EED 498 (Major Project – 2)

HOME AUTOMATION SYSTEM

Project Report

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ACKNOWLEDGEMENT(S)

The satisfaction at the completion of any project would be incomplete without the mentioning of the people whose constant guidance and encouragement made it possible. We humbly present our project, which is result of a studied blend of our knowledge and work

We express our earnest gratitude to our project supervisor, Assistant Professor Dr. Atul Vir Singh, Department of ECE, our project guide, for his constant support, encouragement and guidance. We are grateful for his cooperation and his valuable suggestions. We also like to thank Dr. Madhur Deo Upadhyay and Dr. Sonal Singhal for offering their constructive feedback during the mid-semester presentation

DECLARATION

We the undersigned solemnly declare that the project report HOME AUTOMATION SYSTEM is based on our own work carried out during the course of our study under the supervision of Dr. Atul Vir Singh. We assert the statements made and conclusions drawn are an outcome of our work. We further certify that

I. The work contained in the report is original and has been done by us under the general supervision of our supervisor.

II. The work has not been submitted to any other Institution for any other degree/diploma/certificate in this university or any other University of India or abroad.

III. We have followed the guidelines provided by the university in writing the report.

IV. Whenever we have used materials (data, theoretical analysis, and text) from other sources, we have given due credit to them in the text of the report and giving their details in the references.

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Signature

(Manas Kumar Rai) **(Apurav Kaushik)**

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CHAPTER 1

1.1 Introduction

Throughout history, technology's core purpose has been to make our lives easier. As technology advances, so does the ease of use. Telephones became landlines, landlines became cell phones and cell phones became smartphones. The same applies to the way we manage electrical appliances at home. The "Home Automation" concept has existed for many years. The terms "Smart Home", "Intelligent Home" followed and has been used to introduce the concept of networking appliances and devices in the house. A Home Automation System includes centralized control of lighting, appliances, security locks of gates and doors and other systems, to provide improved comfort, energy efficiency and security system.

Android Smartphone became the top operating system in the market in the present time worldwide and it has become the most popular operating system on smart phones known to man. Home automation was possible with the help of this small device. The fast development of remote correspondence inspired us to utilize cell phones to remotely control a household appliance. Over the years there have been many iterations of the Home Automation System, each of them using different technologies to achieve their primary purpose, that being of controlling household appliances. So far, the most popular versions of these have been Bluetooth, Internet of Things and GSM.

1.2 Motivation

One of technology's front goals is accessibility, a chance for people from all walks of life to get equal opportunities affordable to all. With the outburst in popularity of affordable smartphones, we have now reached a point in our lives where the idea of a sustainable Home Automation System seems like an attainable goal. The demographic can also include people with disabilities who no longer need to worry about taking care of a switch and instead, all they need to do is speak their command and the system will follow.

In a country such as India, this could be the first step in building a truly technologically advanced nation that doesn't need to rely on luxurious resources to be ahead of the game.

1.3 Basic Concepts

Bluetooth:

Bluetooth is a wireless technology standard for exchanging data over short distances using short-wavelength UHF radio waves in the ISM band, industrial scientific and medical radio bands from 2.400 to 2.485 GHz from fixed and mobile devices

Sensors:

A sensor is a device, module, or subsystem whose purpose is to detect events or changes in its environment and send the information to other electronics, frequently a computer processor

Microcontroller:

A microcontroller is a compact integrated circuit designed to govern a specific operation in an embedded system. A typical microcontroller includes a processor, memory and input/output (I/O) peripherals on a single chip. For this project we have used the Arduino Uno Microcontroller

GSM:

GSM (Global System for Mobile communications) is a standard developed by the European Telecommunications Standards Institute (ETSI) to describe the protocols for second-generation (2G) digital cellular networks used by mobile devices such as mobile phones and tablets. It was first deployed in Finland in December 1991. As of 2014, it has become the global standard for mobile communications – with over 90% market share, operating in over 193 countries and territories.

Relay:

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal

CHAPTER 2

2.1 Literature Review:

IEEE Papers

1. Kyung Chang Lee, Associate Member, IEEE, Hong-Hee Lee, "Network-based Fire-Detection System via Controller Area Network for Smart Home Automation", IEEE Transactions on Consumer Electronics, Vol. 50, No. 4, NOVEMBER 2004

   This paper presents a network-based fire detection system via the controller area network (CAN) to evaluate the feasibility of using such a home automation protocol in a smart home

2. R.Piyare, M.Tazil , "Bluetooth based Home Automation System using Cell Phone", 2011 IEEE 15th International Symposium on Consumer Electronics

   This paper presents the design and implementation of a low cost but yet flexible and secure cell phone based home automation system using Bluetooth

3. Muhammad Asadullah, Ahsan Raza, "An Overview of Home Automation Systems", 2016 2nd International Conference on Robotics and Artificial Intelligence (ICRAI)

   In this paper an overview of current and emerging home automation systems is discussed, it goes in detail about the different kinds of home automation systems there are and discusses the advantages and disadvantages of each

4. Rajeev Piyare, "Internet of Things: Ubiquitous Home Control and Monitoring System using Android based Smart Phone", International Journal of Internet of Things 2013

   This paper presents a low cost and flexible home control and monitoring system using an embedded micro-web server, with IP connectivity for accessing and controlling devices and appliances remotely using Android based Smart phone app

CHAPTER 3

3.1 Initial Work Done

- Our job was to go through different iterations of the "Home Automation System", with different papers presenting unique ideas and versions of the same and condensing it down to the few papers that seemed most helpful to us
- To implement a Bluetooth Based Home Automation System, we implemented the following block diagram and circuit

