

# **Smoke detector alarm system using GSM communication**



## **Project title**

**Smoke detector alarm system using GSM communication**

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## Declaration

We declare that we complete this project entitled "**Smoke detector alarm system using GSM communication**" in the department of Electronics and communications Engineering, East West University, in partial requirement to fulfill the degree of B.sc. in Electronics and Telecommunication Engineering. We solemnly declare that to the best of our knowledge, no part of this report has been submitted elsewhere for award of a degree. All sources of knowledge use have been duly acknowledged.

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## APPROVAL

This is to certify that the project "**Smoke detector alarm system using GSM communication**" has been submitted to the respective members of the Board of Examiners of the Faculty of Engineering department to fulfill the requirement for the degree of B.Sc. in Electronics and Telecommunication Engineering under complete supervision of the undersigned.

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## Acknowledgement

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## **Abstract**

Telecommunication is a very important part of our life. We can use this technology in a very sophisticated area like safety and security purpose. Using the GSM technology, telecommunication can be conducive to save our life as well as households from fire accidents which have shown in this project. We design and develop an Arduino circuit with a smoke detector, LCD Display, an alarm and GSM shield. When the smoke detector detects smoke (the detect measurement of smoke can be configured regarding the size and surroundings of the room), there is a LCD Display which shows "Fire in room!" and the alarm rings immediately. Besides, there is a GSM shield where a SIM card is installed and two phone numbers are programmed. The SIM card sends message to the two phone numbers that is programmed in the system. So someone can be aware about the fire accidents even if he/she is not in home at the moment.

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# Chapter 1

## Introduction

### 1.1 Arduino:

Arduino is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software. Arduino is common term for a software company, project, and user community that designs and manufactures computer open-source hardware, open-source software, and microcontroller-based kits for building digital devices and interactive objects that can sense and control physical devices. Finally Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible Package. The Arduino software is free, the hardware boards are pretty cheap, and both the Software and hardware are easy to learn has led to a large community of users.

### 1.2 Figure of Arduino-UNO:



Figure 1.1: Arduino-UNO R3

## 1.3 History of Arduino-UNO

The first Arduino was introduced in 2005, aiming to provide a low cost, easy way for novices and professionals to create devices that interact with their environment using sensors and actuators. The Arduino microcontroller was initially created as an educational platform for a class project at the Interaction Design Institute Ivrea in Milan (Italy) in 2005. It derived from a previous work of the Wiring microcontroller designed by Hernando Barragan in 2004. From the beginning, the Arduino board was developed to attract artists and designers. The Wiring microcontroller was created by Hernando Barragan to be used for parsing data to electronic devices. His aim was that it could be used by non-technical people who only had basic experience with using computers. He first of all wanted it to be used as a prototyping tool. Since he needed help to create an easy software tool to programmed the board he engaged Casey Reas and Massimo Banzi as his assistants. Reas created the visual programming language for the prototyping tool. Common examples of such devices intended for beginner hobbyists include simple robots, thermostats, and motion detectors.

## 1.4 Smoke detector:

A smoke detector is a device that senses smoke, typically as an indicator of fire. Commercial security devices issue a signal to a fire alarm control panel as part of a fire alarm system, while household detectors, known as smoke alarms, generally issue a local audible or visual alarm from the detector itself.



Figure 1.2: Smoke sensor FC-22



**Figure 1.3: Smoke sensor FC-22**

## **1.5 GSM:**

GSM (Global System for Mobile communication) is a digital mobile telephony system that is widely used in Europe and other parts of the world. GSM uses a variation of time division multiple access (TDMA) and is the most widely used of the three digital wireless telephony technologies (TDMA, GSM, and CDMA). GSM digitizes and compresses data, then sends it down a channel with two other streams of user data, each in its own time slot. It operates at either the 900 MHz or 1800 MHz frequency band.

## 1.6 GSM Module:

GSM/GPRS module is used to establish communication between a computer and a GSM-GPRS system. Global System for Mobile communication (GSM) is an architecture used for mobile communication in most of the countries. Global Packet Radio Service (GPRS) is an extension of GSM that enables higher data transmission rate. GSM/GPRS module consists of a GSM/GPRS modem assembled together with power supply circuit and communication interfaces (like RS-232, USB, etc) for computer. GSM/GPRS MODEM is a class of wireless MODEM devices that are designed for communication of a computer with the GSM and GPRS network. It requires a SIM (Subscriber Identity Module) card just like mobile phones to activate communication with the network. Also they have IMEI (International Mobile Equipment Identity) number similar to mobile phones for their identification. A GSM/GPRS MODEM can perform the following operations:

1. Receive, send or delete SMS messages in a SIM.
2. Read, add, search phonebook entries of the SIM.
3. Make, Receive, or reject a voice call.

The MODEM needs AT commands, for interacting with processor or controller, which are communicated through serial communication. These commands are sent by the controller/processor. The MODEM sends back a result after it receives a command. Different AT commands supported by the MODEM can be sent by the processor/controller/computer to interact with the GSM and GPRS cellular network.

