National Institute of Technology Karnataka

Surathkal

EC280 - MINI PROJECT IN ELECTRICAL CIRCUITS AND SYSTEMS
END-SEM REPORT

HOME AUTOMATION

Submitted By

211EC245 Sanganabasu M Herur
211EC249 Sharath Balaji T

Under the guidance of

Dr. Rathnamala Rao
Assistant Professor Dept. of Electronics and Communication Engineering

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
NATIONALINSTITUTE OF TECHNOLOGY KARNATAKA, SURATHKAL

JUNE, 2023

SL. no.	Contents	Page no.
1	Introduction	3
2	Aim Components Required	4
3	Description	5-8
4	Block Diagram	9
5	Timeline	10
6	Working, Observation and Discussion	11-23
7	Application	23
8	Conclusion	24

Introduction

Home automation systems have achieved great popularity in the last decades as it increases the comfort and quality of life. Smartphone applications are used to control and monitor home appliances using different types of communication techniques.

The main objective of this project is to develop a home automation system using an Arduino board with Bluetooth being remotely controlled by any Android OS smart phone. As technology is advancing so houses are also getting smarter. Modern houses are gradually shifting from conventional switches to centralized control system, involving remote controlled switches. Presently, conventional wall switches located in different parts of the house makes it difficult for the user to go near them to operate. Even more it becomes more difficult for the elderly or physically handicapped people to do so. Remote controlled home automation system provides a most modern solution with smart phones. In order to achieve this, a Bluetooth module is interfaced to the Arduino board at the receiver end while on the transmitter end, a GUI application on the cell phone sends ON/OFF commands to the receiver where loads are connected.

The project deals with the design and implementation of a flexible and low-cost Home Automation System for an android device to provide essential functionalities to our homes and associated control operations.

In particular, with the help of an android device, one can manage the operations on home appliances, such as turning ON/OFF a bulb, television or microwave or any other home appliances.

Aim: To build a Home Automation system using Arduino with Bluetooth connection controlled by Android Device.

Components Required

1)ARDUINO UNO

2)4-CHANNEL RELAY (5V)

3)BLUETOOTH MODULE HC05

4)POWER SUPPLY

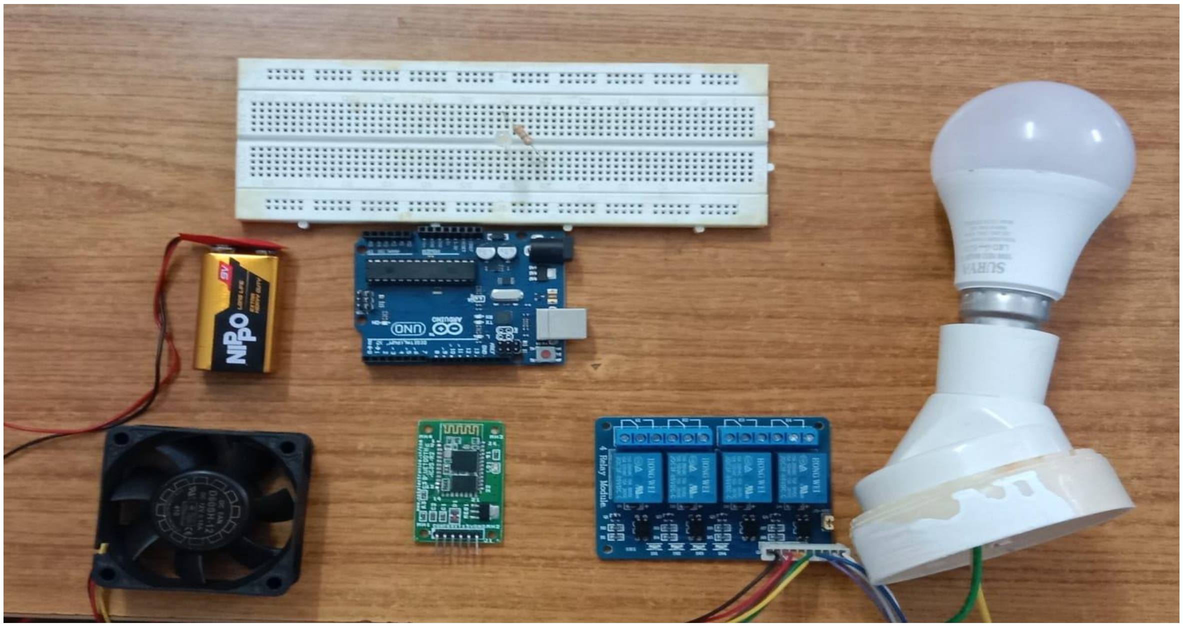
5) LED (X 2)

6)CONNECTING WIRES

7)BREAD BOARD

8)SMARTPHONE (BLUETOOTH ENABLED)