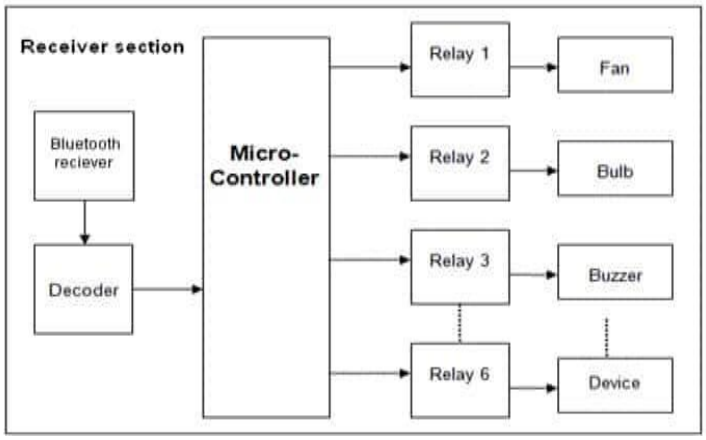
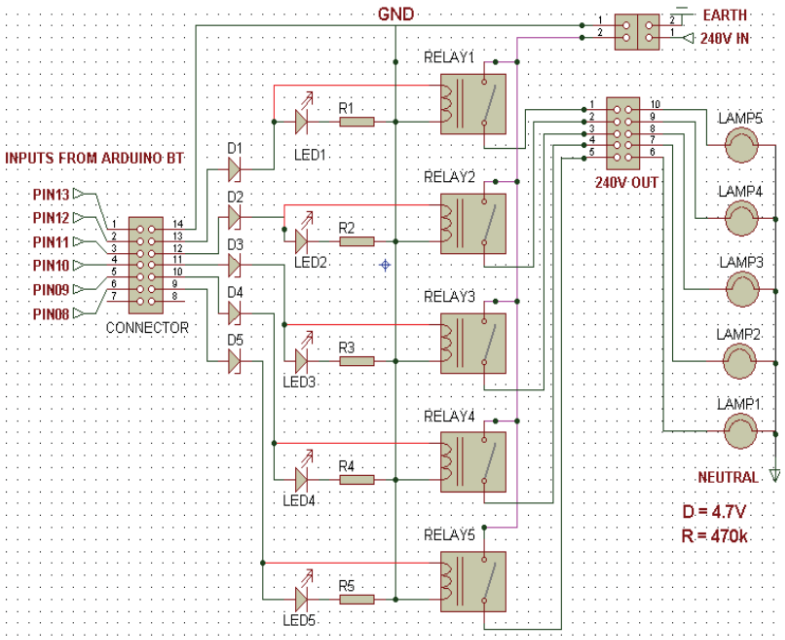


Figure 1 Block Diagram of Bluetooth Based Home Automation System [2]



5V-240V switching circuitry

Figure 2 Circuit Diagram Implemented [2]

Hardware Used:

- Arduino UNO Microcontroller
- Bluetooth HC-05 Module
- Bulb (100W)
- REES52 5V 4 Channel Relay
- Jumper Wires (Male to Male and Male to Female)

Software Used:

- Arduino IDE

The circuit was implemented successfully along with the Arduino IDE program. The program was verified and compiled with no errors. Once this was completed, the two other goals to achieve were implementing voice recognition and a smoke detector system within a single home automation system.

3.2 Proposed System

This wireless Arduino based system includes controlling of home appliances like light, fan, smoke sensing, etc. This project proposes remotely controlling of home appliances with security of home. The project is composed of:

1. Controlling of appliances, which will be controlled with Android phone through Bluetooth communication using Bluetooth module. This is used inside the house only.
2. Gas sensor MQ-2 will sense risky gas and smoke and will send an alert message to the user's phone. This will be done via the GSM Module
3. All appliances can also be controlled by Voice Application and Android Application through Android mobile phone.

CHAPTER 4

4.1 Major Hardware, Software and Circuit Requirements

4.1.1 Arduino UNO:

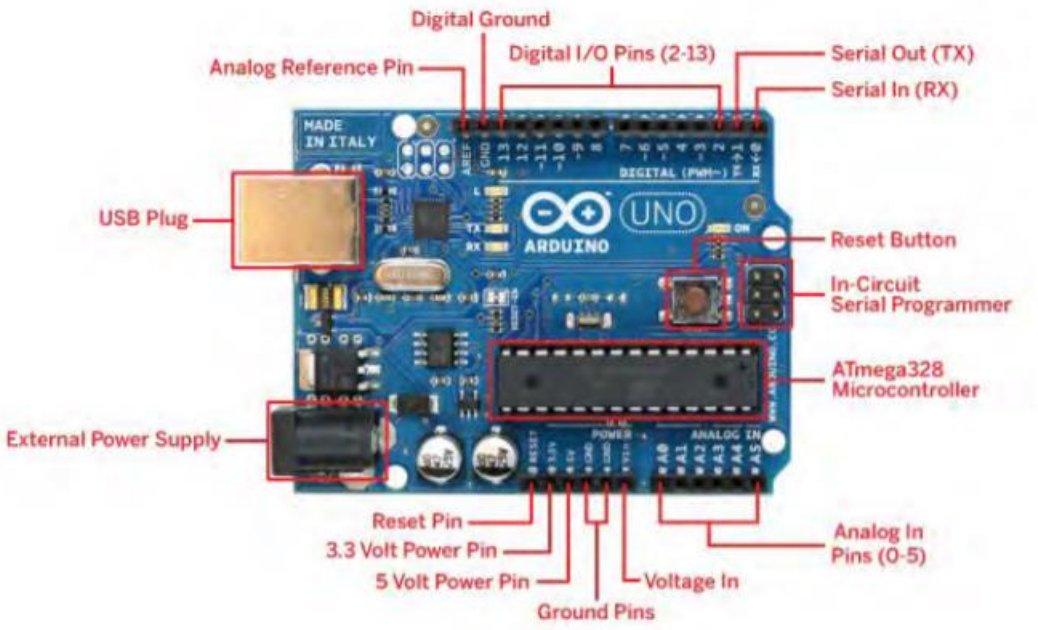


Figure 3 Arduino UNO R3 with pinouts

Arduino is an open source computer hardware and software company, project, and user community that designs and manufactures single-board microcontrollers and microcontroller kits. Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards or Breadboards and other circuits.

Features of the Arduino UNO:

Microcontroller: ATmega328

Operating Voltage: 5V

Input Voltage (recommended): 7-12V

Input Voltage (limits): 6-20V

Digital I/O Pins: 14 (of which 6 provide PWM output)

Analog Input Pins: 6

DC Current per I/O Pin: 40 mA

DC Current for 3.3V Pin: 50 mA

Flash Memory: 32 KB of which 0.5 KB used by bootloader

SRAM: 2 KB (ATmega328)

EEPROM: 1 KB (ATmega328)