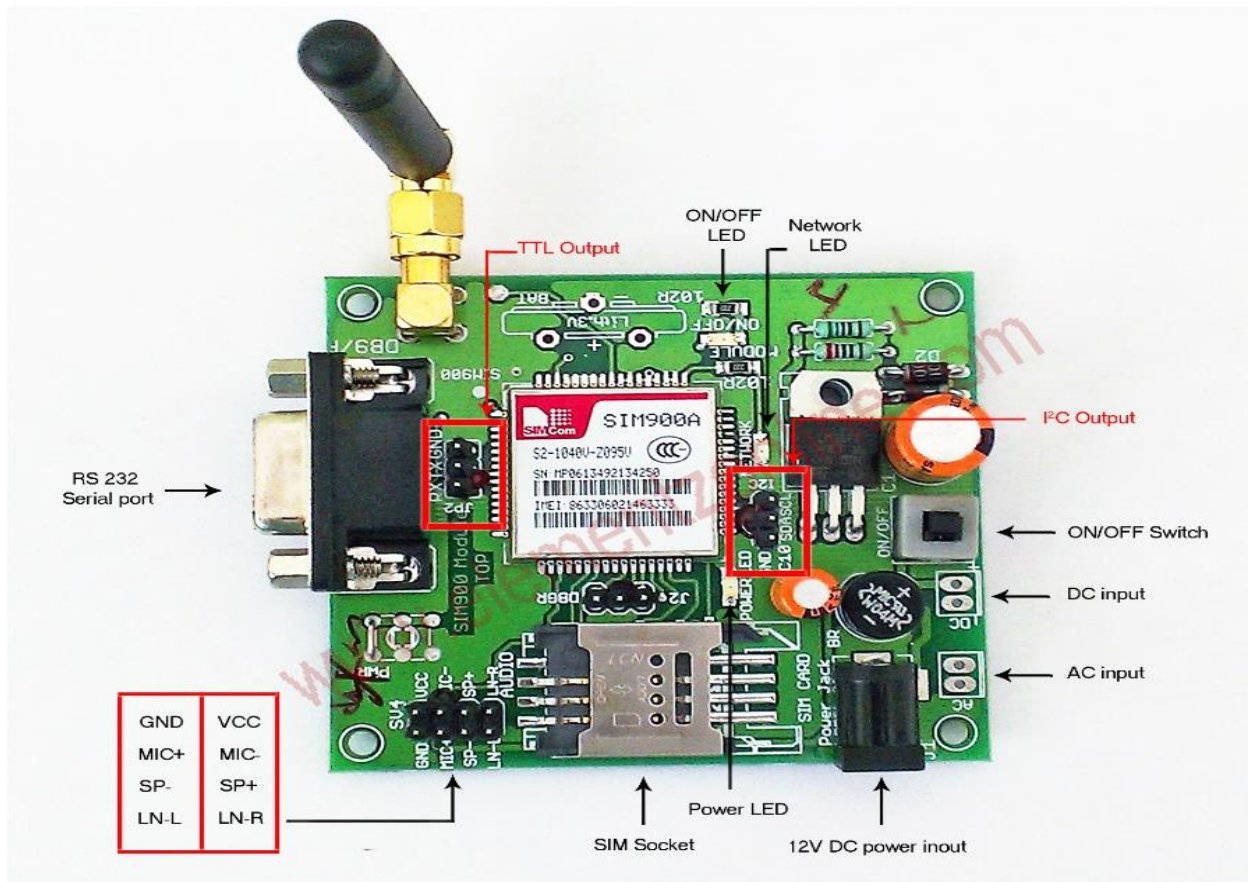


Figure 1.4: GSM module RS 232

## 1.7 Outline of the report:

Here we describe four chapters on the purpose of this project. First we describe the introduction part that purpose of project, aim of the project. Chapter two contains overview of microcontrollers where we describe about Arduino, GSM module, 16x2 LCD display etc. Then we describe theory behind the project. Where we described about equipment which are used in this project. Then we describe the system design and analysis where we show hardware and software design. We show the output of this project. We end it with conclusion and reference part.

## Chapter 2

# THEORY BEHIND THE PROJECT

## 2.1 Introduction

This project include with Arduino Uno board, GSM module, Alarm, LCD display. We want to connect the GSM module to an Arduino .We developed the connection by using upper equipments.

## 2.2 Architecture of Arduino-UNO

There are many varieties of Arduino boards that can be used for different purposes. The Arduino UNO components are:

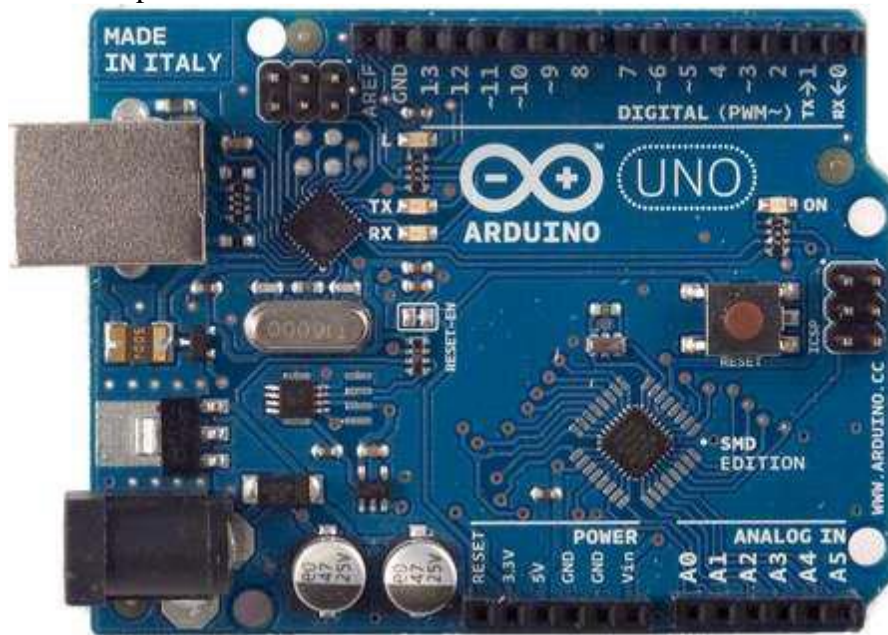


Figure 2.1: Arduino-UNO R3 Board



## 2.2.1 Power -USB / Barrel Jack

Our Arduino board needs a way to be connected to a power source. The Arduino UNO can be powered from a USB cable coming from your computer or a wall power supply that is terminated in a barrel jack. In the picture above the USB connection is labeled and the barrel jack is labeled. The USB connection is also how you will load code onto your Arduino board.

## 2.2.2 Pins (5V, 3.3V, GND, Analog, Digital, PWM, AREF)

The pins of Arduino are the places where connect wires to construct a circuit. The Arduino has several different kinds of pins, each of which is labeled on the board and used for different functions.

- **5V:** The 5V pin supplies 5 volts of power. Most of the simple components used
- Arduino run happily off of 5 or 3.3 volts.
- **GND:** Full name is Ground. There are several GND pins on the Arduino, any of which can be used to ground circuit.
- **Analog:** The area of pins under the ‘Analog In’ label (A0 through A5 on the UNO) is Analog In pins. These pins can read the signal from an analog sensor and convert it into a digital value that we can read.
- **Digital:** Across from the analog pins are the digital pins (0 through 13 on the UNO). These pins can be used for both digital input and digital output (like powering an LED).
- **PWM:** The digital pins (3, 5, 6, 9, 10, and 11) on the UNO are the PWM(~) pins. These pins act as normal digital pins, but can also be used for something called Pulse-Width Modulation (PWM).
- **AREF:** Stands for Analog Reference. It is sometimes used to set an external reference voltage (between 0 and 5 Volts) as the upper limit for the analog input pins.

## 2.2.3 Schematic Diagram

### Arduino™ UNO Reference Design

Reference Designs ARE PROVIDED "AS IS" AND "WITH ALL FAULTS". Arduino DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING PRODUCTS, INCLUDING BUT NOT LIMITED TO, ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Arduino may make changes to specifications and product descriptions at any time, without notice. The Customer must not rely on the absence or characteristics of any features or instructions marked "reserved" or "undefined". Arduino reserves the right to change specifications and shall have no responsibility whatsoever for conflicts or incompatibilities arising from future changes to them. The product information on the Web Site or Materials is subject to change without notice. Do not fabricate a design with this information.

