DESIGN & FABRICATION OF WIRELESS HOME AUTOMATION SYSTEM

This Project paper is submitted to the Department of Mechanical Engineering, Sonargaon University for partial fulfillment of requirements for the degree of Bachelor of Science in Mechanical Engineering.

Sonargaon University (SU)

Submitted By:

Saiful Islam	**ID: BME1803016212**
Md. Shamim Hosen	**ID: BME 1803016213**
Md. Masum Mia	**ID: BME 1501005378**
Md. Muin Bhuiya	**ID: BME 1803016099**

Supervised by:

Md. Mahedy Hasan
Lecturer,
Department of Mechanical Engineering
Sonargaon University, Dhaka

Date of Submission:
September , 2022

DECLARATION

We hereby declare that the project report titled **"Design & Fabrication of Wireless Home Automation System"** submitted to the Department of Mechanical Engineering is done in partial fulfillment of the Bachelor of Science in Mechanical Engineering.

Date: September 21st ,2022

…… ……

Saiful Islam **Md. Shamim Hosen**
ID: BME1803016212 **ID: BME 1803016213**

…… ……

Md. Masum Mia **Md. Muin Bhuiya**
ID: BME 1501005378 **ID: BME 1803016099**

…..……..……
Md. Mahedy Hasan
Supervisor
Department of Mechanical Engineering
Sonargaon University, Dhaka

ACKNOWLEDGEMENTS

Firstly, We want to express gratefulness and humbleness to Almighty Allah for his immense blessing upon us for the successful completion of this thesis work.

We would like to express sincere gratitude to our supervisor, Md. Mahedy Hasan, Lecturer, Department of Mechanical Engineering, Sonargaon University, for his supportive guidance and feedbacks for completion of the thesis.

We express our deep gratitude and thanks to Md Mostafa Hossain, Head of department, Mechanical Engineering, Sonargaon University for his motivation and kind collaboration.

We also would like to express gratitude to Prof. Md. Abul Bashar, Vice-Chancellor of Sonargaon University for his supportive in every aspect of our academic career especially for our Mechanical Workshop.

ABSTRACT

Home automation system is becoming popular day by day all-over the world because of making life smoother and minimizing the work load. Considering the system's contribution toward making daily life easier and strengthening home safety and security, the necessity of development and modernization of the system is apparent. Home automation refers to the automatic and electronic control of household appliances, features and activities. The most important device of present age is mobile phone. At present Android mobile is very common and very important part of our life. Using this device in controlling and surveillance work makes our life easy and comfortable. So, this project is done in such a way we can have the control of our home through a single device. The system is composed of hardware, communication and electronic interfaces that work to integrate electrical devices with one another.

LIST OF FIGURES

LIST OF TABLES

TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

1.1 Introduction:

Home Automation System:

A home automation system is designed which can be controlled by any smartphone. The automation system connects with the smartphone through Bluetooth. The smart phone sends control signals to switch home appliances ON or OFF by an android app through Bluetooth interface.

The project is built on Arduino UNO and is used to control six number home appliances connected to the Arduino through relays. The Arduino board is interfaced to an HC-05 Bluetooth module to pair with the smart phone. The aim of this project to design a circuit such that can control home appliances using help of Bluetooth. Using Bluetooth to control appliances reduces human efforts without compromising on efficiency. The circuit can be operated up to distance of 5-10 meters depending upon Bluetooth which we use.

In this modern era of development, automation of everything is the need of the hour. The basic aim of any development is to ease the human life. Home automation aims at automating the human lives. Activating the home appliances without conventional switch but by using a smart phone is known as home automation. Home automation is the use of one or more computerized remotes to control basic home functions and features remotely and sometimes automatically. An automated home is sometimes called a smart home. In present day world, more emphasis is put on wireless technology. It is because wired networks are messy and really complicated. These wireless technologies have impacted human life in a positive manner and human development speed has increased fore fold. The main wireless technologies used in home automation are GSM, Internet, Cloud and Bluetooth. Each technology has its own advantages and disadvantages. But Bluetooth based home automation systems have way more advantages. Devices can be connected from a range of 10m to 100m and this range can be increased by using piconet architecture. Also, the frequency used for Bluetooth is 2.4GHz, which is globally available. The speed that can be fetched for Bluetooth services is up to 3Mbps. It is these basic advantages that have driven us to the idea of developing a Bluetooth based home automation system

1.2 Objective of the project:

The main objectives of this project are-

1. Design of a Wireless Home Automation System via Bluetooth
2. Wireless control of home appliances such as Switch mode
3. Monitoring status of home appliances
4. Controlled by any device capable of Bluetooth (Android, iOS, PC)

1.3 Overview of proposed System:

This wireless Arduino based system includes controlling of home appliances like light, fan,air conditioner, television, show date, time, dust sensor, room temperature, smoke and motionsensing and finger print sensor security system.