Clock Speed: 16 MHz

4.1.2 Bluetooth HC-05 Module

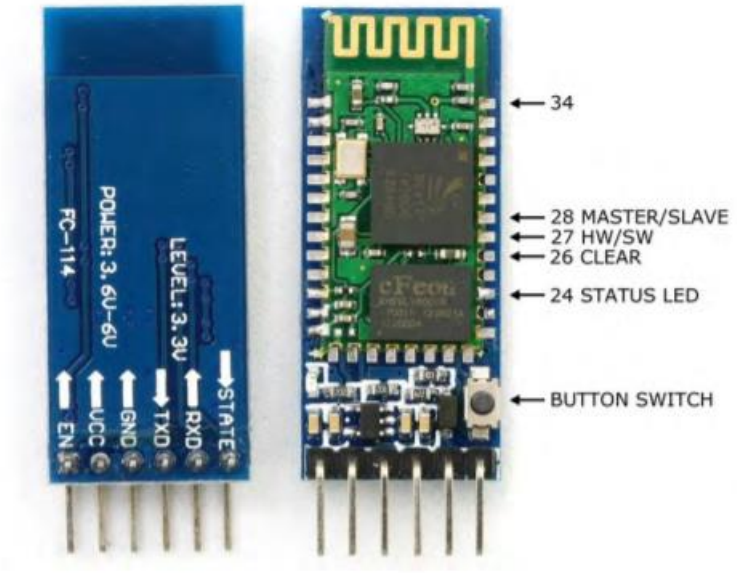


Figure 4 Bluetooth Module HC-05 with pin configurations

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module designed for transparent wireless serial connection setup. The HC-05 Bluetooth Module can be used in a Master or Slave configuration, making it a great solution for wireless communication. This serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3 Mbps Modulation with complete 2.4GHz radio transceiver and baseband.

HC-05 Specifications:

Bluetooth protocol: Bluetooth Specification v2.0+EDR

Frequency: 2.4GHz ISM band

Modulation: GFSK (Gaussian Frequency Shift Keying)

Emission power: ≤ 4dBm, Class 2

Sensitivity: ≤ -84dBm at 0.1% BER

Speed: Asynchronous: 2.1 Mbps (Max) / 160 kbps, Synchronous: 1Mbps/1Mbps

Security: Authentication and encryption

Profiles: Bluetooth serial port

Power supply: +3.3V DC 50mA

Working temperature: -20 ~ +75 Centigrade

Dimension: 26.9mm x 13mm x 2.2 mm

Pin Description:-

The HC-05 Bluetooth Module has 6 pins. They are as follows:

ENABLE:

When enable is pulled LOW, the module is disabled which means the module will not turn on and it fails to communicate. When enable is left open or connected to 3.3V, the module is enabled i.e the module remains on and communication also takes place.

Vcc:

Supply Voltage 3.3V to 5V

GND:

Ground pin

TXD & RXD:

These two pins acts as an UART interface for communication

STATE:

It acts as a status indicator. When the module is not connected to pair with any other Bluetooth device, signal goes Low. At this low state, the led flashes continuously which denotes that the module is not paired with other device.

When this module is connected to/paired with any other Bluetooth device, the signal goes high. At this high state, the led blinks with a constant delay say for example 2s delay which indicates that the module is paired.

HC-05 Default Settings:-

Default Bluetooth Name: HC-05

Default Password: 1234 or 0000

Default Communication: Slave

Default Mode: Data Mode

Data Mode Baud Rate: 9600, 8, N, 1

Command Mode Baud Rate: 38400, 8, N, 1

Default firmware: LINVOR

4.1.3 REES 52 5V 4 Channel Relay

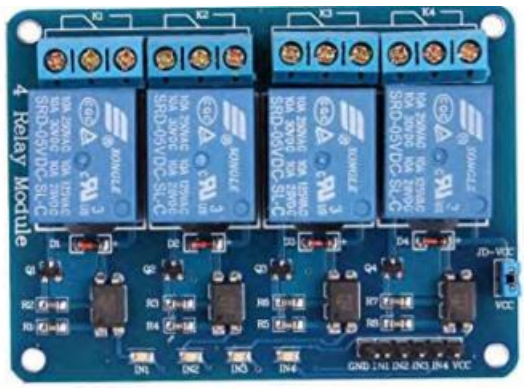


Figure 5 A 5V 4 Channel Relay Module

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits as amplifiers: they repeated the signal coming in from one circuit and re-transmitted it on another circuit.

Relays were used extensively in telephone exchanges and early computers to perform logical operations.

In this project, we use a 5V 4-channel relay interface board, and each channel needs a 15-20mA driver current. It can be used to control various appliances and equipment with large current. It is equipped with high-current relays that work under AC 250V 10A or DC 30V 10A. It has a standard interface that can be controlled directly by microcontroller.

From the picture below, you can see that when the signal port is at low level, the signal light will light up and the opto-coupler 817c (it transforms electrical signals by light and can isolate input and output electrical signals) will conduct, and then the transistor will conduct, the relay coil will be electrified, and the normally open contact of the relay will be closed. When the signal port is at high level, the normally closed contact of the relay will be closed. So you can connect and disconnect the load by controlling the level of the control signal port.

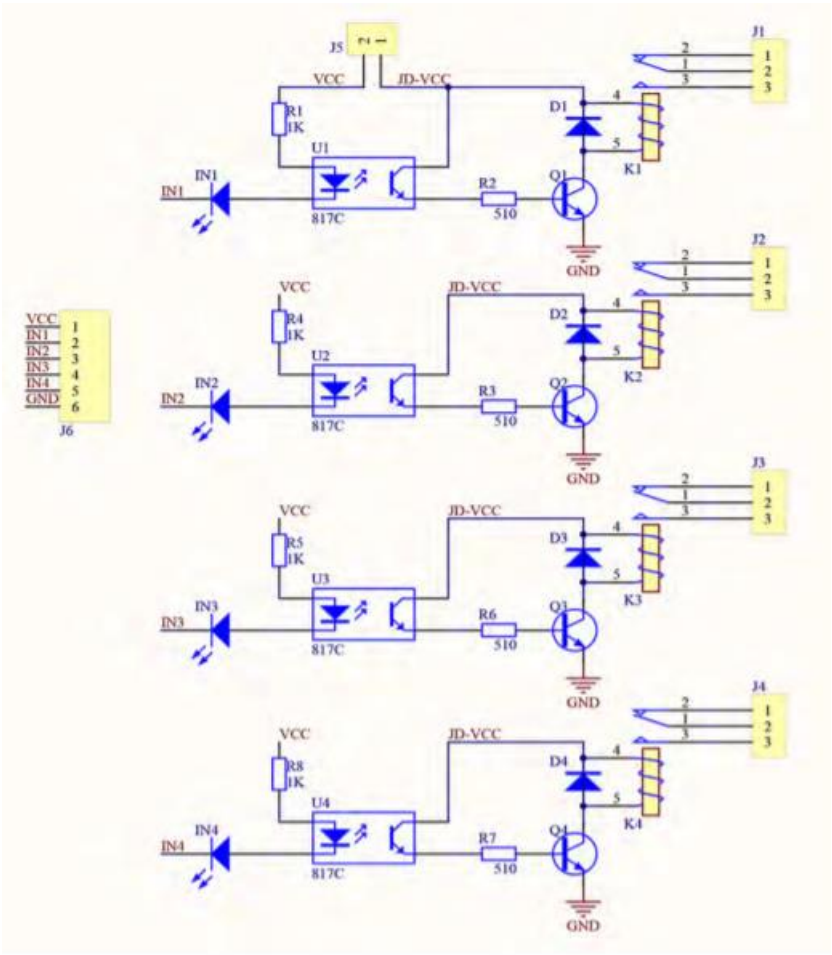


Figure 6 Schematic of 4-Channel Relay module

Pin Description:

