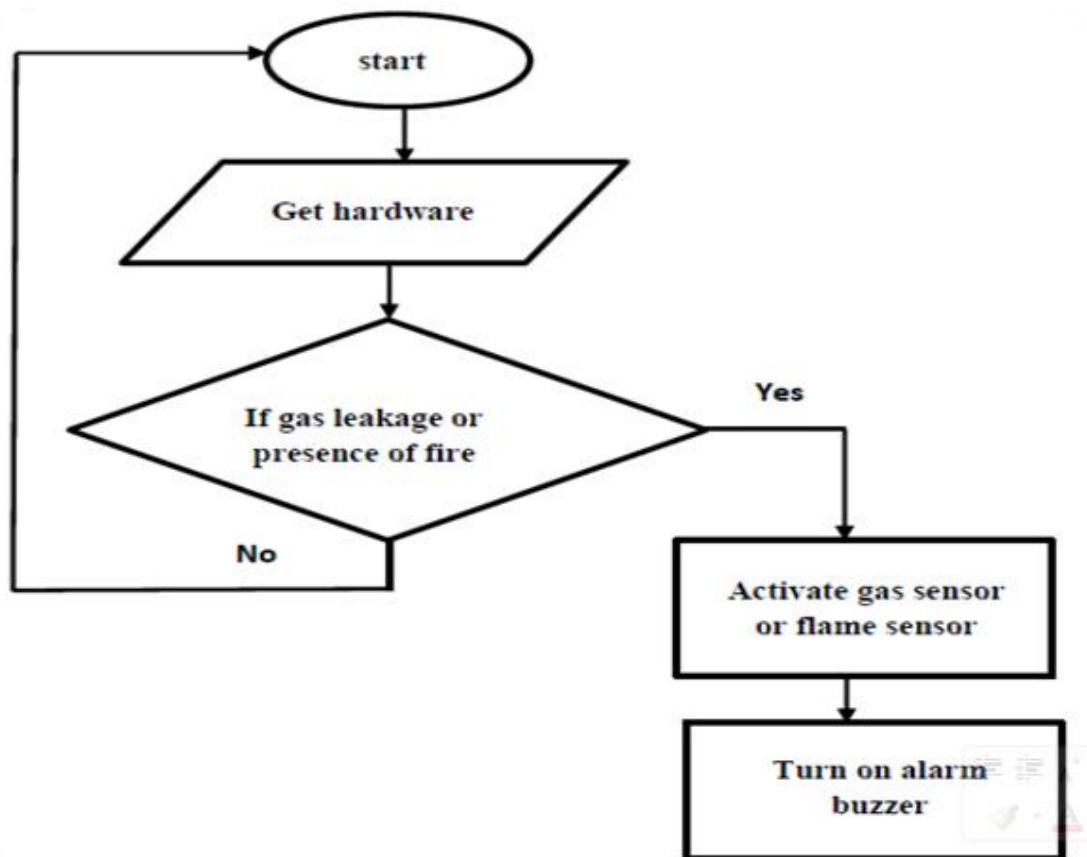


Figure 9. Flowchart of Security Alarm System (without GSM)

### 5.2. Security Alarm System (with GSM)

The hardware of this case consists of Gas sensor (propane gas), flame sensor, Arduino microcontroller, mobile phone that is connected with Arduino through an relay module to control it. When sensor activated the microcontroller control the relay module to make call as shown in "Fig. 10" to a user phone number. The mobile is an important part of the system responsible for communication between the microcontroller and the mobile phone. AT commands are used to interface the module as well as to configure it. AT commands are inserted in C-language as a string of characters which are sent to the module using the terminal program.

The instructions are defined within a program as a C-language code which could be actuated at a specific moment. The code would then be simply compiled and uploaded into the Arduino unit as shown in " Fig.11" and "Fig.12". "Fig.13" shows the flow chart of this case.