This project proposes remotely controlling of home appliances with security of home both inside and outside. The project is composed of:

1. Controlling of appliances like light, table fan, TV, air conditioner, curtains etc. will be controlled with Android phone through Bluetooth communication using Bluetooth module. This is used inside the house only.
2. Density of dust level will be detected with dust sensor and purify.
3. PIR Sensor (HC – SR501) is used for motion detection.
4. Through GSM module we will control the above appliances from a distance via textmessages. This will ensure safety inside the house with the help of PIR sensor.
5. Arduino UNO is the microcontroller in Windows operating system.
6. Finally, all appliances are controlled by Android Application through Android mobile phone.

1.4 Advantages:

In the present-day home automation has becoming essential for the purpose of improving life style.

Home automation offers a futuristic way of life in which an individual gets to control the entire house using a smart phone, from turning on a TV to locking or unlocking doors. It also offers an efficient use of energy. Automation system also allows us to control the home appliances and keep an eye on the house from a distance.

It is beneficial to the grandparents who usually stay at home alone. It is also very helpful for the handicap to look after the home and easy to inform if there is any trouble in the house.

According to World Health Organization, heart diseases like Asthma or Stroke caused by air pollution kills 37,000 in Bangladesh. Some respiratory diseases caused by excess dust gradually leads to infection. Our country is at the 3rd position in the WHO's Southeast Asian Regional Office (SEARO) region that eleven Asian countries in air pollution. Therefore, a dust level detector is a must in every house of Bangladesh.

CHAPTER 2

LITERATURE REVIEW

2.1 Literature Review:

Home automation or smart homes can be described as introduction of technology within the home environment to provide convenience, comfort, security and energy efficiency to its occupants. There are many other projects done on home automation in different countries. They are all different from each other in designs; features, devices, elements and algorithm. They were designed according to specific needs and availability of components in the respective areas. Some of them are cheap; some of them are very expensive. Availability of both hardware andsoftware is necessary to work. After a long searching, we have found a lot of articles. Searching for security purpose articles, we also found some projects done for garage security. These are mainly done in western countries. Many projects are done only for security purpose with Arduino. Again, the projects are done only for controlling home appliances using Arduino. There are few projects on Fingerprint recognition module for strong home security issues. One of the projects used biometric method for next generation E-passport. The e-passport, as it is sometimes called, represents a bold initiative in the deployment of two new technologies: Radio-Frequency Identification (RFID) and biometrics.
Furthermore, there are projects done on fingerprint recognition module describing the methods how to identify the fingerprints. A wide variety of systems requires reliable personalrecognition schemes to either confirm or determine the identity of an individual requesting their services. The purpose of such schemes is to ensure that the rendered services areaccessed only by a legitimate user and no one else. Those papers didn't mention about how touse it for home security using any kind of microcontrollers.
A desktop computer acts as the base station. According to Chen Shih-Chung, the systems proposed by him is designed that can be easilybe adapted for various applications such as control of machines in machining industries, automotive industry, navigating mobile wireless nodes, automating offices etc.

There are few home automation systems that use Bluetooth for the wirelessconnection. With the help of Bluetooth and due to the introduction of IPv6the connection of almost unlimited number of embedded devices is possible.
In Bangladesh, we use IPv4.

CHAPTER 3

Brief Introduction of all components

3.1 Introduction of all components

To begin with the project, let's get the idea of all the components that we used for the project. It is very important to know all the information about both hardware and software specifications. The components we are using are as follows:

- Arduino UNO
- Arduino (Software)
- Controlled by any device supported by Bluetooth (IOS, Android, Laptop)
- Bluetooth module (HC-05)
- 5V Relay
- Two pin plugs
- Three pin Socket Box
- Adapter 9 Volt
- Bulb and bulb holder
- Jumper Wire
- Programming Cable

3.2 Arduino UNO

Arduino UNO is called the 'stock' Arduino. It is easily adaptable to all programming devices. All other Arduino boards are different versions of the UNO board. It has almost all features are like Arduino MEGA with less pin-outs.

Arduino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. You can tinker with your