Input:

VCC: Positive supply voltage

GND: Ground

IN1--IN4: Relay control port

Output:

Connect a load, DC 30V/10A，AC 250V/10A

Features：

- Size: 75mm (Length) * 55mm (Width) * 19.3mm (Height)
- Weight: 61g
- PCB Colour: Blue
- There are four fixed screw holes at each corner of the board, easy for install and fix. The diameter of the hole is 3.1mm
- A common terminal, a normally open terminal, and a normally closed terminal
- Optical coupling isolation, good anti-interference.
- Closed at low level with indicator on, released at high level with indicator off
- VCC is system power source, and JD_VCC is relay power source.
- The maximum output of the relay: DC 30V/10A, AC 250V/10A

4.1.4 GSM Module SIM 900A

Figure 7: GSM SIM900A

It is a breakout board with minimum system of SIM900A Dual-band GSM/GPRS module. It can communicate with controllers via AT commands.

Features:

a) Quad-Band 850/ 900/ 1800/ 1900 MHz
b) Dual-Band 900/ 1900 MHz
c) GPRS multi-slot class 10/8GPRS mobile station class B
d) Compliant to GSM phase 2/2+Class 4 (2 W @850/ 900 MHz)
e) Class 1 (1 W @ 1800/1900MHz)
f) Control via AT commands (GSM 07.07, 07.05 and SIMCOM enhanced AT Commands)
g) Low power consumption: 1.5mA (sleep mode)
h) Operation temperature: -40°C to +85 °C

Electrical Characteristics: Maximum power supply can be given 5.5V. Its consumption is 2000mA for pulse and 500mA for continuous current. Highest baud rate is 115200 bps.

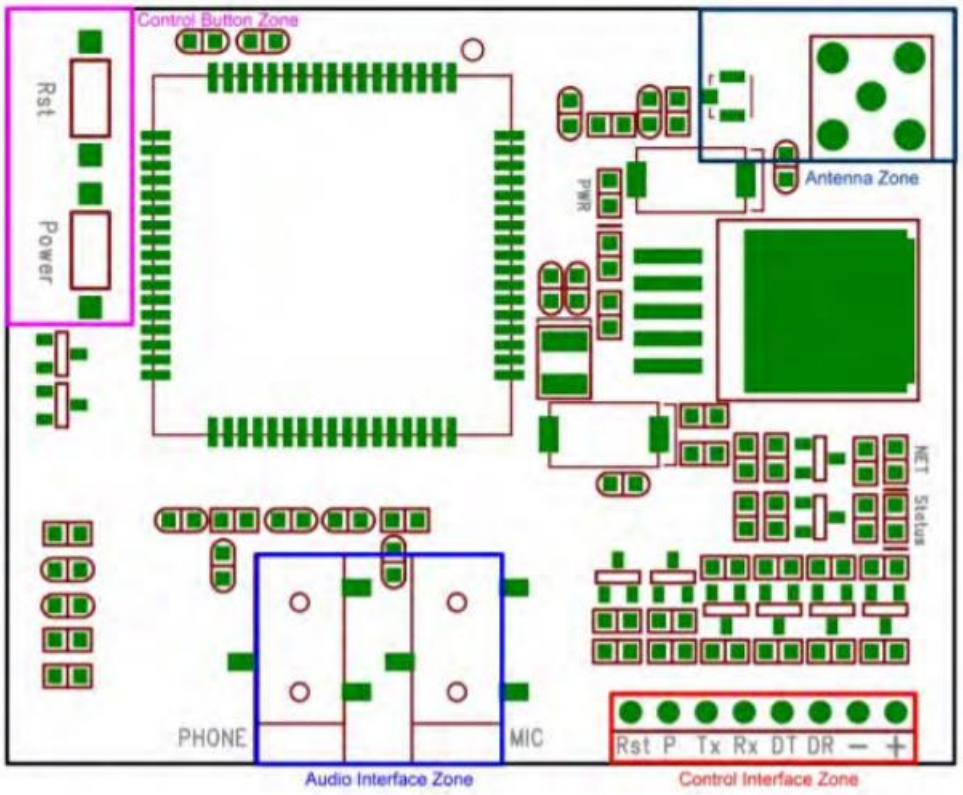


Figure 8 Hardware of GSM SIM900A (top view)

The GSM plays a very important role wireless communication. It has to follow different protocols to perform secure wireless communication. They are:

a) Specifications for data: Maximum 85.6 Kbps with GPRS class 10. USSD and PPP stack specified. Coding scheme CS 1,2,3,4
b) Specifications for SMS: Point-to-point MO and MT, SMS cell broadcast, text and PDU mode.
c) Software Features: 0710 MUX protocol with embedded TCP/UDP protocol and FTP/HTTP

4.1.5 MQ-2 Gas Sensor

Figure 9 MQ-2 Gas Sensor

The MQ – 2 Gas Sensor module is useful for gas leakage detection (home and industry). It is suitable for detecting H2, LPG, CH4, CO, Alcohol, Smoke or Propane. Due to its high sensitivity and fast response time, measurement can be taken as soon as possible. The sensitivity of the sensor can be adjusted by potentiometer.

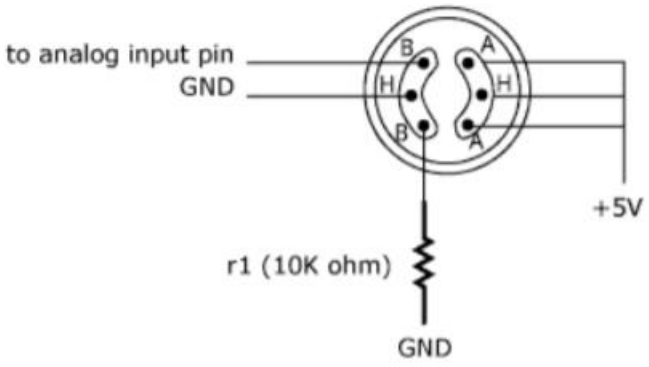


Figure 10 Pinout diagram of gas sensor

This device works in 5V power supply in both AC and DC supply. It works well in room temperature. This also has an adjustable load resistor. Detecting range: The gas detecting ranges are –