9)DC FAN



Description

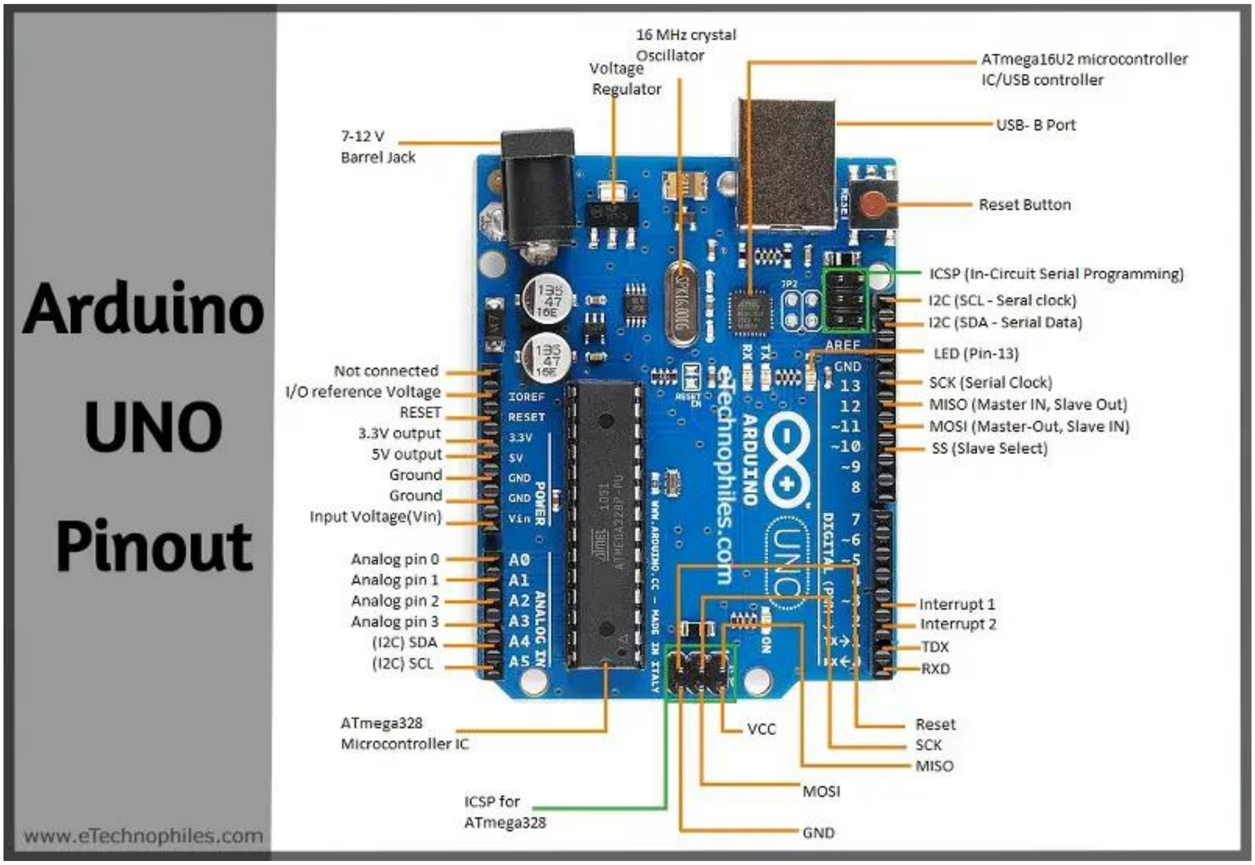
❑ ARDUINO UNO

Arduino is an open-source computer hardware and software company, project, and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical and digital world.

The microcontrollers are typically programmed using a dialect of features from the programming languages C and C++. In addition to using traditional compiler toolchains, the Arduino project provides an integrated development environment (IDE) based on the Processing language project.

Microcontroller: ATmega328

Operating Voltage: 5V



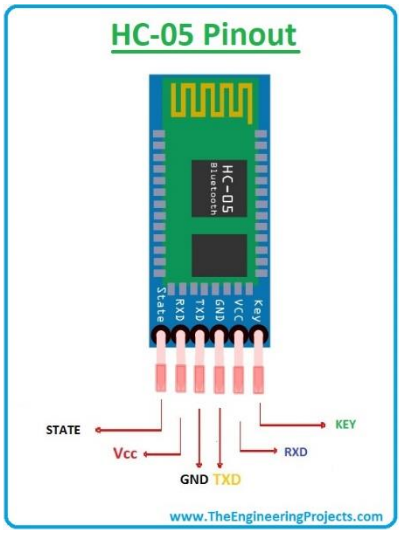
❑ BLUETOOTH MODULE (HC-05)

HC-05 is a Bluetooth module which is designed for wireless communication. This module can be used in a master or slave configuration. HC-05 has red LED which indicates connection status, whether the Bluetooth is connected or not. This module works on 3.3V. We can connect 5V supply voltage as well since the module has on board 5 to 3.3 V regulator.

The data transfer rate of HC-05 module can vary up to 1Mbps and is in the range of 10 meters.

In this project we are in use with mainly 4 pins of Bluetooth, neglecting the config pins.

1. **VCC:** Connect 5 V or 3.3 V to this Pin.
2. **GND:** Ground Pin of module.
3. **TXD:** Transmit Serial data (wirelessly received data by Bluetooth module transmitted out serially on TXD pin)
4. **RXD:** Receive data serially (received data will be transmitted wirelessly by Bluetooth module).

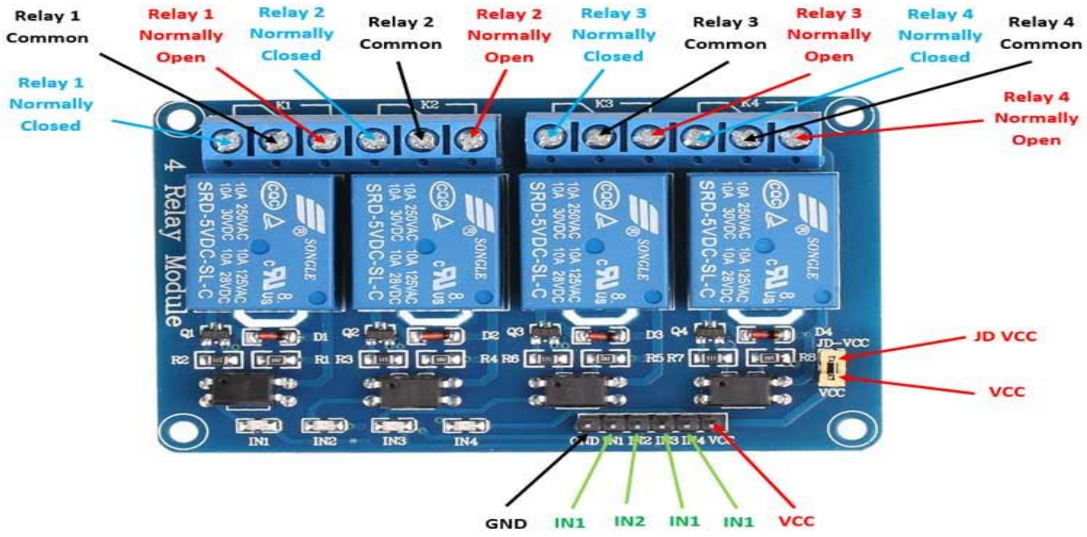


❑ 4-CHANNEL RELAY MODULE

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.

We can control high voltage electronic devices using relays. A Relay is actually a switch which is electrically operated by an electromagnet. The electromagnet is activated with a low voltage, for example 5 volts from a microcontroller and it pulls a contact to make or break a high voltage circuit.