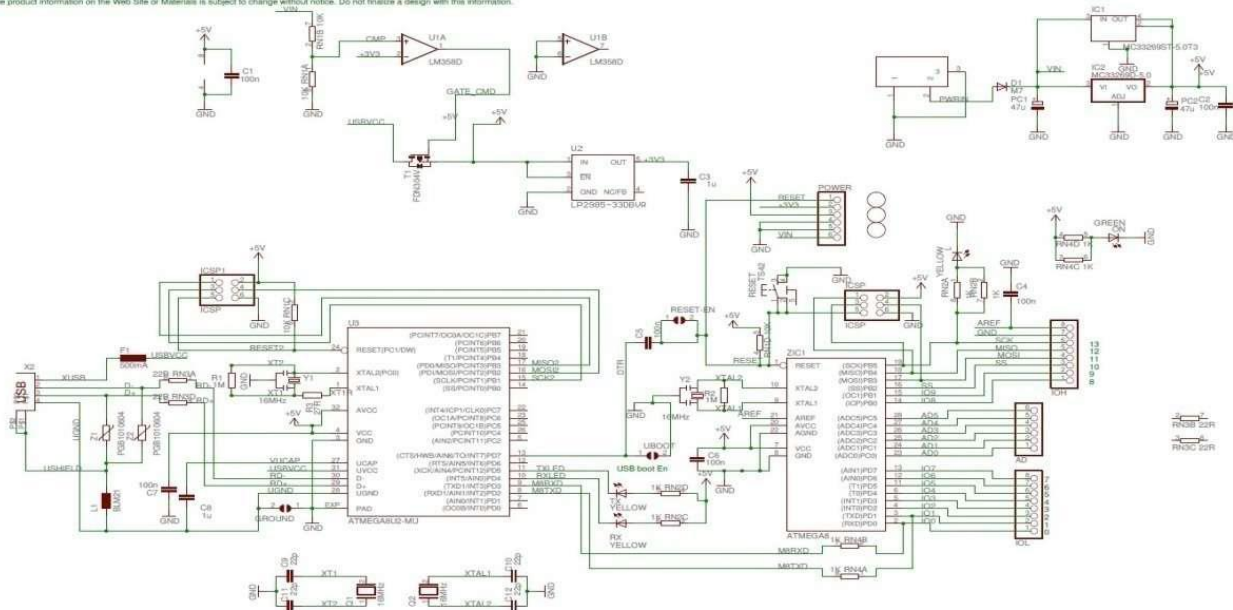


Figure 2.2: Schematic Diagram for Arduino Uno Board

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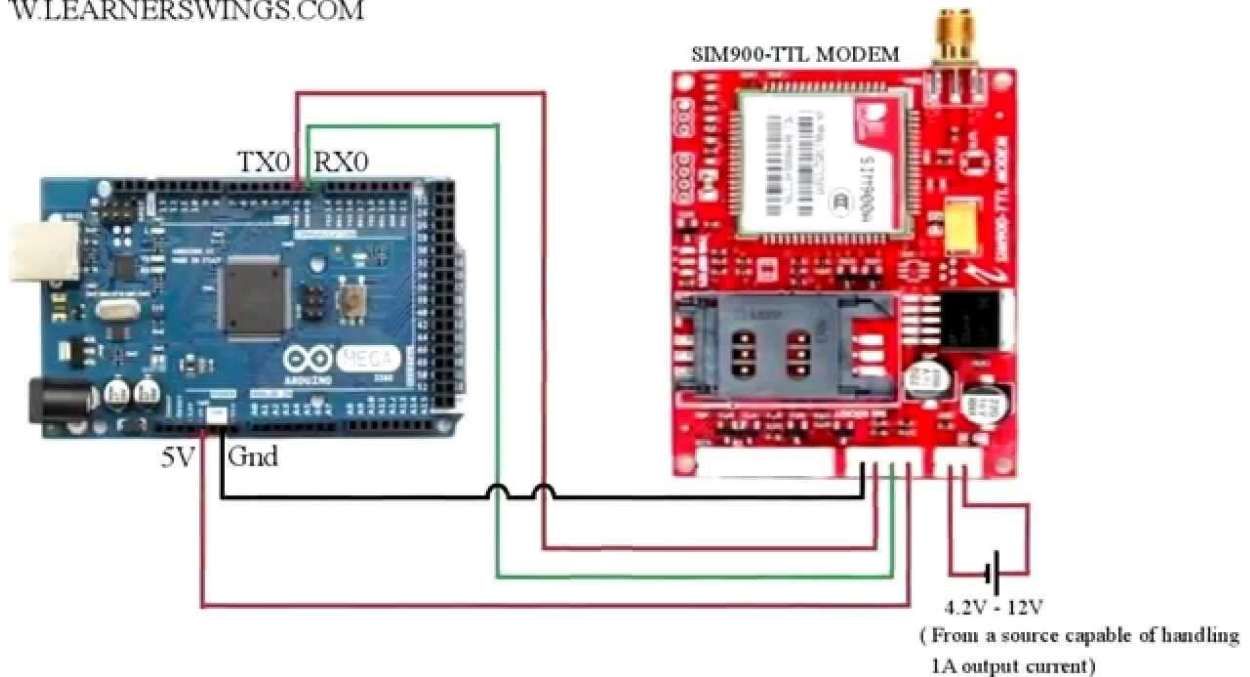


Figure 2.3: Schematic Diagram for Arduino and GSM module.

## 2.3 Getting started with Arduino Software

First download and install the Arduino for Mac, Linux or Windows from [arduino.cc](http://arduino.cc). Windows users also need to install a driver. Connect your board via USB, launch the Arduino application and select Arduino-Uno from the tools to board menu. Open the sketch File.

Examples: 01. Basics: Blink. Click the toolbar button to upload it to your board.

### 2.3.1 The Integrated Development Environment (IDE)

Every microcontroller needs software to be programmed. The Arduino board is not a case apart. It has its own integrated development environment (IDE). It is free and everyone can download it from its official website using either the Windows, Mac OS X or Linux platform. That allows Arduino Board to gain more users and it also helps it to grow.

### 2.3.2 IDE Parts

- **Compile:** Before program “code” can be sent to the board, it needs to be converted into instructions that the board understands. This process is called Compiling.
- **Stop:** This stops the compilation process.
- **Create new Sketch:** This opens a new window to create news ketch.
- **Open Existing Sketch:** This loads a sketch from a file on our computer.
- **Save Sketch:** This saves the changes to the sketch.
- **Upload to Board:** This compiles and then transmits over the USB cable to our board.
- **Serial Monitor:** Until this point when our programs (sketches) didn’t work, we just pulled out our hair and tried harder.

- **Tab Button:** This lets you create multiple files in your sketch. This is for more advanced programming than we will do in this class.
- **Sketch Editor:** This is where write or edit sketches
- **Text Console:** This shows you what the IDE is currently doing and is also where error messages display if make a mistake in typing program.
- **Line Number:** This shows what line number your cursor is on.

## 2.4 Smoke detector/ sensor:

A smoke detector is a device that senses smoke, typically as an indicator of fire. Commercial security devices issue a signal to a fire alarm control panel as part of a fire alarm system, while household detectors, known as smoke alarms, generally issue a local audible or visual alarm from the detector itself.