(a) 20ppm-2000ppm carbon monoxide

(b) 500ppm-10000ppm CH4

(c) 500ppm-10000ppm LPG

Specification:

Item	Parameter	Min	Typical	Max	Unit
VCC	Working Voltage	4.9	5	5.1	V
PH	Heating consumption	0.5	-	800	mW
RL	Load resistance		adjustable		
RH	Heater resistance	-	33	-	Ω
Rs	Sensing Resistance	3	-	30	kΩ

4.1.6 LED's

Figure 11 LED Schematic symbol

A light-emitting diode (LED) is a semiconductor light source. LEDs are used as indicator lamps in many devices, and are increasingly used for lighting. When a light-emitting diode is forward biased (switched on), electrons are able to recombine with holes within the device, releasing energy in the form of photons. This effect is called electroluminescence and the colour of the light (corresponding to the energy of the photon) is determined by the energy gap of the semiconductor. An LED is often small in area, and integrated optical components may be used to shape its radiation pattern. LEDs present many advantages over incandescent light sources including lower energy consumption, longer lifetime, improved robustness, smaller size, faster switching, and greater durability and reliability.

LEDs are monochromatic (one colour) devices. The colour is determined by the band gap of the semiconductor used to make them. Red, green, yellow and blue LEDs are fairly common. White light contains all colours and cannot be directly created by a single LED.

In our proposed system, the LED's are used to indicate when the sensor threshold value has been exceeded. When LED switches to RED, it implies that the sensor threshold value has exceeded, if LED is GREEN, it implies that the Sensor value hasn't exceeded the given threshold value

4.1.7 Arduino IDE

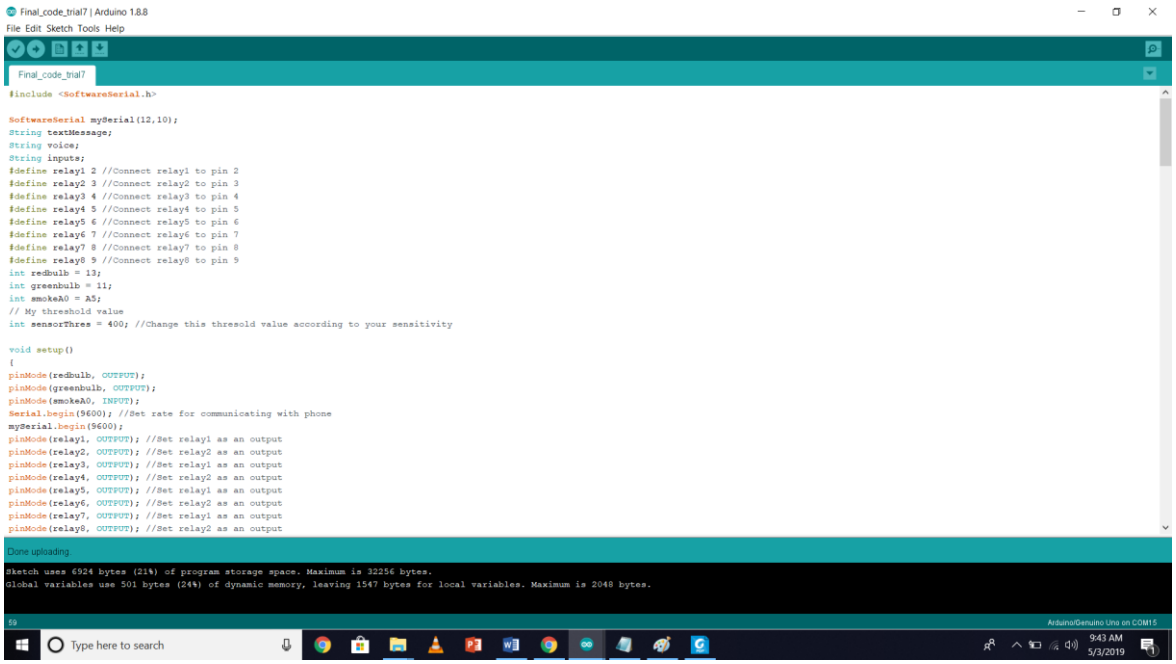


Figure 12 Arduino IDE Sketch

The Arduino integrated development environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in the programming language Java. It originated from the IDE for the languages *Processing* and *Wiring*. It includes a code editor with features such as text cutting and pasting, searching and replacing text, automatic indenting, brace matching, and syntax highlighting, and provides simple *one-click* mechanisms to compile and upload programs to an Arduino board.

The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures.

4.1.8 Smartphone

Figure 13 Smartphone Used in Project

Smartphones are a class of mobile phones and of multi-purpose mobile computing devices. They are distinguished from feature phones by their stronger hardware capabilities and extensive mobile operating systems, which facilitate wider software, internet (including web browsing over mobile broadband), and multimedia functionality (including music, video, cameras, and gaming), alongside core phone functions such as voice calls and text messaging. Smartphones typically include various sensors that can be leveraged by their software, such as a magnetometer, proximity sensors, barometer, gyroscope and accelerometer, and support wireless communications protocols such as Bluetooth, Wi-Fi and satellite navigation. For our project, we use the RealMe 1 Smart Phone for remote control of appliances

4.1.9 Other Circuit Requirements

i. 12V 1A Adapter – To power up the GSM Module
ii. Jumper Wires (Male to Male and Male to Female)
iii. Bulbs (50W & 7W)