Number of Relays: 4
Control signal: TTL level
Rated load: 10A/250VAC 10/30VDC 10A/125VAC 10A/28VDC

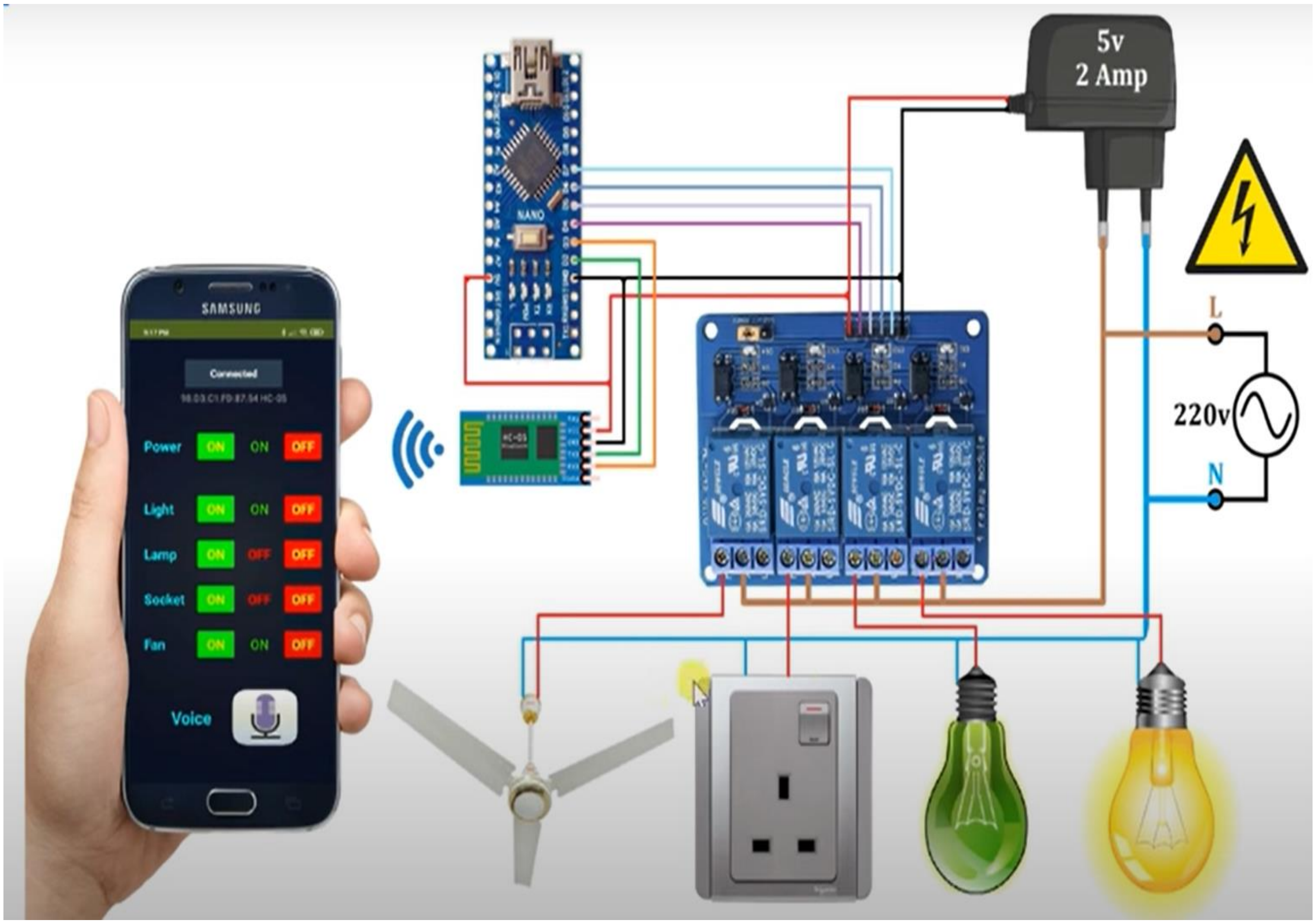


❑ ARDUINO IDE

The Arduino integrated development environment (IDE) is a cross-platform application that 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. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub *main()* into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution.

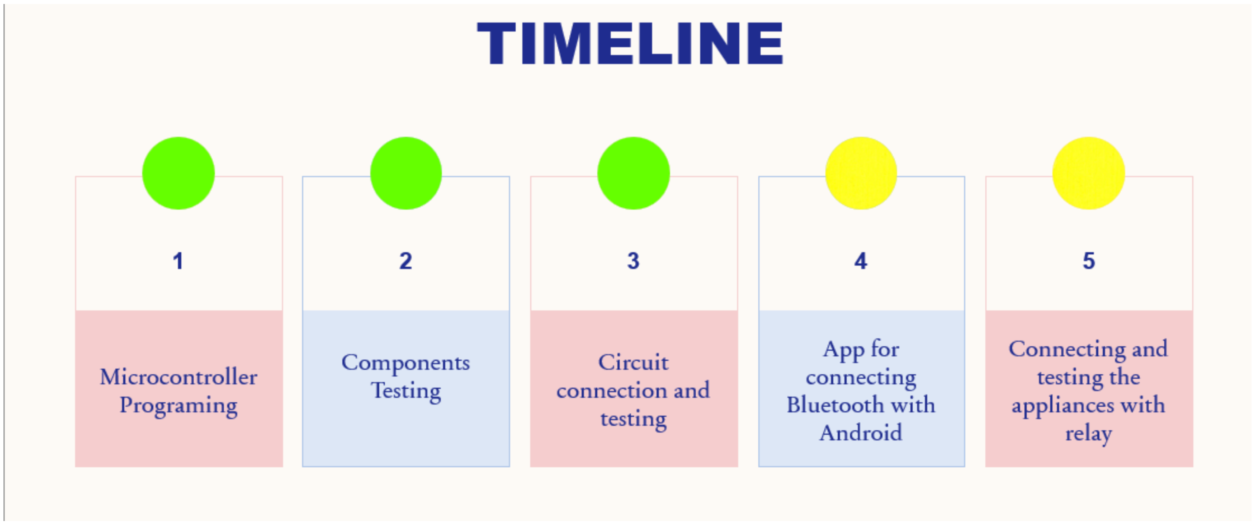
BLOCK DIAGRAM OF THE PROJECT

An Overview Circuit connection of the project is show below, which will be detailed in each step of the project we proceed.



TIMELINE

Basically, this project has been divided into 5 stages of work to be done.



TIMELINE

1 Microcontroller Programing

2 Components Testing

3 Circuit connection and testing

4 App for connecting Bluetooth with Android

5 Connecting and testing the appliances with relay

The one in green color indicates that the task has been completed, and the one in yellow is yet to be done. So, till this Mid evaluation we have done 3 stages of work and soon would be winding up with remaining two. Now we will see the different work that has been done till now.

The following works have been shown with evidence of the photos of the circuits which are purely taken based on what work we have done and are not plagiarized or downloaded from internet.

We will see the detailed work done below.