Smoke detectors are housed in plastic enclosures, typically shaped like a disk about 150 millimeters (6 in) in diameter and 25 millimeters (1 in) thick, but shape and size varies. Smoke can be detected either optically (photoelectric) or by physical process (ionization), detectors may use either, or both, methods. Sensitive alarms can be used to detect, and thus deter, smoking in areas where it is banned. Smoke detectors in large commercial, industrial, and residential buildings are usually powered by a central fire alarm system, which is powered by the building power with a battery backup. Domestic smoke detectors range from individual battery-powered units, to several interlinked mains-powered units with battery backup; if any unit detects smoke, all trigger even in the absence of electricity.

## 2.5 GSM Playground - GSM Shield for Arduino:

GSM Playground is a GSM Shield designed for Arduino based boards (Arduino Duemilanove, Arduino MEGA, Seeeduno Mega...). It is built on a well known and reliable GSM/GPRS Module GE-863 QUAD from Telit. This Module is pretty small so it is placed directly on the Shield printed circuit board. The GSM Playground offers next to the GSM capabilities lots of other features like recognizing of DTMF signal, measuring of ambient temperature and others. It will show you the way how there is possible to use GSM network in your application built on the great Arduino board

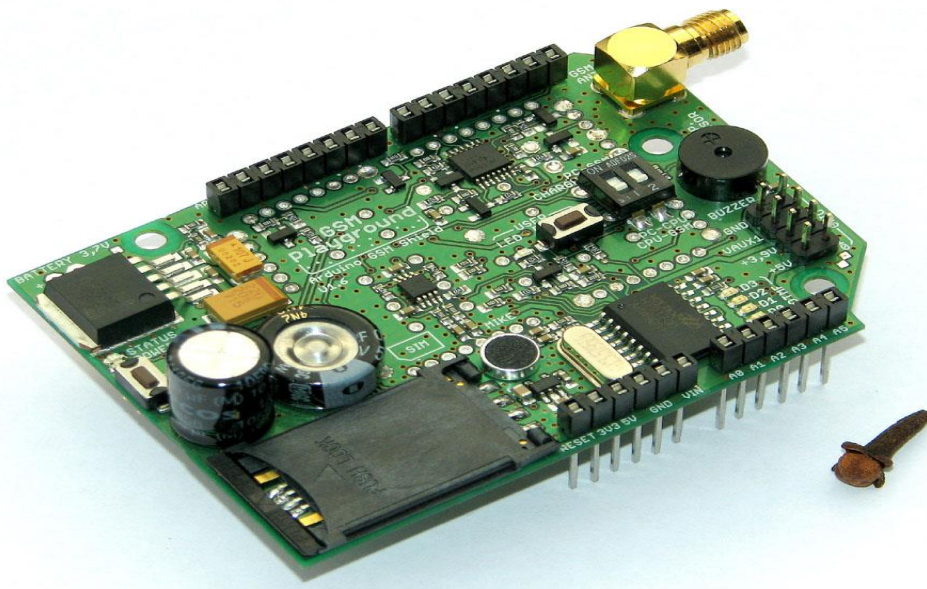


Figure 2.4 : GPRS Module GE-863 QUAD

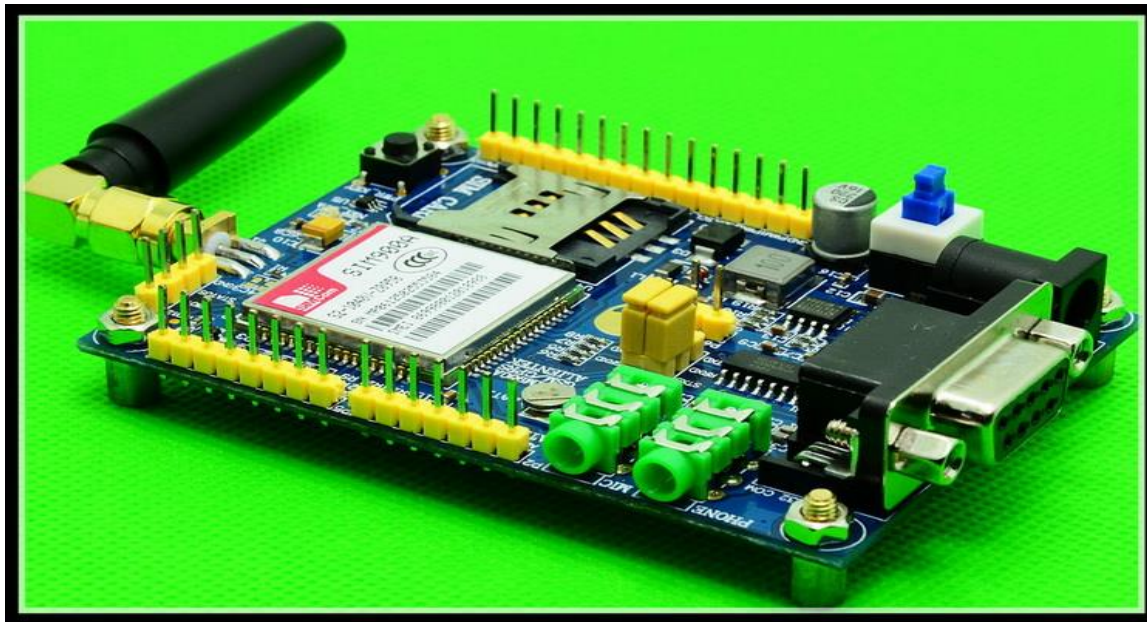
### 2.5.1 900MHz Spectrum analyzer:

A spectrum analyzer measures the magnitude of an input signal versus frequency within the full frequency range of the instrument. The primary use is to measure the power of the spectrum of known and unknown signals. The input signal that a spectrum analyzer measures is electrical, however, spectral compositions of other signals, such as acoustic pressure waves and optical light waves, can be considered through the use of an appropriate transducer. Optical spectrum analyzers also exist, which use direct optical techniques such as a monochromator to make measurements.

By analyzing the spectra of electrical signals, dominant frequency, power, distortion, harmonics, bandwidth, and other spectral components of a signal can be observed that are not easily detectable in time domain waveforms. These parameters are useful in the characterization of electronic devices, such as wireless transmitters.

### 2.5.2 ATK-SIM900A GSM / GPRS module:

ATK-SIM900A module is ALIENTEK the development of a high-performance industrial grade GSM / GPRS module (development board), rich interface, complete functions, especially for applications that require voice / SMS / GPRS data services in various fields, as shown by its resources show:



**Figure 2.5 : ATK-SIM900A GSM/GPRS**

ATK-SIM900A module not only look beautiful, but also functional, rich interfaces, module size (not the antenna part) is 80mm \* 58mm, and with mounting holes, very small, and conducive to install, can be easily applied to a variety of product design .