Figure 15 Bulb

Figure 14 12V 1A Adapter

Figure 17 Jumper Wires

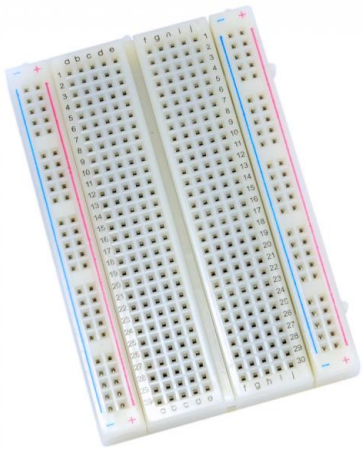


Figure 16 Breadboard

CHAPTER 5

5.1 Circuit Block Diagram & Connections

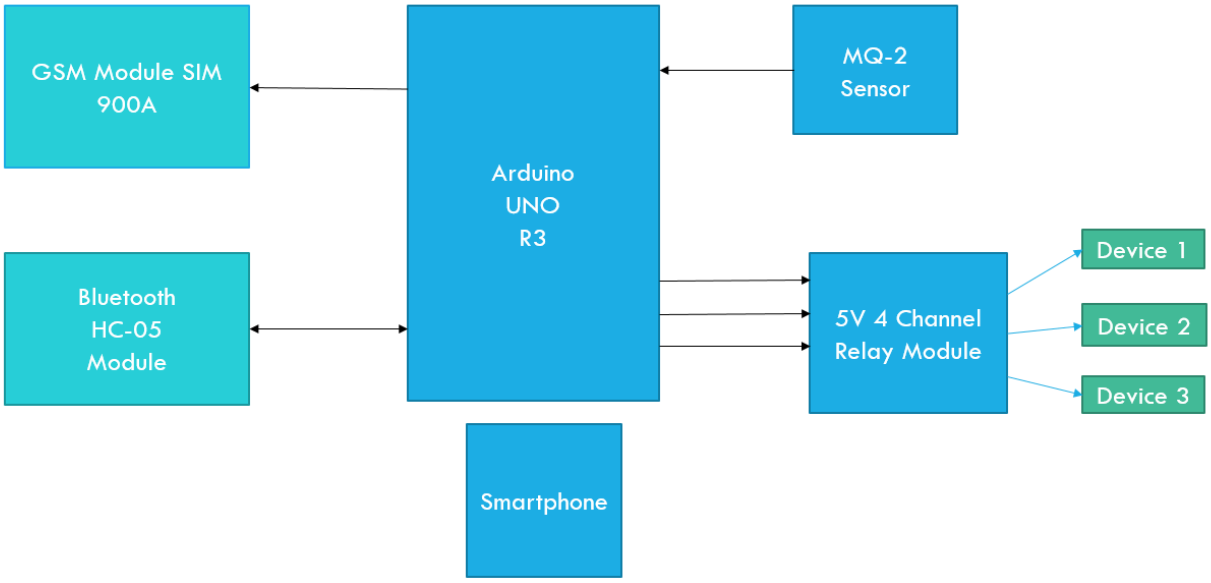


Figure 18 Block Diagram of Proposed System

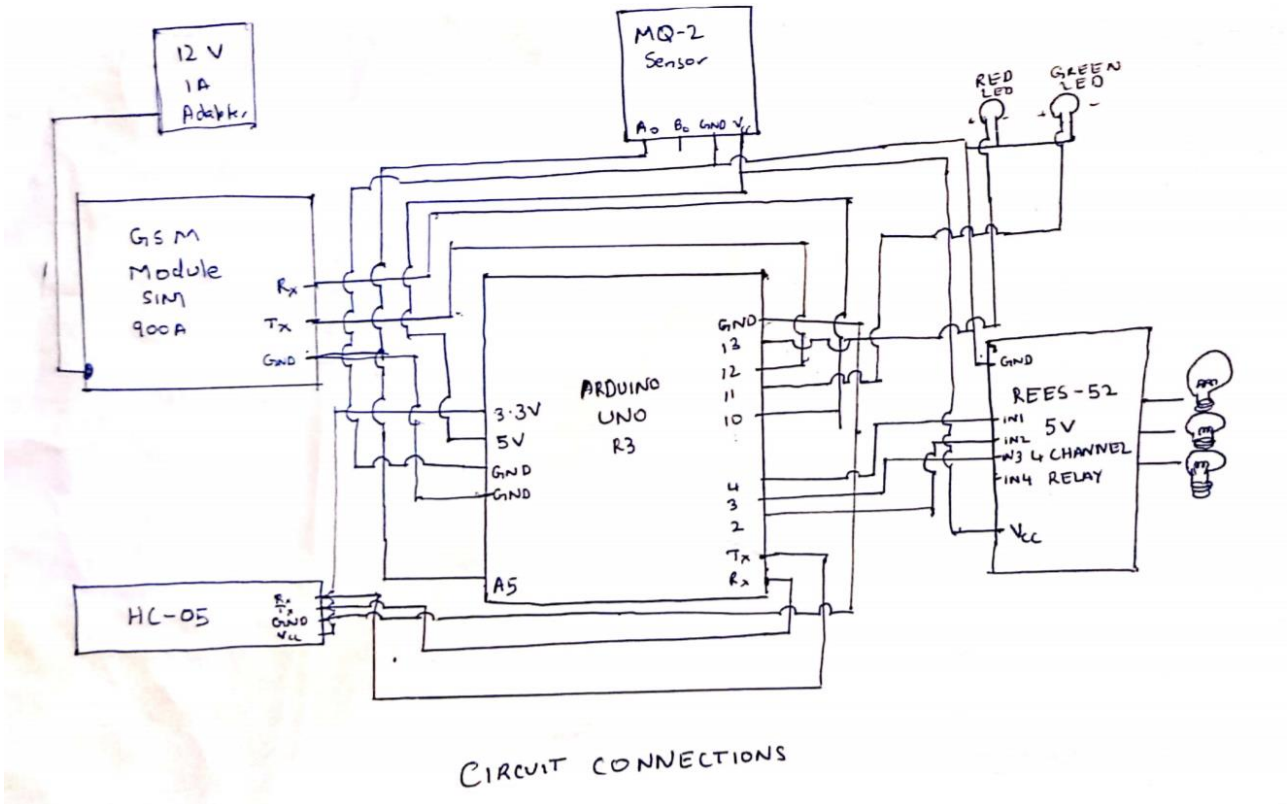


Figure 19 Circuit Connections made for proposed system

5.2 Working

5.2.1 Code

```
#include <SoftwareSerial.h>
SoftwareSerial mySerial(12,10); // Rx and Tx Pin for GSM Module
String voice;
String inputs;
#define relay1 2 //Connect relay1 to pin 2
#define relay2 3 //Connect relay2 to pin 3
#define relay3 4 //Connect relay3 to pin 4
#define relay4 5 //Connect relay4 to pin 5
#define relay5 6 //Connect relay5 to pin 6
#define relay6 7 //Connect relay6 to pin 7
#define relay7 8 //Connect relay7 to pin 8
#define relay8 9 //Connect relay8 to pin 9
int redbulb = 13;
int greenbulb = 11;
int smokeA0 = A5;
// My threshold value
int sensorThres = 400; //Change this thresold value according to your sensitivity

void setup()
{
pinMode(redbulb, OUTPUT);
pinMode(greenbulb, OUTPUT);
pinMode(smokeA0, INPUT);
Serial.begin(9600); //Set rate for communicating with phone
mySerial.begin(9600);
pinMode(relay1, OUTPUT); //Set relay1 as an output
pinMode(relay2, OUTPUT); //Set relay2 as an output
pinMode(relay3, OUTPUT); //Set relay1 as an output
pinMode(relay4, OUTPUT); //Set relay2 as an output
```

```
pinMode(relay5, OUTPUT); //Set relay1 as an output
pinMode(relay6, OUTPUT); //Set relay2 as an output
pinMode(relay7, OUTPUT); //Set relay1 as an output
pinMode(relay8, OUTPUT); //Set relay2 as an output
digitalWrite(relay1, LOW); //Switch relay1 off
digitalWrite(relay2, LOW); //Swtich relay2 off
digitalWrite(relay3, LOW); //Switch relay1 off
digitalWrite(relay4, LOW); //Swtich relay2 off
digitalWrite(relay5, LOW); //Switch relay1 off
digitalWrite(relay6, LOW); //Swtich relay2 off
digitalWrite(relay7, LOW); //Switch relay1 off
digitalWrite(relay8, LOW); //Swtich relay2 off
delay(100);
}
void loop()
{
int analogSensor = analogRead(smokeA0);
while(Serial.available()) //Check if there are available bytes to read
{
delay(10); //Delay to make it stable
char c = Serial.read(); //Conduct a serial read
if (c == '#'){
break; //Stop the loop once # is detected after a word
}
inputs += c; //Means inputs = inputs + c
voice += c;
}

if (inputs.length() >0)
{
Serial.println(inputs);
```

```
if(inputs == "A")
{
digitalWrite(relay1, LOW);
}
else if(inputs == "a")
{
digitalWrite(relay1, HIGH);
}
else if(inputs == "B")
{
digitalWrite(relay2, LOW);
}
else if(inputs == "b")
{
digitalWrite(relay2, HIGH);
}
else if(inputs == "C")
{
digitalWrite(relay3, LOW);
}
else if(inputs == "c")
{
digitalWrite(relay3, HIGH);
}
else if(inputs == "D")
{
digitalWrite(relay4, LOW);
}
else if(inputs == "d")
{
digitalWrite(relay4, HIGH);
}
```

```
else if(inputs == "E")
{
digitalWrite(relay5, LOW);
}
else if(inputs == "e")
{
digitalWrite(relay5, HIGH);