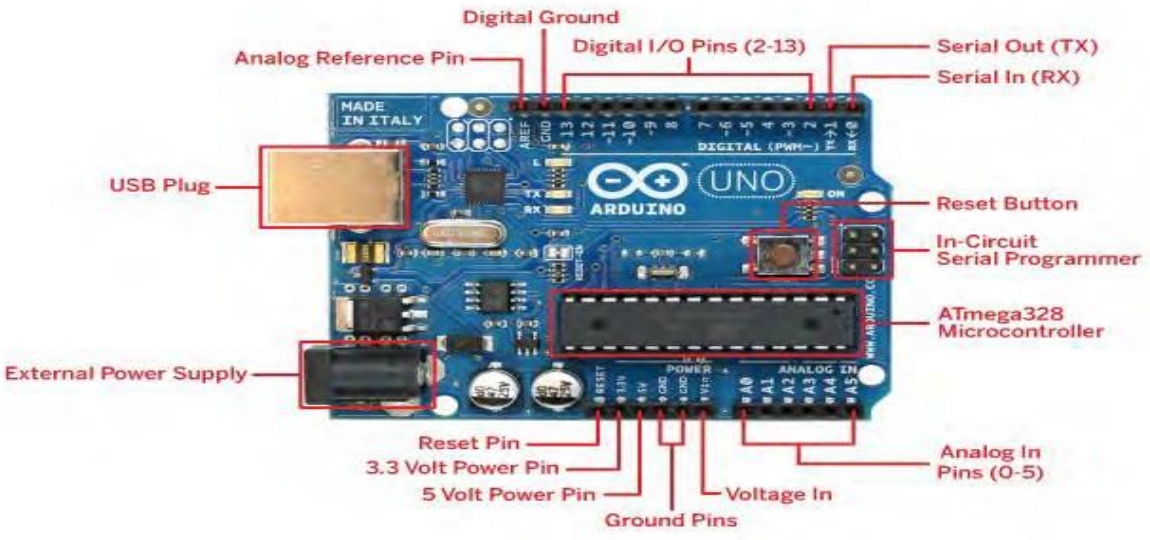

Fig : 1 Arduino UNO Process

Uno without worrying too much about doing something wrong, worst-case scenario you can replace the chip for a few dollars and start over again.

Figure 2 : Arduino UNO

3.3 Arduino IDE Software:

PIO9 and PIO8 can be connected to red and blue led separately. When master and slave are paired, red and blue led blinks 1time/2s in interval, while disconnected only blue led blinks 2times/s. Auto-connect to the last device on power as default.
Permit pairing device to connect as default. Auto-pairing PINCODE:"1234" as default.
Auto-reconnect in 30 min when disconnected as a result of beyond the range of connection.

3.4 Bluetooth Module HC-05:

Bluetooth module breakout is a well-known, most available and latest wireless serial cable. This module is an easy SPP (Serial Port Protocol) module. This module consists of Bluetooth V2.0+EDR (Enhanced Data Rate) 3 Mbps Modulation with 2.4GHz radio transceiver and baseband. It uses CMOS technology with CSR Blue core 04 External chip Bluetooth systems and AFH (Adaptive Frequency Hopping Features). This module provides switching mode between master and slave mode which means it is not able to receiving or transmitting data.

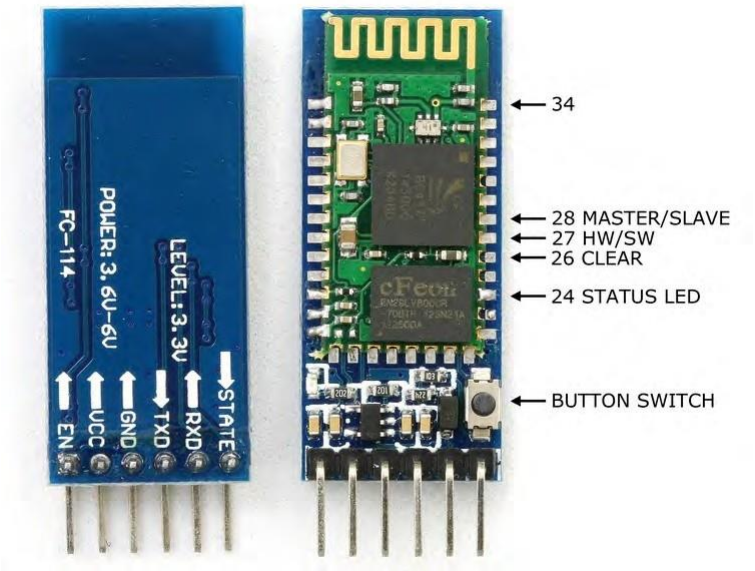

Figure 3: Bluetooth Module HC-05 with pin configurations.

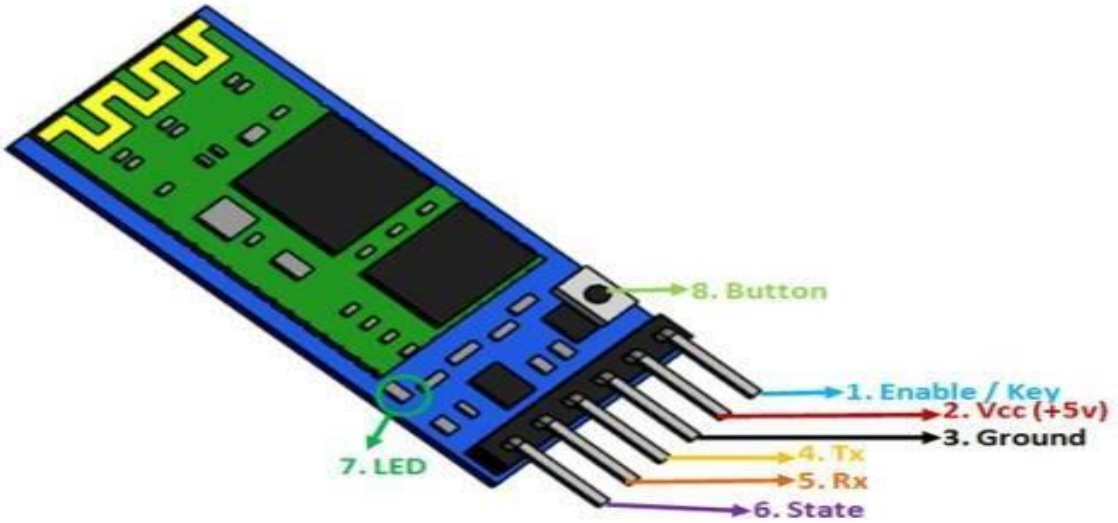

Figure 4: Bluetooth Module HC-05

3.5 Microcontroller:

Hardware features: Bluetooth takes 1.8V for operation, 3.3 to 5 V I/O. Sensitivity is typically -80dBm and UART interfacing with baud rate programmable. Edge connector isalso present.