ALIENTEK ATK-SIM900A module (development board) onboard resources as follows:

GSM		module:		SIM900A	
1		RTC	backup	battery	
1		a	microphone	port	
1		a	headphone	jack	
1	x	RS232	interface	selection	
1		RS232	serial	port	
1		lithium	battery	Interface	
1		x	power	input	connector
1	x	power	LED	(blue)	
1		x	power	switch	
1		clamshell	SIM	card	
1	SMA antenna	interfaces	and supporting	small chili	antenna
1		Power	On / Off	button	
1	network	status	indicator	(red)	

▪ SIM900A modules were used for all IO port pin leads, easy to use

ATK-SIM900A module (development board) using industry-standard design, features include:

- onboard RS232 serial port (supports hardware flow control), convenient and PC / IPC and other devices;
- seat onboard 3.5mm headphone and microphone for easy voice communication development;
- SIM900A module leads all the IO ports, and communications section IO port compatibility design made for easy connection 3.3V/5V SCM system;
- efficient synchronous buck circuit board, the conversion efficiency up to 90%, support for wide voltage range (5 ~ 24V), ideal for industrial applications;
- onboard power anti-reverse protection, TVS power protection and SIM card ESD protection, the protection function;
- board RTC backup battery (XH414H-IV01E), without worrying about the power-down problem;
- peppers onboard antenna, can effectively improve the signal reception;
- adopt international A-level PCB material, immersion gold processing technology, stable and reliable;
- processed using the new components, copper plated pin, durable;
- humanized design, each interface has a screen annotation, use a glance;

connector location and reasonable arrangements designed to facilitate smoothly.

- PCB size is 80mm \* 58mm, and with mounting holes, small and exquisite;

#### 4, ATK-SIM900A GSM / GPRS module (development board) Specification

ATK-SIM900A SIMCOM module onboard the company's industrial-grade dual-band GSM / GPRS module: SIM900A, working band frequency: 900/1800Mhz, can achieve low-power voice, SMS (SMS, MMS is not supported), data, and fax messages transmission.

ATK-SIM900A and LVTTL module supports RS232 serial port, and with hardware flow control, support for 5V ~ 24V the wide scope of work, so that the module can be very convenient to connect with your product, giving your product, including voice, SMS and GPRS data transmission and other functions.

## 2.6 Liquid Crystal Display (LCD)

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD

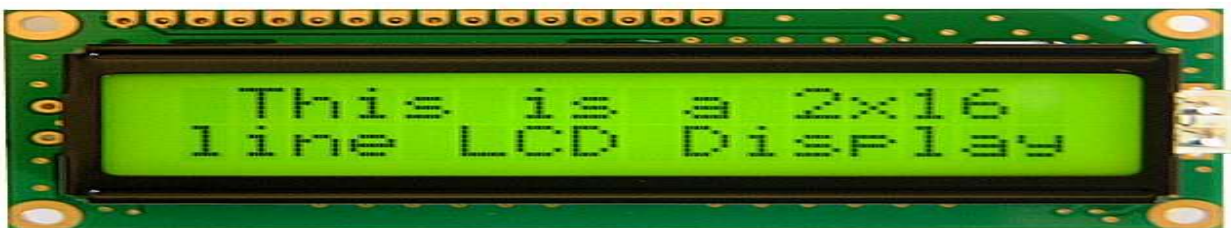


Figure 2.6: Liquid Crystal Display (LCD)



## 2.6.1 Features of LCD Display

- 5 x 8 dots with cursor
- Built-in controller (KS 0066 or Equivalent)
- + 5V power supply (Also available for + 3V)
- 1/16 duty cycle
- B/L to be driven by pin 1, pin 2 or pin 15, pin 16 or A.K (LED)
- N.V. optional for + 3V power supply

## 2.7 Schematic Diagram for Arduino and GSM module.

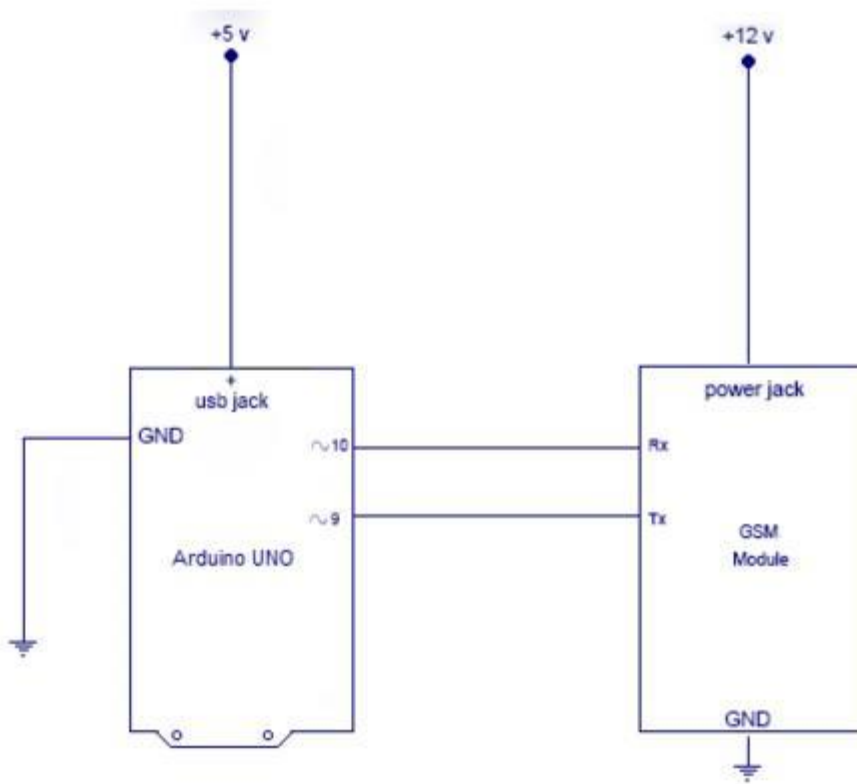


Figure 2.7 : Circuit Diagram for Arduino and GSM module.