1) Microcontroller Programing

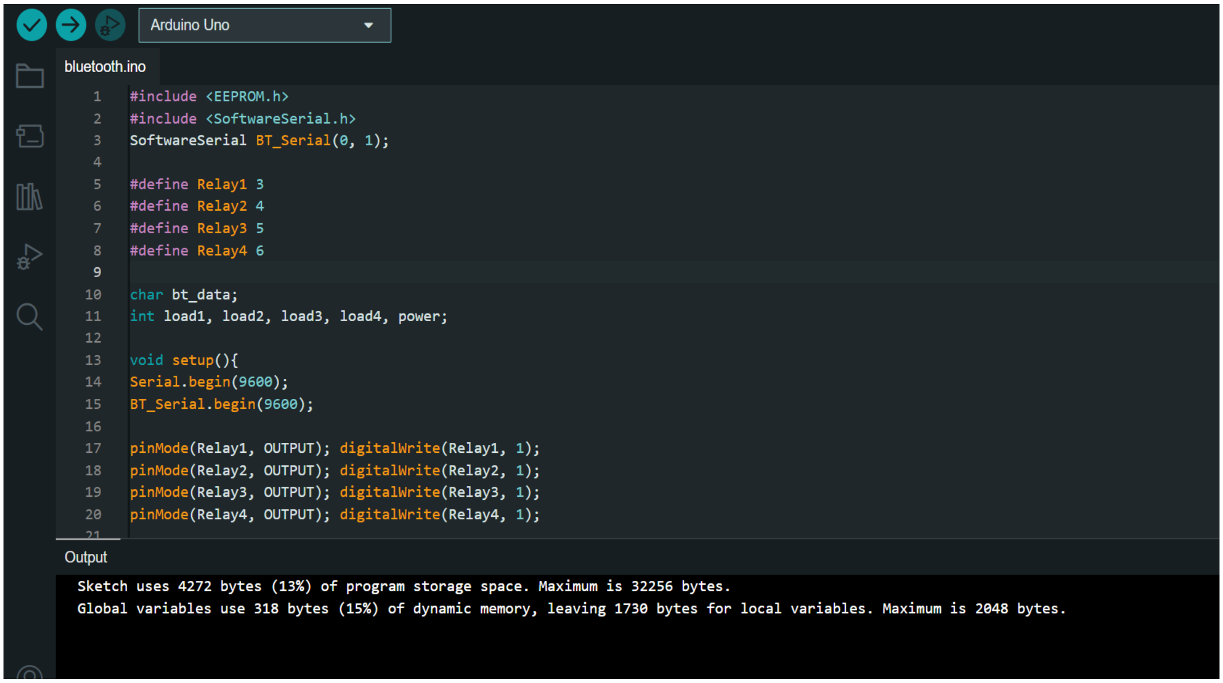
2) Components Testing

3) Circuit connection and testing

1) Microcontroller Programing

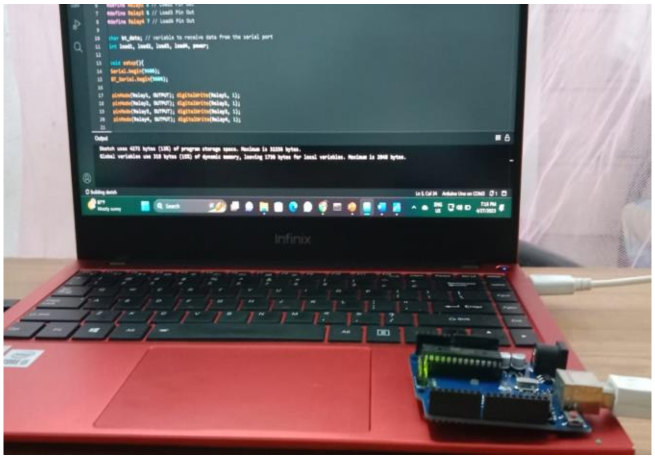
The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures.

User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub main() into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution.



```
#include <EEPROM.h>
#include <SoftwareSerial.h>
SoftwareSerial BT_Serial(0, 1);

#define Relay1 3
#define Relay2 4
#define Relay3 5
#define Relay4 6

char bt_data;
int load1, load2, load3, load4, power;

void setup(){
Serial.begin(9600);
BT_Serial.begin(9600);

pinMode(Relay1, OUTPUT); digitalWrite(Relay1, 1);
pinMode(Relay2, OUTPUT); digitalWrite(Relay2, 1);
pinMode(Relay3, OUTPUT); digitalWrite(Relay3, 1);
pinMode(Relay4, OUTPUT); digitalWrite(Relay4, 1);
```

```
Sketch uses 4272 bytes (13%) of program storage space. Maximum is 32256 bytes.
Global variables use 318 bytes (15%) of dynamic memory, leaving 1730 bytes for local variables. Maximum is 2048 bytes.
```