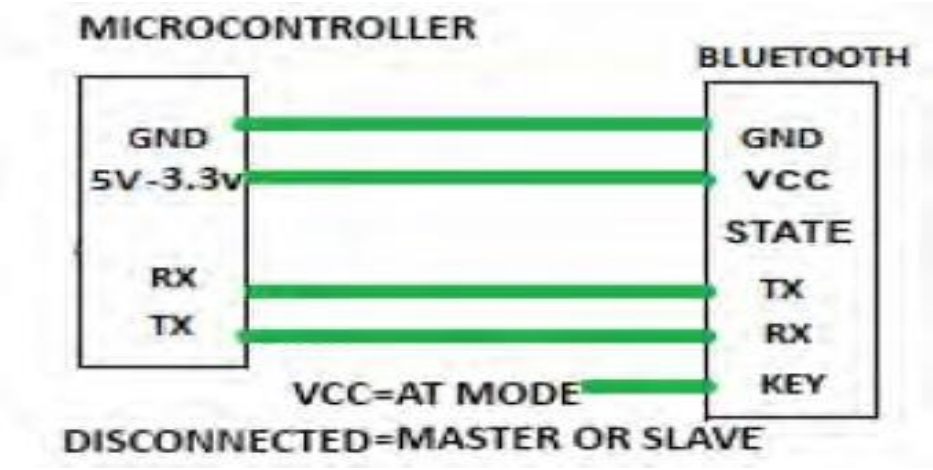

Figure 5 Typical circuit connection of Bluetooth module.

3.6 Relay Module

The 4 Channel Relay Module is an advantageous board utilized for controlling high voltage, high current burden like engine, lights, solenoid valves and AC load. It is intended to interface with microcontrollers like, PIC, Arduino, and so on Screw terminal is carried out alongside the Relay's terminal. It likewise accompanies a LED to show the transfer's status. It ships 5V transfer as a matter of course is shown in Figure 3.

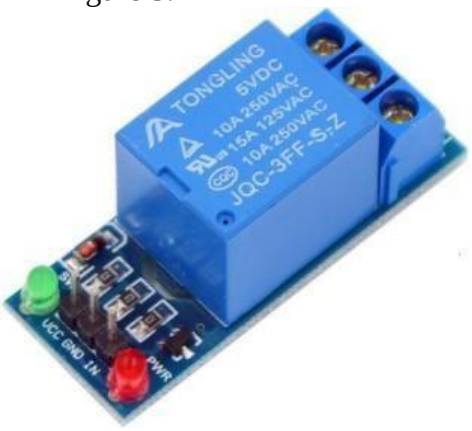

Figure 6. Relay Module

It is a 5V 4-channel relay board used to control various appliances. It can be used with or without microcontrollers. Each 5V relay needs 20mA driving current. It has LEDs for indication of output status.

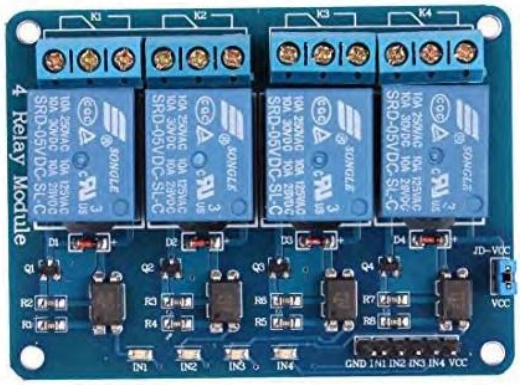

Figure 7: 5V 4-Channel Relay Module.