}
else if(inputs == "F")
{
digitalWrite(relay6, LOW);
}
else if(inputs == "f")
{
digitalWrite(relay6, HIGH);
}
else if(inputs == "G")
{
digitalWrite(relay7, LOW);
}
else if(inputs == "g")
{
digitalWrite(relay7, HIGH);
}
else if(inputs == "H")
{
digitalWrite(relay8, LOW);
}
else if(inputs == "h")
{
digitalWrite(relay8, HIGH);
}
```

```
inputs="";
}

else if (voice.length() >0)
   {
    Serial.println(voice);
    if(voice == "*switch on")
    {
     switchon();
    }            //Initiate function switchon if voice is switch on
    else if(voice == "*switch off")
    {
     switchoff();
    }            //Initiate function switchoff if voice is switch off
    else if(voice == "*light on")
    {
//You can replace 'light on' with anything you want...same applies to others
     digitalWrite(relay1, HIGH);
    }
    else if(voice == "*light off")
    {
     digitalWrite(relay1, LOW);
    }
     else if(voice == "*fan open")
    {
     digitalWrite(relay2, HIGH);
    }
    else if(voice == "*fan close")
    {
     digitalWrite(relay2, LOW);
    }
    voice="";
```

```
    }


else if (analogSensor > sensorThres) // When set Threshold value is exceeded
    {
      Serial.println(analogSensor);
      digitalWrite(redbulb, HIGH);
      digitalWrite(greenbulb, LOW);
      mySerial.println("AT+CMGF=1");    //Sets the GSM Module in Text Mode
      delay(1000);  // Delay of 1 second
      mySerial.println("AT+CMGS=\"+919354386120\"\r"); // Replace x with mobile number
      delay(1000);
      mySerial.println("Fire in the house");// The SMS text you want to send
      delay(100);
      mySerial.println((char)26);// ASCII code of CTRL+Z for saying the end of sms to  the
module
      delay(1000);
    }
      else
    {
      digitalWrite(redbulb, LOW);
      digitalWrite(greenbulb, HIGH);
    }
delay (50);
}
void switchon()              //Function for turning on relays
{
  digitalWrite(relay1, HIGH);
  digitalWrite(relay2, HIGH);
}
```

```
void switchoff()            //Function for turning off relays
{
  digitalWrite(relay1, LOW);
  digitalWrite(relay2, LOW);
}
```

5.2.2 Circuit implementation and working

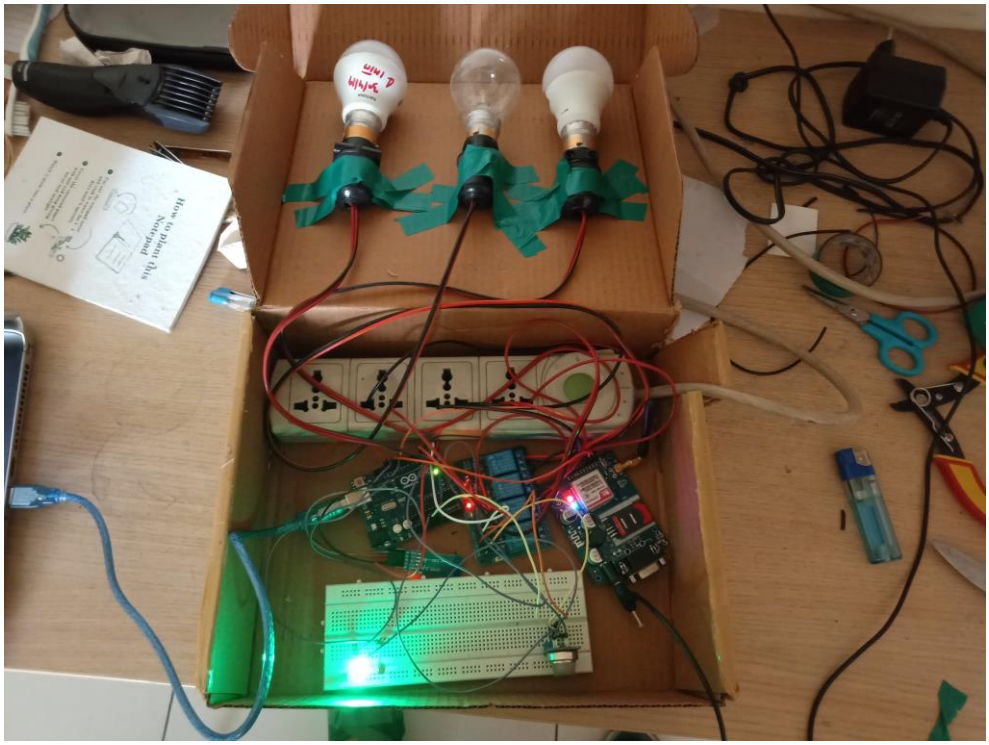


Figure 20 Implemented Circuit

According to the proposed system, we have designed the system structure shown in the block diagram. We have designed the model in such a way that it can be kept at a safe place inside the house. All programming and components installation are done and tested inside the laboratory and in home. There are a lot of components and wires that we have used for the system. This is done in the easiest and lowest cost possible. However, the system is flexible and can be customized by the user. Changing one of the components setup has to be compatible with the right software available. Every components used in this system was programmed and tested separately for safety measures and matching with the right driver. Each component was programmed