## **Chapter 3**

### **SYSTEM DESIGN AND ANALYSIS**

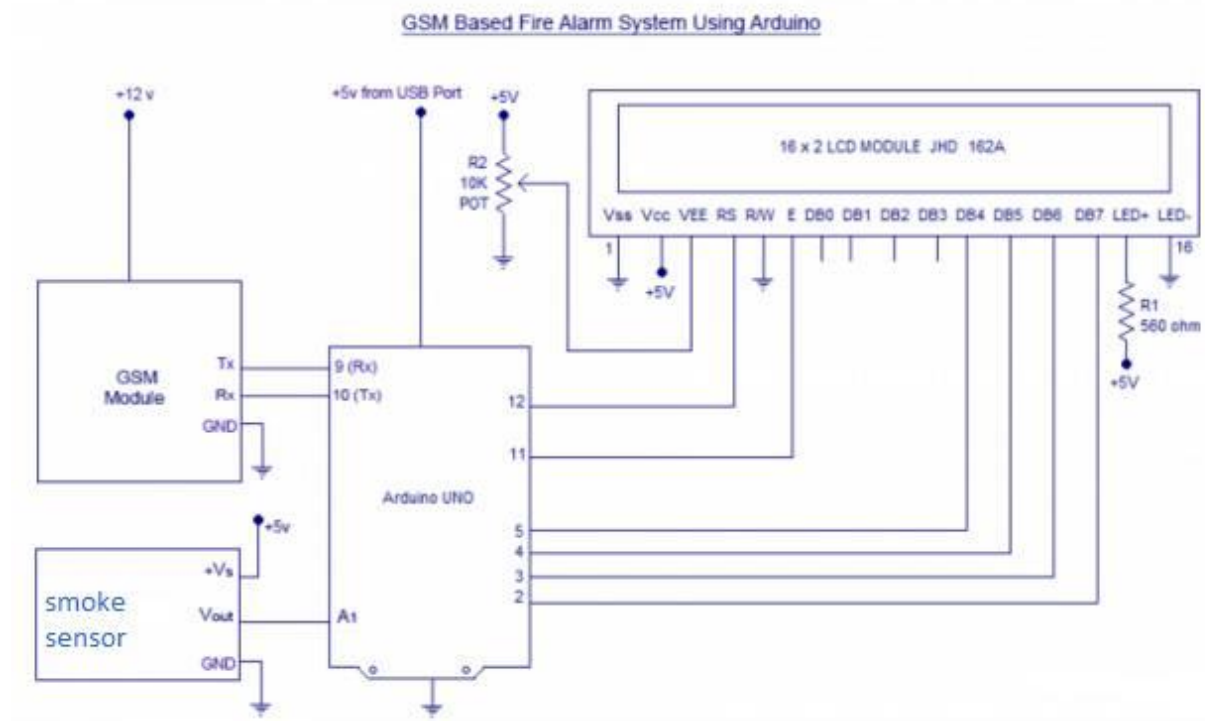
#### **3.1 Introduction**

In this project helps those people who interested to build something with Arduino. To Design a Project includes into two parts, one is hardware design and another part is software design. We use GSM module FC-22, LCD, MQ 2 smoke sensor for the hardware design and we connected these Components with microcontroller. Arduino microcontroller is more suitable for establishing a New project including robotics. Arduino software is downloaded from [www.arduino.cc](http://www.arduino.cc) and C/C++ programmable language is used. Many examples are given in the [ardiono.cc](http://ardiono.cc) and this software is easy to usage.

#### **3.2 Hardware Design**

The whole system design is divided into two parts to design a smart home appliance control system. One is the design the smart system in the breadboard and controls the designed system. Another part is the display part design to send sms . Finally, the smoke detector system is formed a complete integrated system. In this project Arduino & GSM development board is more efficient.

### 3.2.1 Full Circuit Design



**Figure 3.1 : Full Circuit Design**

Mainly we use four major components for designing a full control system. The GSM module Receiving signal from Arduino 9 and 10 port and the GSM module and alarm , LCD device connected to Arduino UNO board and the Arduino board connected with power control circuit. The output will shown by getting to send SMS in specific number.

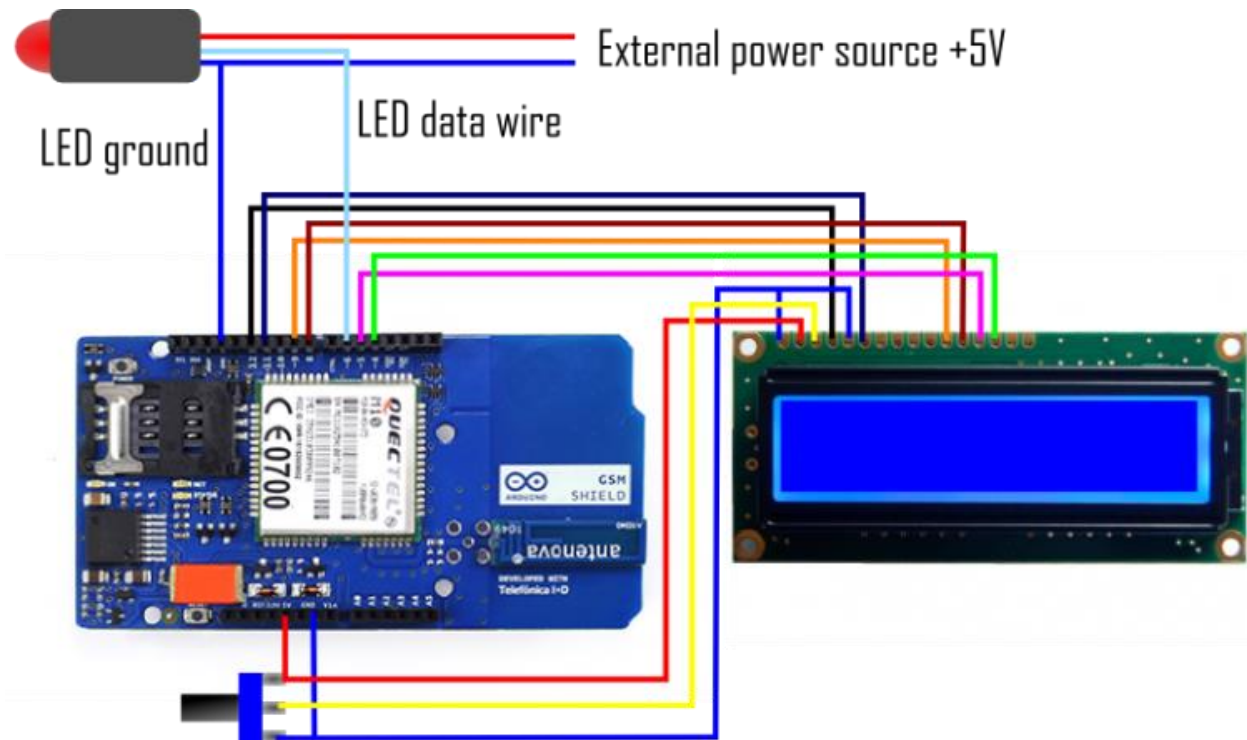
### **3.2.2 Equipments Used in this System**

To design the project we use following component:

- One Arduino Uno Board
- Two bread board
- GSM Module
- MQ -2 smoke sensor
- 16 \* 2 LCD
- USB & 12V power supply

### **3.2.3 16 x 2 LCD Display Connections with Arduino**

We use 16 x 2 LCD for making expert for this project. When we developed this we learn the basic properties of Arduino board. Here we learned that A Read/ Write (R/W) pin that selects reading mode or writing mode. The Enable pin that enables writing to the registers .The 8 data pins (D0 -D7). The states of these pins (high or low) are the bits that we writing to a register. There's also a display contrast pin (Vo), power supply pins (+5V and Ground)and LED Backlight (Bklt+ and BKlt-) pins that web use to power the LCD, control the display contrast, and turn on and off the LED backlight, respectively.