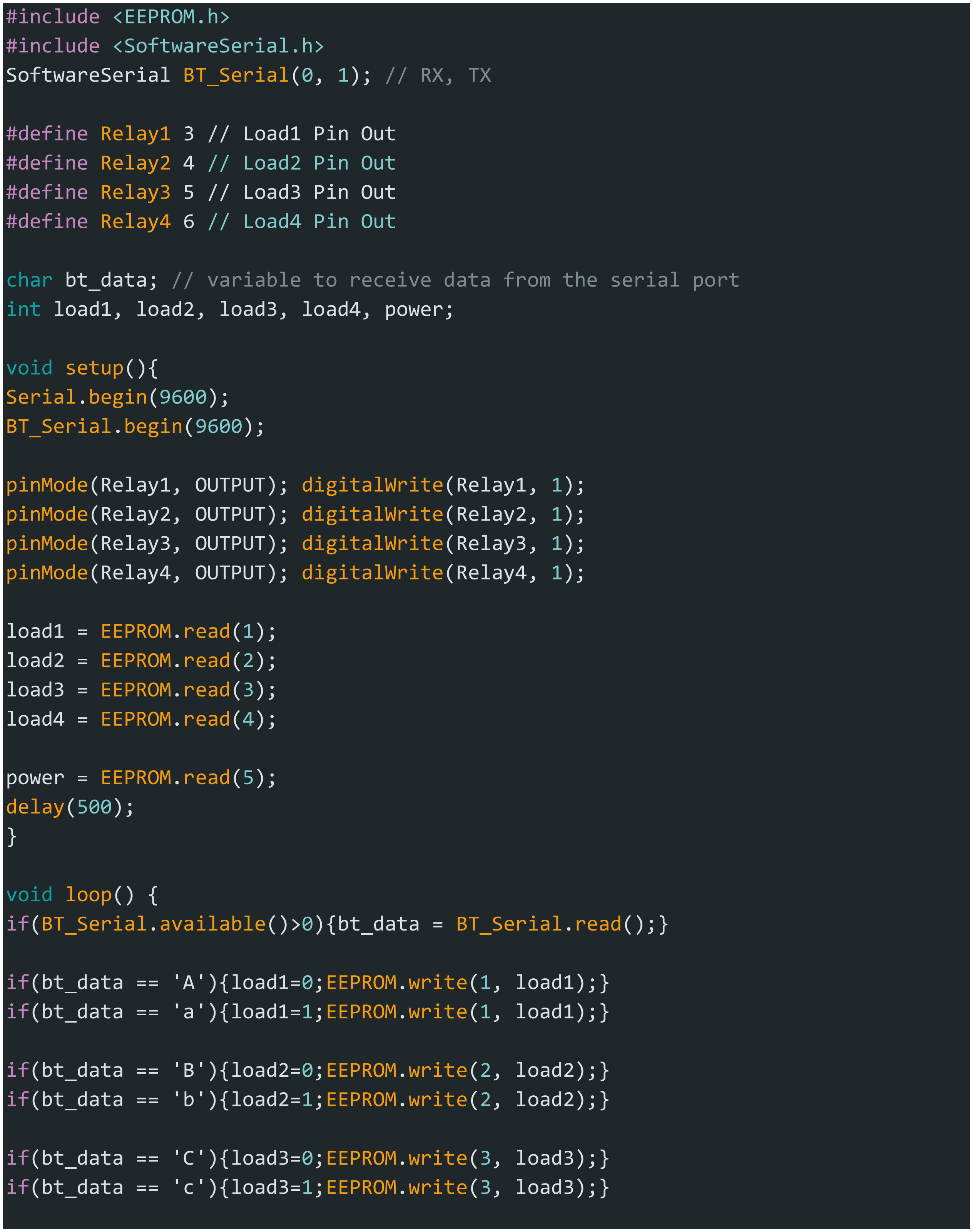


```
#define Relay3 6 // Load3 Pin Out
#define Relay4 7 // Load4 Pin Out

char bt_data; // variable to receive data from the serial port
int load1, load2, load3, load4, power;

void setup(){
Serial.begin(9600);
BT_Serial.begin(9600);

pinMode(Relay1, OUTPUT); digitalWrite(Relay1, 1);
pinMode(Relay2, OUTPUT); digitalWrite(Relay2, 1);
pinMode(Relay3, OUTPUT); digitalWrite(Relay3, 1);
pinMode(Relay4, OUTPUT); digitalWrite(Relay4, 1);
```

```
Output
Sketch uses 4271 bytes (13%) of program storage space. Maximum is 32256 bytes.
Global variables use 318 bytes (15%) of dynamic memory, leaving 1730 bytes for local variables. Maximum is 2048 bytes.
```

- **CODE COMPILED AND DRIVEN INTO THE ARDUINO**

The code is given below:



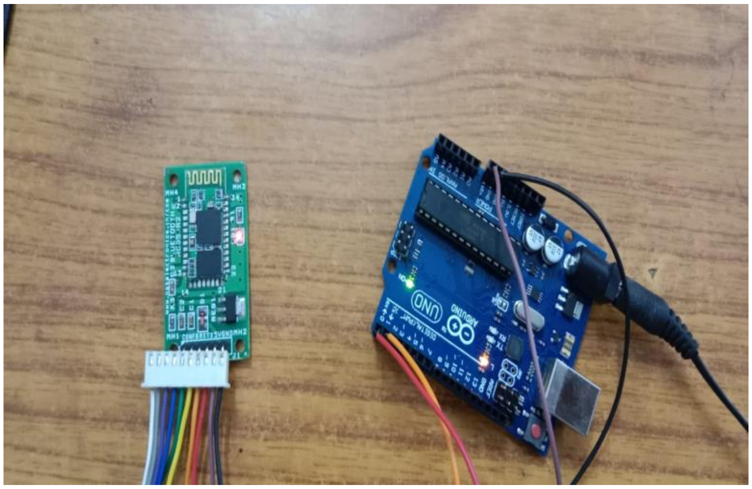
```
#include <EEPROM.h>
#include <SoftwareSerial.h>
SoftwareSerial BT_Serial(0, 1); // RX, TX

#define Relay1 3 // Load1 Pin Out
#define Relay2 4 // Load2 Pin Out
#define Relay3 5 // Load3 Pin Out
#define Relay4 6 // Load4 Pin Out

char bt_data; // variable to receive data from the serial port
int load1, load2, load3, load4, power;

void setup(){
Serial.begin(9600);
BT_Serial.begin(9600);

pinMode(Relay1, OUTPUT); digitalWrite(Relay1, 1);
pinMode(Relay2, OUTPUT); digitalWrite(Relay2, 1);
pinMode(Relay3, OUTPUT); digitalWrite(Relay3, 1);
pinMode(Relay4, OUTPUT); digitalWrite(Relay4, 1);

load1 = EEPROM.read(1);
load2 = EEPROM.read(2);
load3 = EEPROM.read(3);
load4 = EEPROM.read(4);

power = EEPROM.read(5);
delay(500);
}

void loop() {
if(BT_Serial.available()>0){bt_data = BT_Serial.read();}

if(bt_data == 'A'){load1=0;EEPROM.write(1, load1);}
if(bt_data == 'a'){load1=1;EEPROM.write(1, load1);}

if(bt_data == 'B'){load2=0;EEPROM.write(2, load2);}
if(bt_data == 'b'){load2=1;EEPROM.write(2, load2);}

if(bt_data == 'C'){load3=0;EEPROM.write(3, load3);}
if(bt_data == 'c'){load3=1;EEPROM.write(3, load3);}
if(bt_data == 'D'){load4=0;EEPROM.write(4, load4);}
if(bt_data == 'd'){load4=1;EEPROM.write(4, load4);}

if(bt_data == 'E'){power=0;EEPROM.write(5, power);}
if(bt_data == 'e'){power=1;EEPROM.write(5, power);}

bt_data = '0';

if(power==1){
digitalWrite(Relay1, 1);
digitalWrite(Relay2, 1);
digitalWrite(Relay3, 1);
digitalWrite(Relay4, 1);
}else{
digitalWrite(Relay1, load1);
digitalWrite(Relay2, load2);
digitalWrite(Relay3, load3);
digitalWrite(Relay4, load4);
}

 BT_Serial.print(power); //send distance to MIT App
 BT_Serial.print(";");
 BT_Serial.print(load1); //send distance to MIT App
 BT_Serial.print(";");
 BT_Serial.print(load2); //send distance to MIT App
 BT_Serial.print(";");
 BT_Serial.print(load3); //send distance to MIT App
 BT_Serial.print(";");
 BT_Serial.print(load4); //send distance to MIT App
 BT_Serial.println(";");

delay(500);
}
```