separately with Arduino UNO using Arduino IDE. Later on all were combined in a single Arduino IDE sketch. It is not possible to run the system without the Wi-Fi and computer. All sensors are connected with the microcontroller through wires. All input voltages are applied from the microcontroller with the computer with the exception of the GSM Module, which is connected to a 12 V 1A adapter.

Before working with the GSM, we have to check the following conditions:

a) Insert SIM: Placing the SIM card in the card holder marked in the figure. Make sure there is balance in the SIM card. Connect the antenna: We fix the RF antenna to the SMA antenna connector and tighten it by rotating the nut.
b) Connect the pins: We connect the pins according to our schematic diagram.
c) Power the GSM Module: We power the module with suitable power supply (>1A). We have used an adapter for the power supply.
d) Check the status of LED: once it slows down blinking, indicating that the GSM Module has recognized the network

Bluetooth module plays a very important role in interfacing the home appliances with the Android phone but it has only four pins for connection. Pin connections are given below:

Arduino Pins	**Bluetooth Pins**
RX (PIN 0)	TX
TX (PIN 1)	RX
5V	VCC
GND	GND

Once the program is uploaded to the Microcontroller, and all modules are successfully interfaced with the Arduino, we can control appliances remotely, through voice and through text (in case of smoke detector)

While using Android Application, the user can switch on or switch off devices at his/her discretion wirelessly. This can only be done within the given range. In this

project, we have used 3 bulbs to act as our appliances, each of which can be controlled remotely with the use of the Android Application

In the case of Voice Recognition, the Android Application (AMR Voice) uses the help of the google speaker to decipher spoken words into texts, based on our program, if a person says “light on”, or any other pre-determined text, the google speaker will send those words as texts to the Arduino via the Bluetooth Module (HC-05) to either switch on or switch off devices

Finally, with regards to the GSM Module, once the MQ-2 Sensor value crosses the given threshold, the GSM Module sends a text alert to the user’s phone indicating that there is an unusually high concentration of smoke in the room.

CHAPTER 6

6.1 Observations

After successful implementation of circuit and code, the following was observed

- The Bluetooth HC-05 Module range was approximately 7.2 meters, after this distance, signal was faint. Within the confines of the university hostel room, the signal was strong and responsive in the case of both voice recognition and Android Application
- Once the threshold value of 400 is exceeded (This value was chosen because the potentiometer of the MQ-2 Sensor was tinkered with to make the sensor more sensitive in nature), an alert SMS text was sent to user with the line “Fire in the house”
- MQ-2 Sensor information is a combination of different concentrations of gases, i.e. LPG, Smoke, Alcohol, Propane, Hydrogen, Methane and Carbon Monoxide. The average beginning value starts around 100 – 150
- The analog output voltage provided by the sensor changes in proportional to the concentration of smoke/gas. The greater the gas concentration, the higher is the output voltage; while lesser gas concentration results in low output voltage

6.2 Analysis (Advantages and Disadvantages)

This project is a prototype of possibly another larger system for an actual house. After performing all the tasks we have seen that the voltage and current is not the same always as given in the components' specifications. We have used a lot of devices that that need high and constant supply. Otherwise there is a delay in the task. There is also a risk of destroying the devices if there is very high voltage supply. The number of wires that we have used in this project doesn't make significant power loss but the modules need constant power supply.

In case of the GSM module, it needs 1A current to send text messages, otherwise no communication is possible. There will be a problem if there is no electricity or internet, as much of the project runs on both, however in this case the use of Bluetooth would be an advantage as it doesn't need an internet connection, but voice recognition won't be possible. There is also the risk of an imminent fire because the main switches are always on in such projects. The chances of a fatal short circuit can lead to disastrous results. The security system that we have added is not enough, more safe guards need to be put in place

All sensors need time to give a stable reading like, the same applies to the MQ-2 sensor. While processing voice command, the maximum delay we have encountered in 3 seconds. The sensitivity of the sensors can be varied according to the need of the user. The whole program is written in a single Arduino IDE so it is very easy for the user to change any kind of function, allowing the experience of use to be homogenized. Overall the use of this automation system is easy, flexible and reliable. We can certainly add extra features with system.

CHAPTER 7

7.1 Conclusion

7.1.1 Discussion

In the project we carried out, we find the system effectively low cost and user friendly. The whole house remains under the user's control all the time. In future we may find some devices that are more reliable, faster and cheaper. We have tried to make a well controlled and secure system. The components that we have used can be changed with the latest device but it should have the right software and the right driver. All the tasks of this project are done successfully. We were able to fulfil our goals as proposed in this system.

7.1.2 Limitations

- The project relies on power supply. So if the power supply fails, the connection will be halted. In our project, security system is powered by another power source for security safety.
- The cost of installing a home automation system can be expensive. Though that depends on the apparatus. The more sophisticated the system is the more expensive it will be.
- Due to the homogenised nature of the circuit and all appliances being connected to a single point (i.e. Arduino UNO), the entire system will fail if and when the Arduino does
- If the individual does not handle the equipment safely or make use of the exact key to carry out the operations, human error can occur
- Can inspire lethargic behaviour

7.1.3 Future Scope

- As we have mentioned earlier this is a basic structure of another complete system. We have only considered all of the basic necessities of a typical house. The tasks that we have done are not the only tasks the components are able to do. There are a lot of other scopes for this project

- More appliances can be added in this system with a powerful relay module. Garage automatic door system can be added for extra security. All available smart devices can interface with this system including a car
- Solar power system can make this system durable
- Different Home Automation Systems can be made that cater towards different demographics, disabled people, senior citizens
- In the case of those who are deaf and mute, other systems can be put in place where hand signs can be recognised to perform different actions
- Lighting can also be arranged for different times of the day. If it is later in the morning or early in the afternoon, no lights are required. If it is night time, lights need to be on. Based on the lights used most frequently AI can be used to program the system to respond to the users preferences (i.e. Low lighting, bright, atmospheric, etc.)

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