**Figure 3.2: LCD display and Arduino connection**

We connect the LCD pins with Arduino in following steps:

Pin 1 is connected to Arduino GND

Pin 2 is connected to Arduino 5V

Pin 3 is connected to wiper (this is the middle pin of the 10k potentiometer )

Pin 4 is connected to Arduino pin 12

Pin 5 is connected to Arduino GND

Pin 6 is connected to Arduino pin 11

Pin 11 is connected to Arduino pin

Pin 12 is connected to Arduino pin 4

Pin 13 is connected to Arduino pin 3

Pin 14 is connected to Arduino pin 2

Because we will only be writing, pin 5 will be dropped to ground to show that there will be no reading. For we use the backlight, connect LCD pin 16 to GND and LCD pin 15 to +4.2V. Connect one side of the potentiometer to Arduino GND, the opposite to Arduino 5v and the center to LCD pin 3. The pin 7, 8,9,10 are not used in the Arduino.

### 3.3 Software Design

Software design is divided into two parts. First we write the Arduino program in Arduino software. Then we compile it to the Arduino hardware. This Arduino command is control the Arduino hardware and other circuit connection. For making connection between Arduino and GSM module.

### 3.4 Flow chart

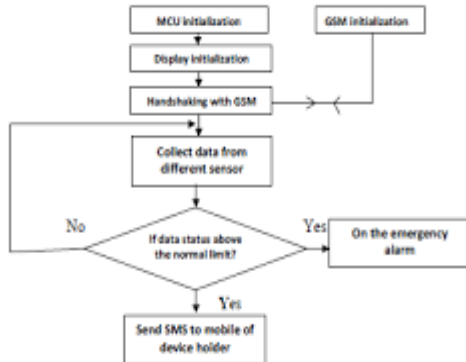


Figure 3.3: Flow chart

## Chapter 4

### IMPLEMENTATION AND RESULT

#### 4.1 Implementation

All the parts are connected as circuit design. Then we upload the programming code in the Arduino and GSM module, we get positive result. It works properly according to our design.

#### 4.2 Development of the Whole System:

Firstly we connect Arduino in bread board with LCD display alarm, implement system with detect smoke in system with smoke detector.

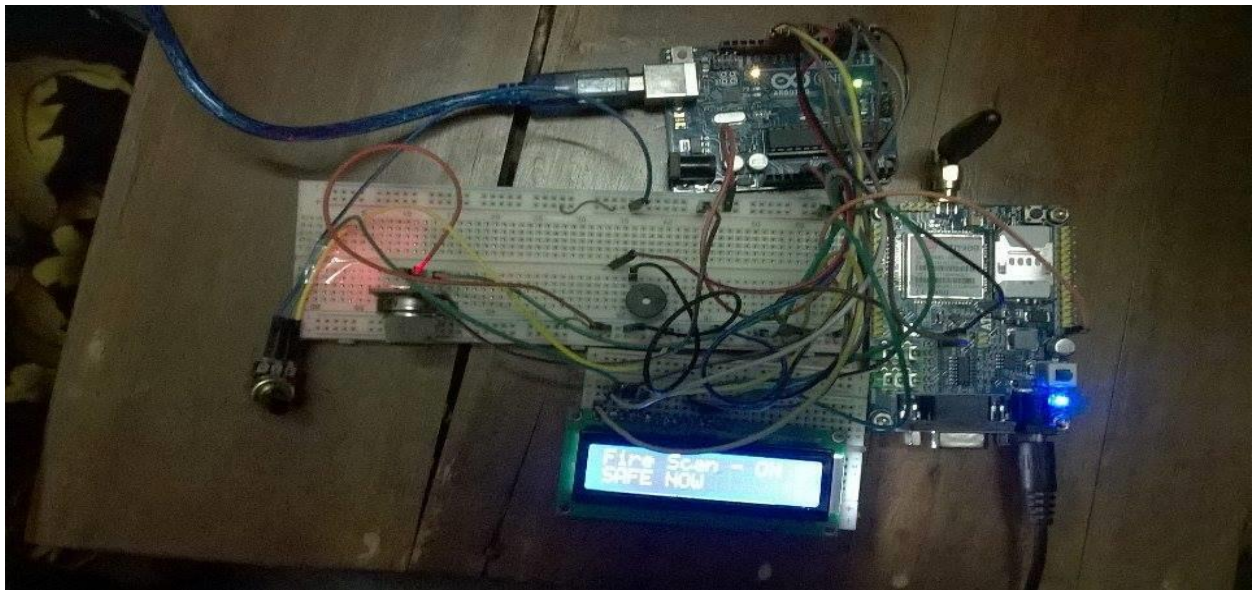
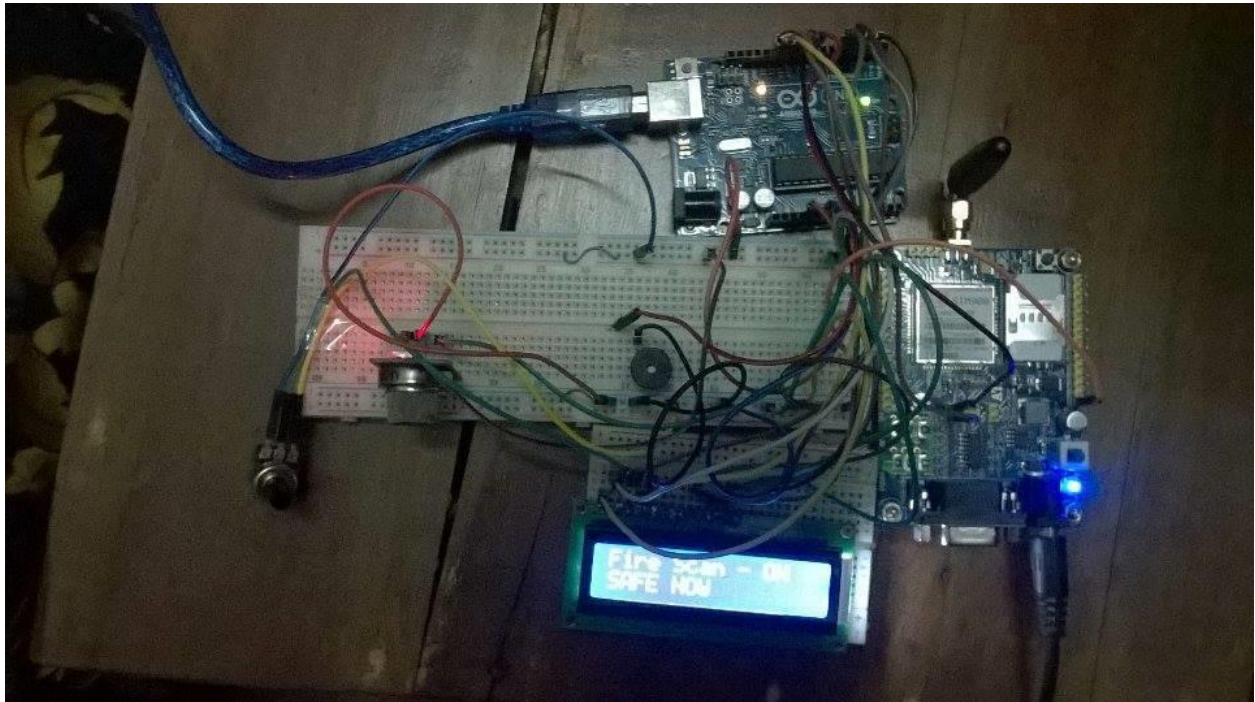


Figure 4.1 : Connecting GSM module 900 shield



In this stage we developed the main connection of this project. We said as last part about GSM 900 SIM connection of shield. We designed a connection with GSM module in code then We give connection to Arduino board from detector Then we upload a program to Arduino for this project. After all successful connection we will get output by controlling SMS . We can send sms from GSM module.