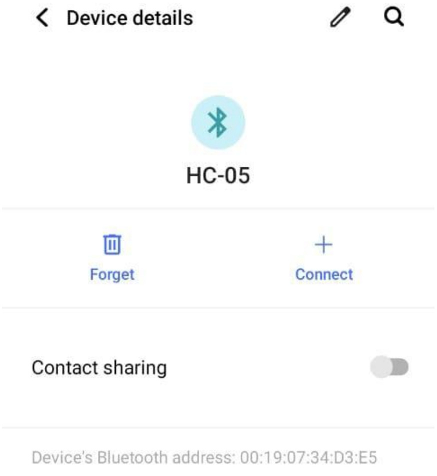
Mainly setup and loop are the two important function which are predefined, setup deals with the initial state of the relay and Bluetooth module to be on/off and the loop runs the communication of Bluetooth receiver/transmitter with the microcontroller which then controls the ON/OFF of the relay circuit .

2) Components Testing

We have divided this component testing into 2 parts , as we need AC supply for appliances we can't test those in this stage we will be doing it later on in the project. Now we will see the working of the Bluetooth and 4-Channel relay modules.

- **BLUETOOTH MODULE**




Device details

HC-05

Contact sharing

Device's Bluetooth address: 00:19:07:34:D3:E5

As we have already seen the HC-05 Bluetooth Module can be used in a Master or Slave configuration, making it a great solution for wireless communication.
The following are the Observations made while testing the HC-05 module:

□ HC-05 module can operate for both voltage supplies(5V/3.3V)

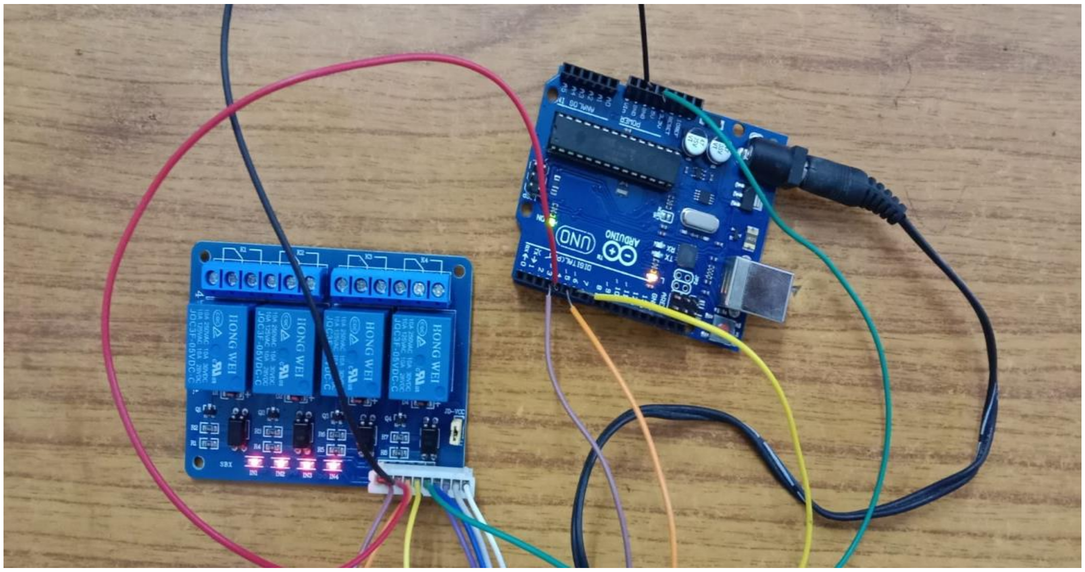
□ Power is supplied by Microcontroller of 5V using Vin pin

□ Tested range in open air is ~10m

□ Gets blinked when our code gets into setup mode and stops when connected/given command

□ Works on RX(Receiver) and TX (Transmitter) model

- **4-CHANNEL RELAY MODULE**



As the relay module works on a electromagnetic model it acts as a automated electric switch controlled by Microcontroller.

In the figure above we can observe the 4 LEDs are on that is because they all are given on(1) in the program when setup proving that our code is working properly and is all set for working and switching with all the 4 relays ,however the appliances are to be given to the screws in open looped or closed loop manner and can directly be connected to a DC device of 5V.

It is helpful in connecting large valued appliances like 220V bulb which can be connected to relay with the external AC supply.

3) Circuit connection and testing

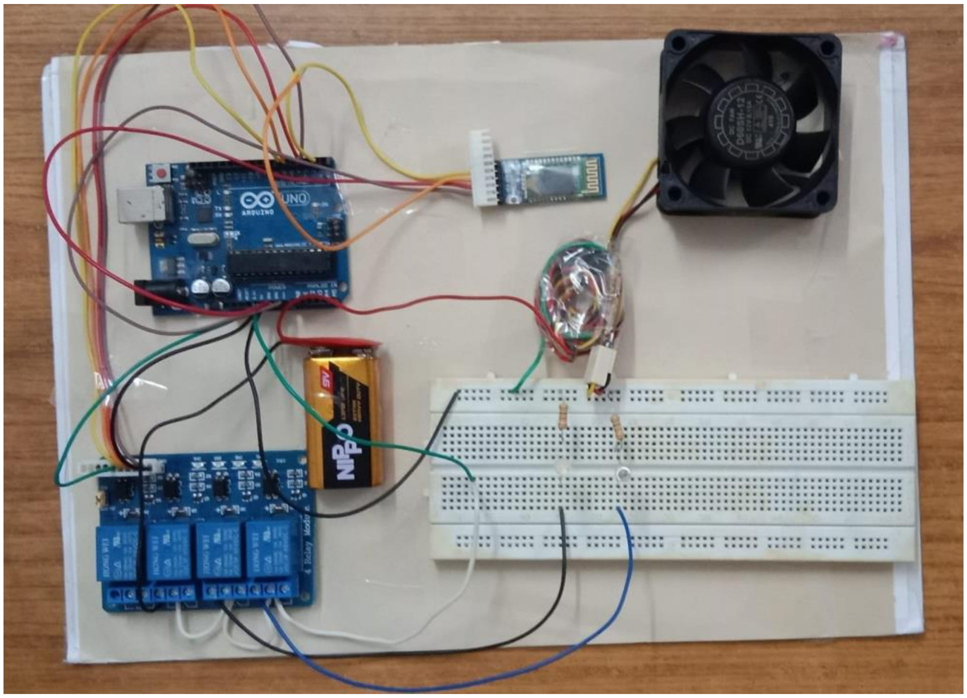


Figure: Circuit consisting of Bluetooth, Arduino UNO, relay module and appliances in connection

The system consists of mainly components like BLUETOOTH module, Arduino microcontroller and relay circuit, breadboard, LEDs and 12V DC Fan.