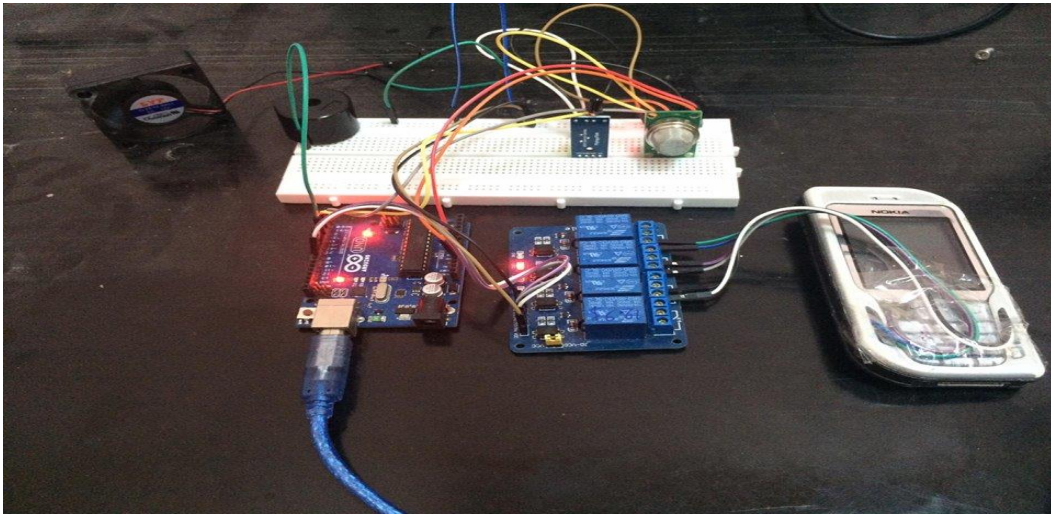


Figure 10. Hardware of Security Alarm System (with GSM).

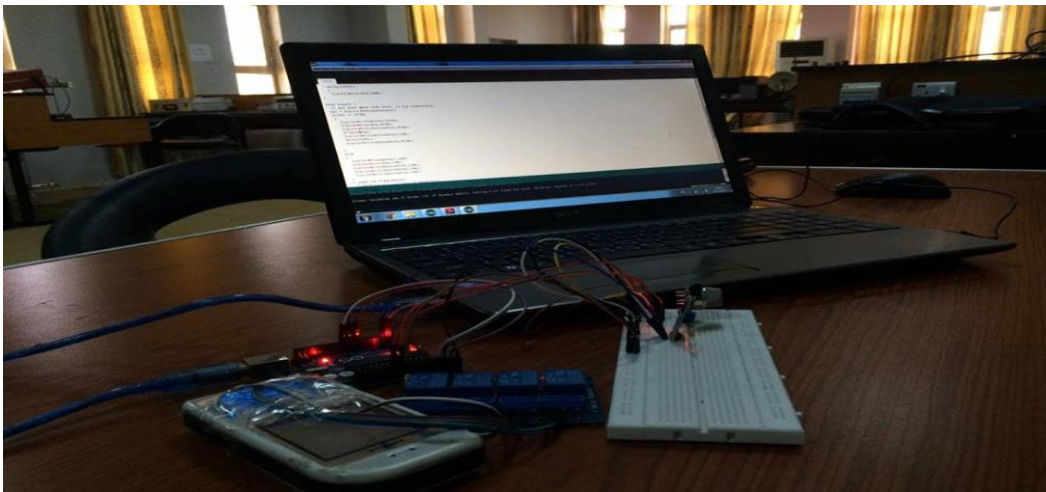


Figure 11. Hardware and software of proposed system.

```
File Edit Sketch Tools Help
AHMED_333$
int val;
int val2;
const int buttonPin1 = 7;
const int buttonPin2 = 8;
const int buttonPin3 = 9;
void setup() {
  // put your setup code here, to run once:
  pinMode(flamesensor, INPUT);
  pinMode(buzzer, OUTPUT);
  pinMode(gassensor, INPUT);
  pinMode(buttonPin1, OUTPUT);
  pinMode(buttonPin2, OUTPUT);
  pinMode(buttonPin3, OUTPUT);
  for(int i=0; i<1; i++)
  {
    digitalWrite(buzzer, HIGH);
    delay(1000);
    digitalWrite(buzzer, LOW);
    delay(1000);
  }
  digitalWrite(fsm, LOW);
```

Figure 12. Arduino Software Programmed using C-language.