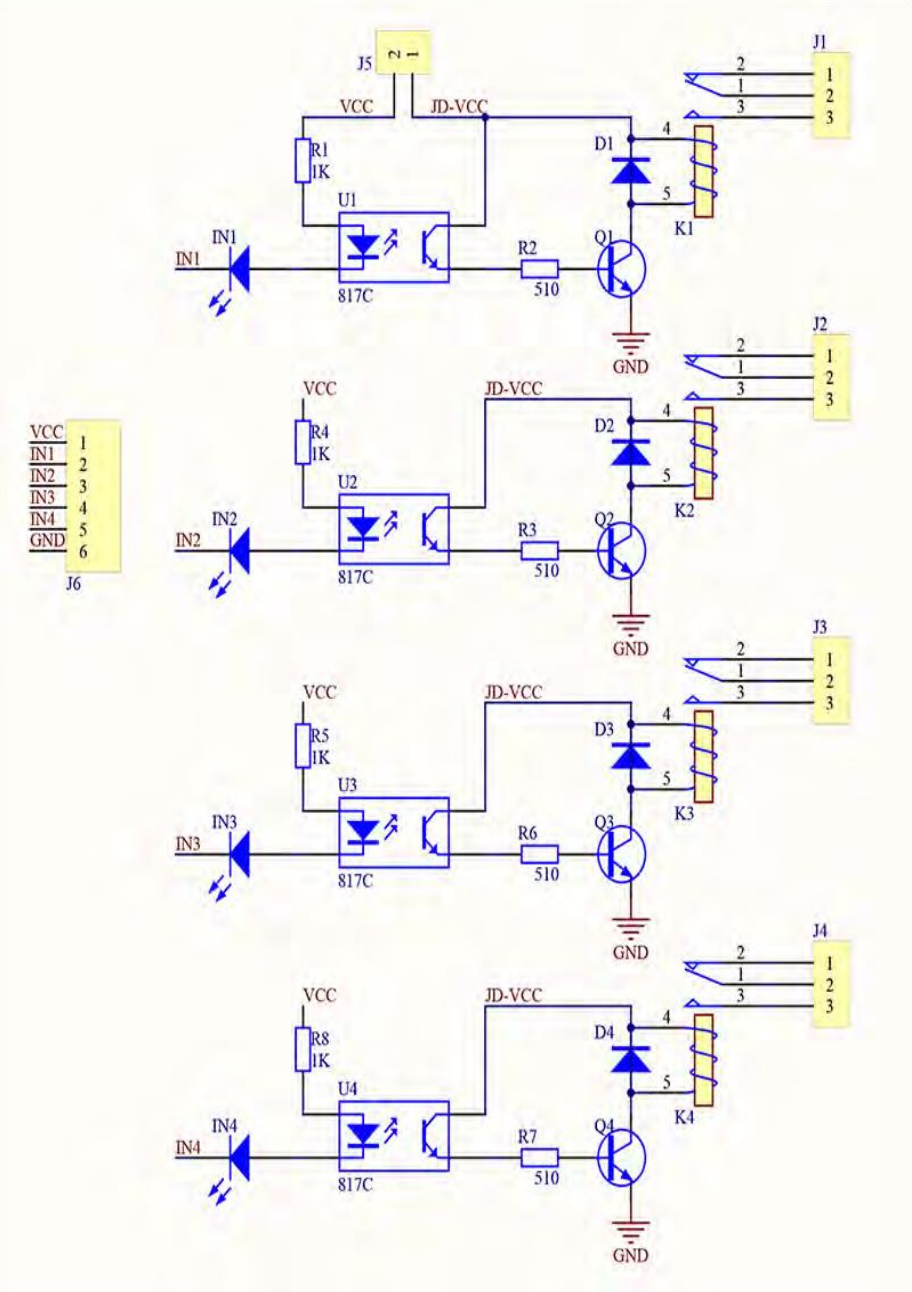

Figure 8: Schematic of 4-Channel Relay module.

3.7 Adapter :

In this report explains how to convert 220/230v AC to 9v, 220v AC to 12v DC circuit Diagram, 220v ac to 9 v dc, 230v ac to 9 v dc regulated power supply circuit, 9v DC converter circuit diagram, ac to dc converter, ac to dc supply circuit, ac to dc voltage regulator circuit, Bridge Rectifier circuit Diagram, circuit diagram of regulated power supply, how to convert ac to dc, how to make 220v ac to 9v dc, how to regulate voltage Regulated dc power supply, Regulated DC Power supply circuit, regulated voltage circuit diagram, voltage regulator using 7805, voltage regulator using 7812.

Transformer-based linear converter which uses a simple diode bridge, capacitor, voltage regulator. Simple Diode Bridge can be constructed either with single semiconductor device like DB107 or with 4 independent diodes like 1N4007. The other type of converter is SMPS or Switch mode power supply which uses a high-frequency small transformer and a switching regulator to provide DC output.

CHAPTER 4

Methodology

4.1Relay Module(4-channel)

All the components are with the relay. The relay is on after all the sensors and modules are high. In case of door unlocking, when the fingerprint matches the relay is on and the door opens by servo motor. In case of all sensors, when they are high the relay turns on to sendtext message to the phone. Relay, obviously as a switch is connected with all the home appliances. Also controlling of relay is possible through the GSM. We have also controlled the room curtains with the help of relay and servo motor. The connection is done according tothe schematic diagram.

4.2 Bluetooth Module HC-05:

Bluetooth module plays a very important role in interfacing the home appliances with theAndroid 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

Table 1 : Bluetooth pin interface.

4.3 Hardware Implementation:

The system is integrated using Arduino Uno board, a HC-05 Bluetooth module, relays modules, an android device, and other electronic components. Figure ( ) shows the system architecture of the proposed system which indicates the connection between the Arduino card and the peripheral devices which is Fan, Bulb, Heater and DC Motor. A connection between the Arduino Uno and the Bluetooth module is required in order to enable the android to control the Arduino Uno. The VCC and GND pins of the Bluetooth module are connected to the VCC and GND port in the Arduino-Uno board respectively. Then connect the receiver of the Bluetooth module to the transmitter of the Arduino-Uno board and the transmitter of the Bluetooth module to the receiver of the Arduino-Uno board.