**Figure 4.2 : Connecting GSM module 900 shield With alarm**



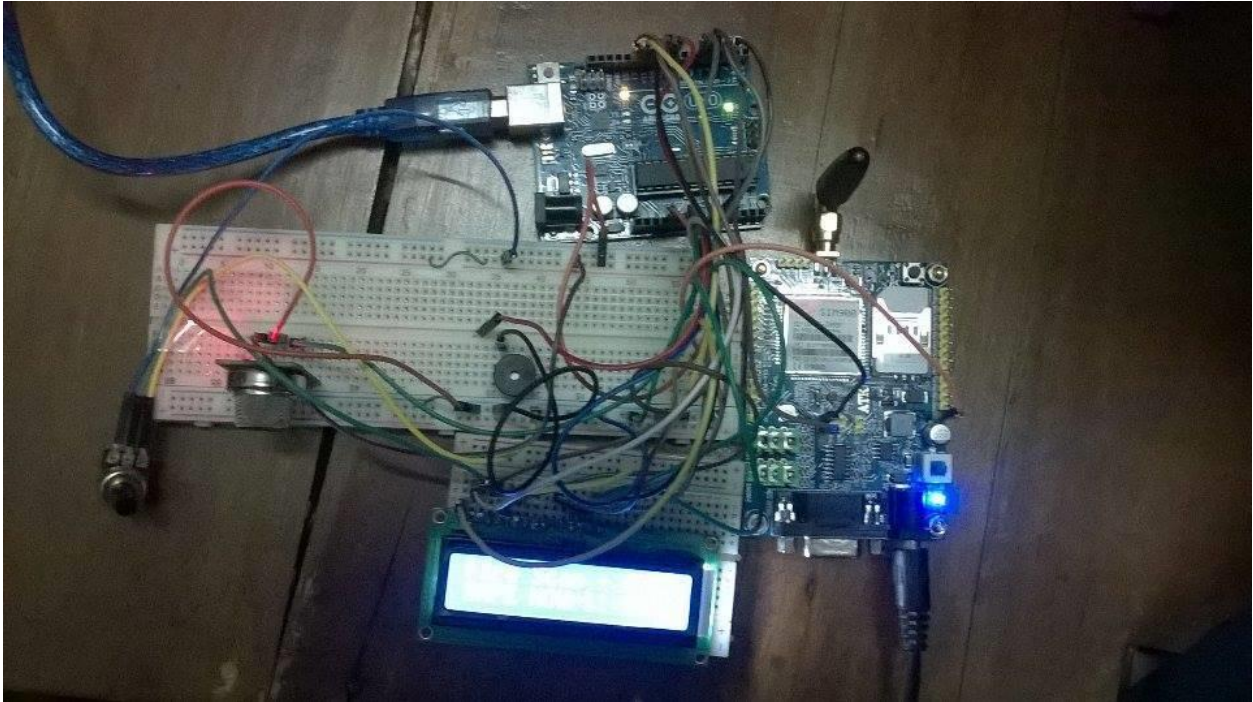


Figure 4.3 : Connecting GSM module 900 shield in sending sms.

### 4.3 Product Commercialization

After completing all the circuit and developing the control system, we connected this control system in a room and saw that it works properly. Therefore, we can say that the **Smoke detector alarm system using GSM communication** is ready for commercial uses.

## Chapter 5

### CONCLUSION

#### 5.1 Conclusion:

The **Smoke detector alarm system using GSM communication** has been designed and developed for making our life more easy and secured. We use 5V from Arduino board and use 12V DC power supply for GSM shield. We use the GSM module for receiving signal from an Arduino. Finally, we have designed and developed the whole control system and tested using Smoke detector. We fix all the problems encountered during the design and testing of the system. Finally, we successfully achieved our goals. In this study, the application of microcontroller with improved algorithm of extended specifications has increased the use of GSM shield and improves the controlling the smoke. So, our **Smoke detector alarm system using GSM communication** is suitable.

#### 5.2 Future Work Scope:

This project gives us an opportunity to do a big project in future. The applications stated above are some demo applications that are absolutely possible with its future development. Initially for the limitation of time and required fund we were able to develop just a Smoke detector alarm system. The system will also work using GSM communication. It will more efficient by using 16x2 LCD display. So, we have a big work scope in this sector. We hope that, we will be able to complete all the features needed for its ultimate applications.

## Chapter 6

### APPENDIX

#### 6.1 Programming Code for Whole System:

```
#include <SoftwareSerial.h>

#include<LiquidCrystal.h>

LiquidCrystal lcd(12, 11, 5, 4, 3, 2);

SoftwareSerial mySerial(9, 10);

int pin8 = 8;

int sensor = A1;

int sensorValue = 0, sms_count;

void setup()

{

  pinMode(sensor,INPUT);

  pinMode(pin8, OUTPUT);

  mySerial.begin(9600);
```

```
Serial.begin(9600);  
lcd.begin(16,2);  
delay(500);  
}  
  
void loop()  
  
{  
  sensorValue=analogRead(sensor);  
  Serial.println(sensorValue);  
  
  lcd.setCursor(0,0);  
  lcd.print("Fire Scan - ON");
```

```
if (sensorValue>=200)

{

  lcd.setCursor(0,1);

  lcd.print("Fire Alert! SMS Sent!");

  digitalWrite(pin8,HIGH);

  mySerial.println("AT+CMGF=1"); //To send SMS in Text Mode

  delay(2000);

  mySerial.println("AT+CMGS=\"+8801824985722\"\\r"); // change to the phone
number you using

  delay(2000);

  mySerial.println("Fire in NEW ROOM!");//the content of the message

  delay(200);

  mySerial.println((char)26);//the stopping character

  delay(5000);

  mySerial.println("AT+CMGS=\"+8801914348648\"\\r"); // change to the phone
number you using

  delay(2000);

  mySerial.println("Fire in NEW ROOM!");//the content of the message

  delay(200);

  mySerial.println((char)26);//the message stopping character
```

```
delay(5000);  
sms_count++;  
while(sms_count==3)  
mySerial.println("AT+CMGF=0"); //to stop sms  
}
```

```
else  
{  
digitalWrite(pin8,LOW);  
lcd.setCursor(0,1);  
lcd.print("SAFE NOW");  
}  
}
```

## Chapter 7

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