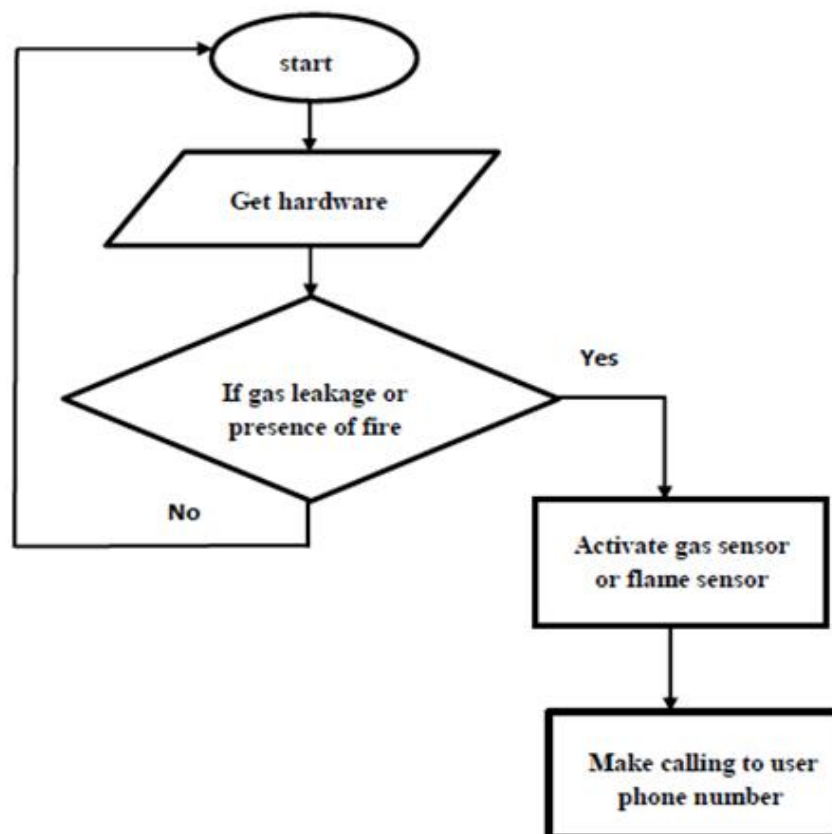


Figure 13. Flowchart of Security Alarm System (with GSM).

## 6. Conclusions

In this proposed system, a new approach for gas leakage detection and flame detection system is described. The proposed leakage is detected with the help of MQ-6 gas sensor and flame sensor. Sensors directs a signal to microcontroller. In the next step microcontroller directs an active signal to other externally connected devices. the proposed system can be used in any place like homes, hostels, industries, vehicles with Low power consumption, only 2.4mWatts. . And final Low cost operating system using Arduino module [AT-mega328] in Micro C programming language and Overall cost effective and parts are easily available on the market.

## 7. References

1. V.Ramya and B. Palaniappan. (2012). "Embedded system for Hazardous Gas detection and Alerting", International Journal of Distributed and Parallel Systems (IJDPS), Vol. 3, No. 3.
2. Selvapriya, Sathya Prabha, Abdulrahim and Aarthi K.C (2013). "LPG Leakage Monitoring and Multilevel Alerting System", international journal of engineering sciences & research technology (IJESRT).

3. Nandeesh G. S, B Srinivasalu Reddy and Sunil Kumar K M. (2014). "*Intelligent Security System for Industries by using GPS and GSM*", International Journal of Advanced Research in Computer Science & Technology (IJARCST) Vol. 2, Issue. 1.
4. Pushkar Yelave, Pravin Gawhale, Abhilash Jawlekar and Mr. R. S. Sahu. (2015). "*Security Management System for Oilfield Using GSM & Zigbee Communication*", International Journal of Innovative Research in Computer and Communication Engineering, Vol. 3, Issue. 7.
5. Md Iftekharul Mobin, Md Abid-Ar-Rafi, Md Neamul Islam and Md Rifat Hasan. (2016). "*An Intelligent Fire Detection and Mitigation System Safe from Fire (SFF)*", International Journal of Computer Applications, Vol. 133, No. 6.
6. Sayemul Islam and Md. Saiduzzaman. (2013). "*Design of A Bank Vault Security System with Password, Thermal & Physical Interrupt Alarm*", International Journal of Scientific & Engineering Research, Vol. 4, Issue. 8.
7. Santoso Budijono, Jeffri Andrianto, Muhammad Axis and Novradin Noor. (2014). "*Design and Implementation of Modular Home Security System with Short Messaging System*". Proc. Int. conf. EDP Sciences, EPJ Web of Conferences 68.
8. Gudipudi Sushma, Mary Joseph, A.Ruth Tabitha and M.B.Prashanth Yokesh (2015). "*Image Tracking Based Home Security Using Arduino Microcontroller*". International Journal of Innovative Research in Computer and Communication Engineering, Vol. 3, Special Issue. 8.
9. <http://www.datasheetpdf.com/PDF/MQ6/699271/1>.
10. Derci Felix Da Silva<sup>1</sup> and Daniel Acosta-Avalos. (2006). "*Sensors*", pp. 514-525.
11. [www.winsensor.com](http://www.winsensor.com)