Using wires and connector blocks connect the positive end of the home appliance (e.g. Heater) to the normally open port in the relay module and the negative end of the appliance to a power source then connect the other port of the same relay module to the wanted Arduino-Uno port Apply the same for the other appliances only use different relays and different Arduino Uno Ports

Figure 9. Representation of Hardware Implementation

4.4 Software implementation:

The software we used is Arduino IDE 1.8.5. All code is written in a single IDE called sketch. All the components are Arduino compatible so we have included respective Arduino AdafruitLibrary. For this section we have also divided the working procedure into four parts: sensors, modules, Android Application and Voice controller.

4.5 Android Application:

In this system we have the Android application to control all the home appliances. From Android phone we select any home appliance from the options that appear in the App then weselect ON or OFF. This can be done only when the user is inside the house. There should be Bluetooth connection for the App. The user cannot run the App from outside the house even if there is internet connection in the phone. It is related with the Bluetooth module. It allows establishing point-to-point connection with Bluetooth support devices. This technology is known by Android's support for the Bluetooth network stack which permits to exchange data wirelessly.

The Android Software Development Kit (SDK) provides all necessary tools to develop Android Application (API). This application is a Java based program. The Android uses .apk file to install the application. The code is written in Android Studio IDE. All appliances' buttons list will appear first. Then the user has to choose an option. Later the action buttonON and OFF appears. There are 2 layouts of the code structure, two Class code and user

4.6 Block Diagram System:

The proposed system functions as a remote controller for the electronic appliances that we have paired this system with. When the user unlocks the app using fingerprint the app will ask for connection to the Bluetooth devices. On touching that it will look for the device and gets paired with it. Then they can ON/OFF the appliances using the options available below. The Microcontroller gets the ON value as '1' and OFF value as '0'. Then it will send the signal received to the Relay module which will take care of the remaining functions is shown in Figure 6.