The whole system shown in the figure is connected to a 5V 2-amp supply, so the whole circuit is working with 5 V supply. These are connections that are done till now. Yet the appliances are to be connected and are to be brought to control.

By this circuit connection we have come across different aspects of Bluetooth module, Arduino microcontroller, relay circuit and appliances, and how they are connected to fulfill the circuit requirement as shown in the block diagram.

4) Application for connecting Android to Bluetooth

In this project, we have used MIT App Inventor for building up the application for controlling the bluetooth through the Android device. This helps us to send what data to be encrypted through signal when a button is chosen on the app like we have used "A" for Lamp on and "a" for Lamp off using if else if block it goes through all the possible buttons and chooses the required one.

By using this application, we can build user friendly interface for controlling the controller using app through Bluetooth. You can go through all the background work that has been for building the app.

After building the app in MIT App Inventor, it generates an APK file, in our case it is named as "MINIPROJECT" where it can be downloaded in our mobile and can connect through bluetooth device (HC-05).

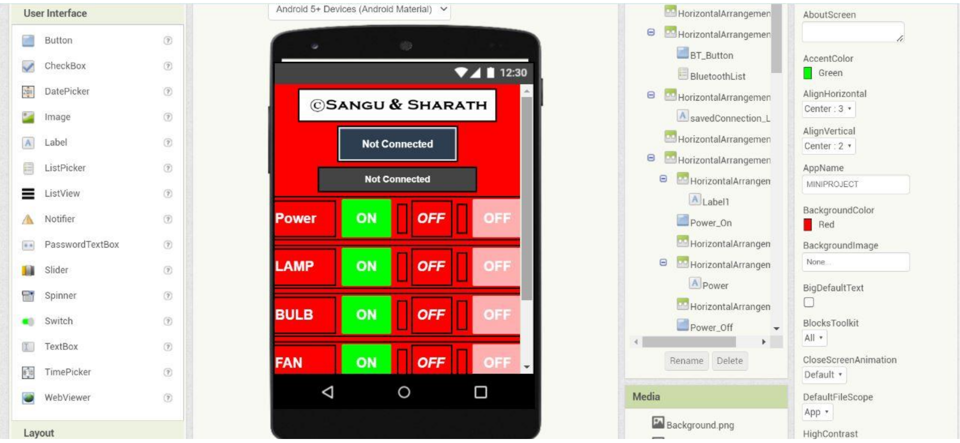


Fig: building app through MIT App Inventor

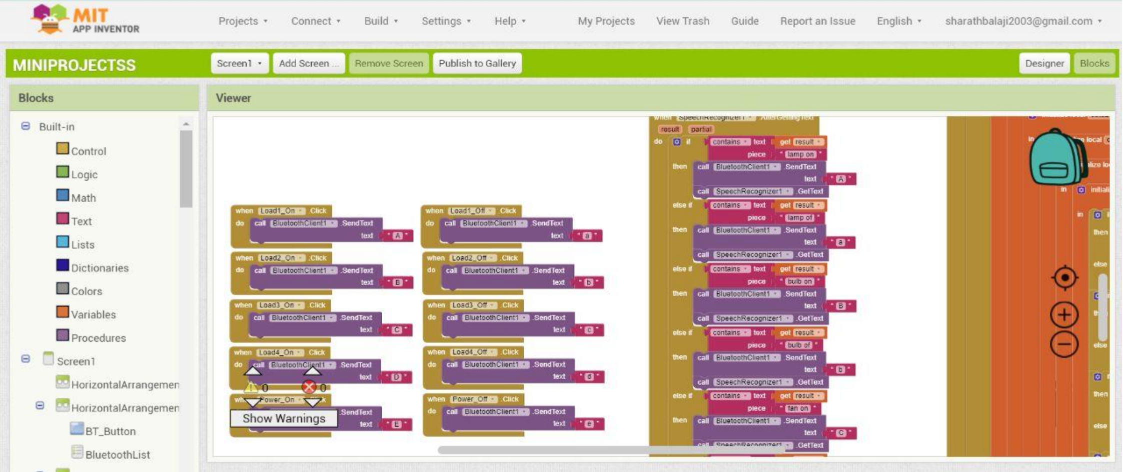


Fig: for building different if else if block to send the encrypted message through button on app

The downloaded apk file installs our MINIPROJECT app and the user interface is as shown below.