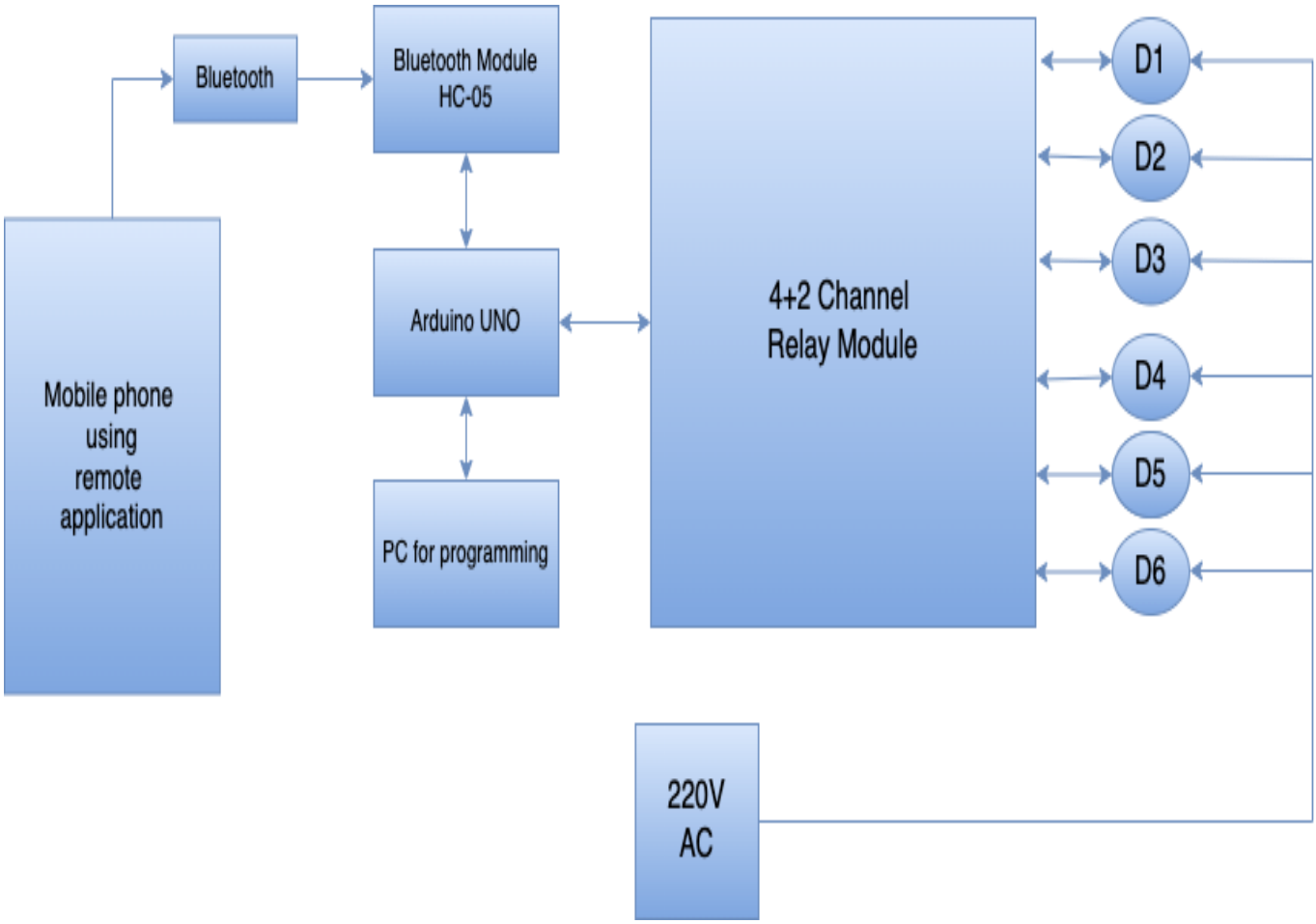

Figure 10. Block Diagram of the Proposed System

4.7 Flowchart:

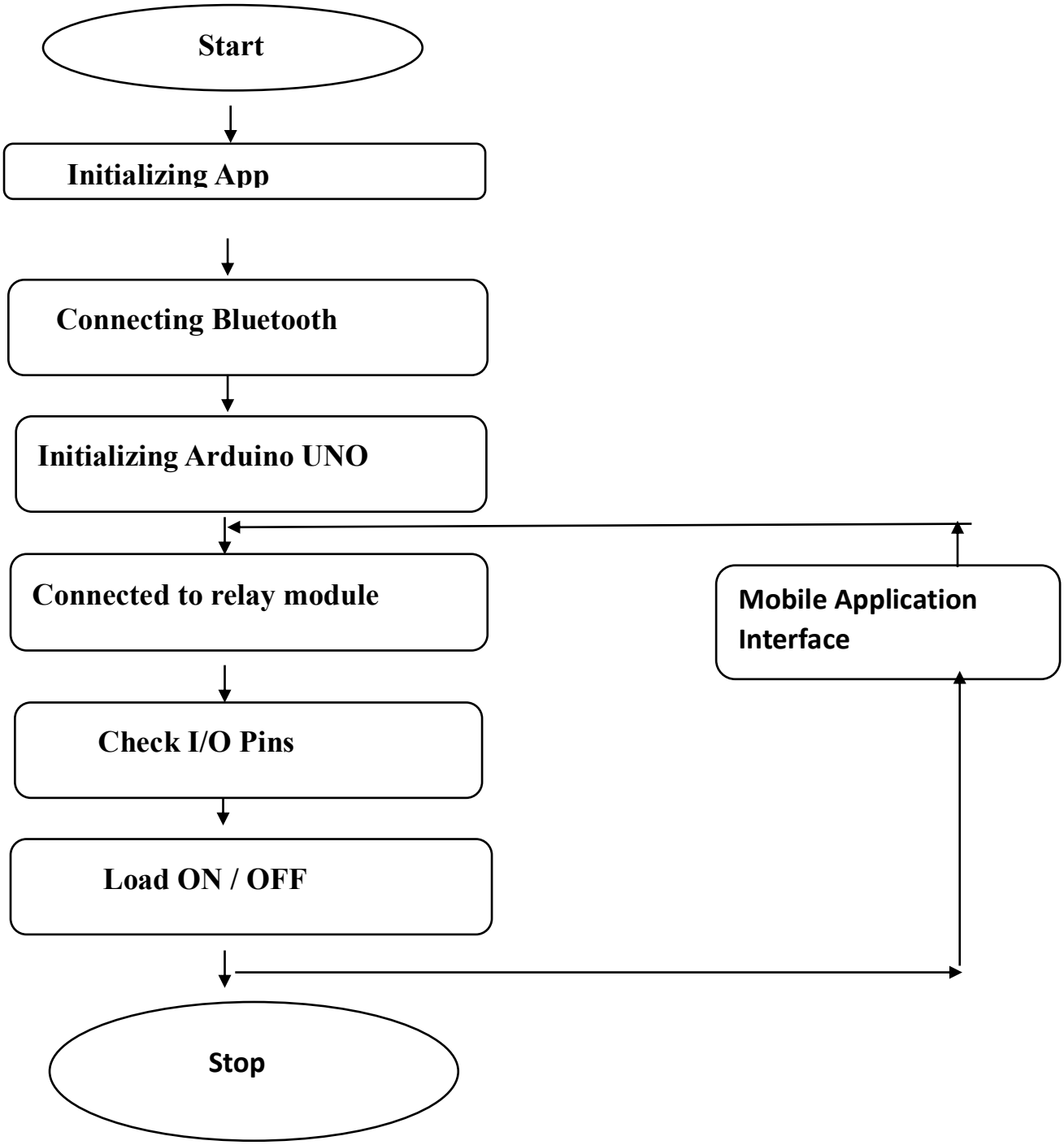

Figure11: Flowchart of the Proposed design wireless Home Automation System

4.8 Programming:

```
char val;
#define led1 2
#define led2 3
#define led3 4
#define led4 5
#define led5 6
#define led6 7
void setup()
{
 Serial.begin(9600);
 pinMode(led1,OUTPUT);
 pinMode(led2,OUTPUT);
 pinMode(led3,OUTPUT);
 pinMode(led4,OUTPUT);
 pinMode(led5,OUTPUT);
 pinMode(led6,OUTPUT);
 // put your setup code here, to run once:
}void loop() {
 if (Serial.available())
 {
   val = Serial.read();
   Serial.println(val);
   if(val == 'A')
   digitalWrite(led1,HIGH);
   else if(val == 'a')
   digitalWrite(led1,LOW);
   else if(val == 'B')
   digitalWrite(led2,HIGH);
   else if(val == 'b')
```

```
  digitalWrite(led2,LOW);
  else if(val == 'C')
  digitalWrite(led3,HIGH);
  else if(val == 'c')
  digitalWrite(led3,LOW);
  else if(val == 'D')
  digitalWrite(led4,HIGH);
  else if(val == 'd')
  digitalWrite(led4,LOW);
  else if(val == 'E')
  digitalWrite(led5,HIGH);
  else if(val == 'e')
  digitalWrite(led5,LOW);
  else if(val == 'F')
  digitalWrite(led6,HIGH);
  else if(val == 'f')
  digitalWrite(led6,LOW);
}
// put your main code here, to run repeatedly:
}
```

CHAPTER 5

Result & Analysis

5.1 Results:

After connecting and programming all the components with the, we conducted the experiment. We have run all the components according to the proposed system. We have designed a prototype of a house placing inside room and outside door. All modules and microcontroller are kept together with a lot of wires. This part is the main center of the home automation system.

5.2 Analysis:

There are a lot of important matters to observe in this project. 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 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 Bluetooth module, it needs 3A currentto send and receive text message. Otherwise, no communication is possible. From the test we conducted it seems the mobile communication is very fast.

To maintain a constant power supply, we had to add DC-DC buck converter and an adapter. There will be a problem if there is no electricity or internet.

All sensors need time to give a stable reading like, temperature and fingerprint sensor. Again, in processing voice command, it has maximum 4 second's delay.

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. Overall, the use of this automation system is easy, flexible and reliable. We can easily add extra features with system.

That is a lot of money to save in a year. If we add the expenses of the home appliances with this amount, it is not very expensive. The automatic control of the home appliances will also bring down the electricity bill because the appliance will automatically turn off.

CHAPTER 6

Conclusion

6.1 Conclusion:

In this report, we have shown the design and features of a Smart Home Automation System. It is Bluetooth based, hence wireless and can be flexible in terms of cost. It has a special feature for smart speech sense, which would decode user's sentences into appropriate commands. It requires authentication details as a medium of security, thus preventing the use of application by unauthorized users.

The ease of installation is taken into account by this system. The system is designed to directly install along with the electrical switches on the wall. Complex wiring, reinstallation and overhead wiring on the wall can be done away with the use of this system. The existing switch connection is connected and controlled by the relay circuit inside the main control board. The purpose of the system is to use mobile phone's inbuilt Bluetooth facility for automation.

Furthermore, multiple control boards can be installed in homes. Bluetooth master device in PC/laptop with these simple and low-cost components, the main control board can be constructed in pretty small size but can still perform the strong functions and features of the system. The wireless Automation System furnishes a good paradigm for any Automation System based on Bluetooth.

6.2 Future Scope

As we have mentioned earlier this thesis is not a complete project. This is just a basic structure of another complete system. We have done all 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.

1)Arduino based device control using Bluetooth on smartphone project can be enhanced to control home appliances
2) GPS system using through Smartphone
3) Street light Management
4) Irrigations Pump management
5) Industrial power control
6) Weather station monitoring
7) Electricity Grid Control & monitoring

References:

1) Ayan Maity, Avijit Paul, Priyanka Goswami, Ankan Bhattacharya, "Android Application Based Bluetooth Controlled Robotic Car", International Journal of Intelligent Information Systems"

2) Abhi. cool. (n.d.). How to Build a Bluetooth controlled Home Automation Setup Using Arduino. Retrieved from https://smartify.in/knowledgebase/build-bluetooth-controlledhome-automation-setup-using-arduino/

3) The official Bluetooth website from Bluetooth SIG: http://www.bluetooth.com

4) **Neng- Shiang Liang; Li-Chen Fu; Chao-Lin Wu**. "An integrated, flexible, and Internet-based control architecture for home automation system in the internet era". Proceedings

5) **K. Mandula, R. Parupalli, C. A. S. Murty, E. Magesh and R. Lunagariya,** "Mobile based home automation using Bluetooth "

6) **D. Chowdhry, R. Paranjape and P. Laforge**, "Smart home automation system for intrusion detection

7) **N. Skeledzija, J. C. Edin, V. Bachler, H. N. Vucemilo, H. Dzapo** , " Smart home automation system for energy efficient housing "

8) **R. K. Kodali, V. Jain, S. Bose and L. Boppani,** "Bluetooth based smart security and home automation system "

9) **R. Piyare and M. Tazil,** "Bluetooth based home automation system using cell phone,"

10) **B. Ghazal and K. AI-Khatib,** "Smart home automation system for elderly, and handicapped people using bluetooth"

11) **Rahul Gogawale, et aI.,** " Bluetooth remote home automation system using android application",