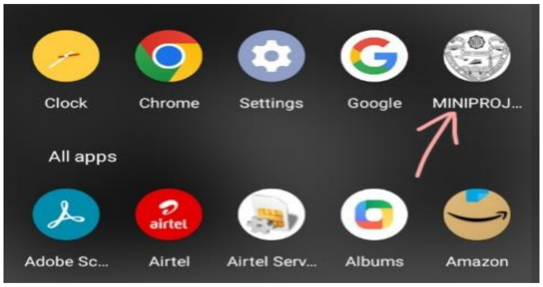


Fig: Created App from MIT App Inventor

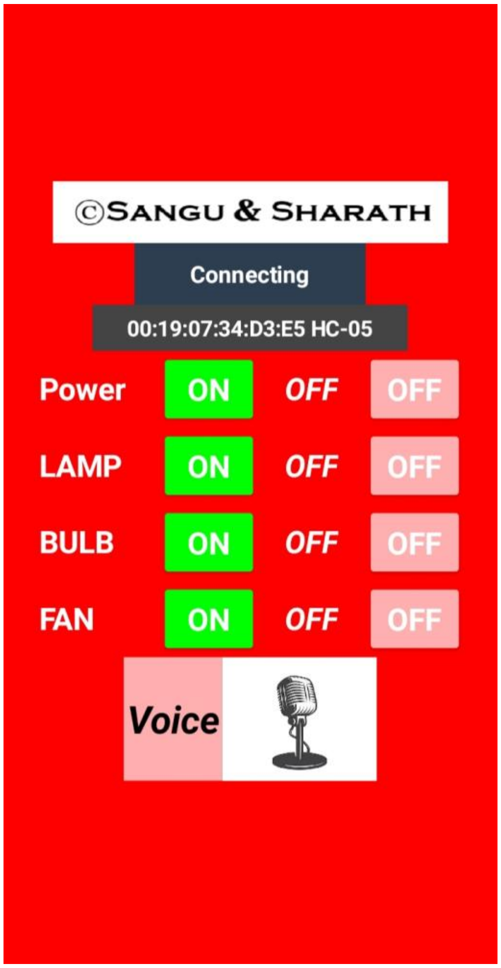
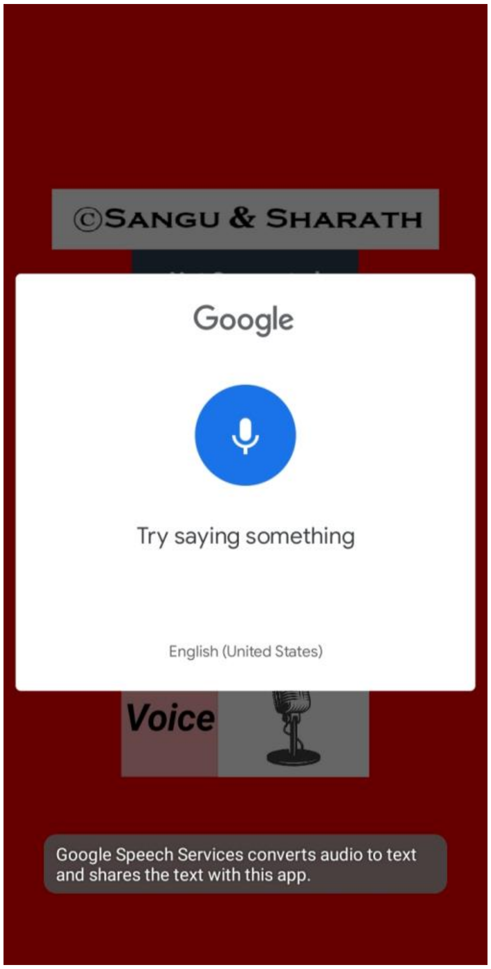


Fig: Application viewed on Android

Voice Control

As Modern user are fonder of voice controlling, we have added this functionality to our application it reads what the tells and if the commands match with those in the build blocks of ‘if else if’, then the encrypted data will be sent according. We have taken help of Google Speech for reading user data.



Try saying something

English (United States)

Google Speech Services converts audio to text and shares the text with this app.

Fig: Voice control in the App

5) Connecting and testing the appliances

We have used three appliances – 2 x LEDs, 1 x D.C. Fan for this project, one with red light and other white light led. DC fan of 12 v and it is given supply from series combination of 9v DC battery and 5v circuit voltage. You can see the illustrated pictures showing working of three different appliances. **(Observe Relay lights in photos)**

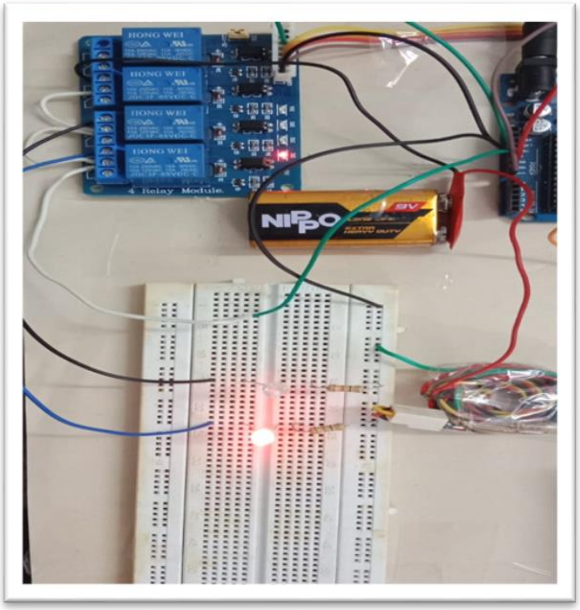


Fig: Working of the Red LED and output 1 of relay

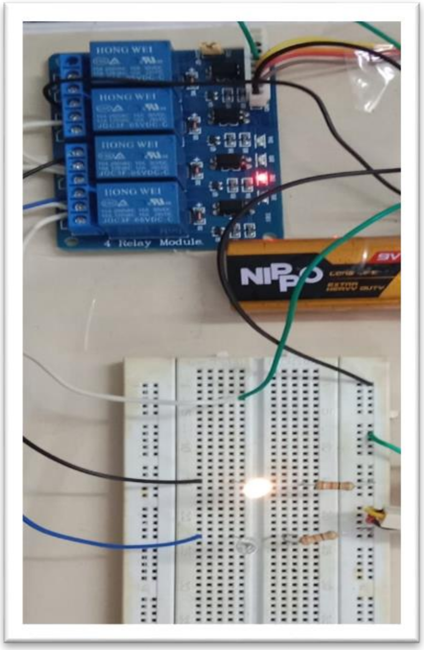


Fig: Working of the White LED and output 1 of relay

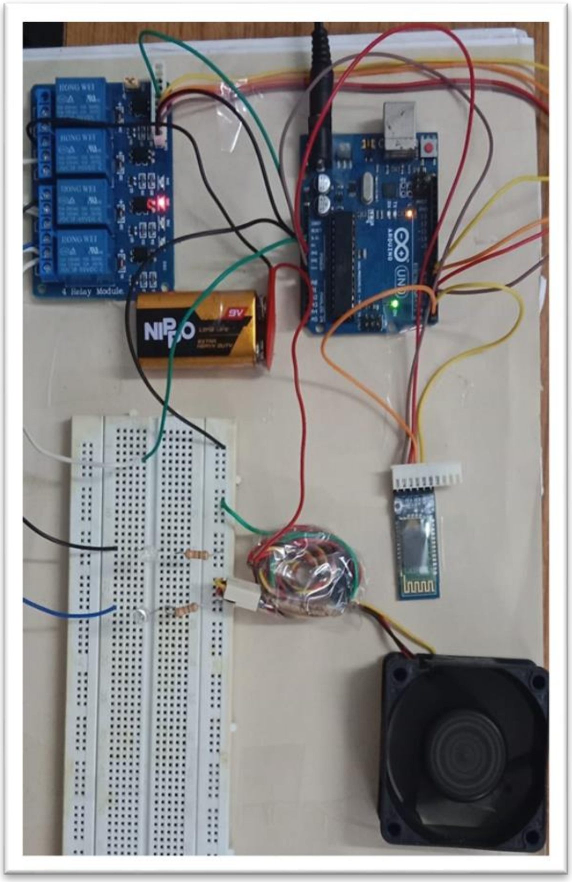


*Fig: Working of the DC fan (****Observe the Series connection of the voltage supply****)*

The integration of all the work we have done till now will result in the Completion of our HOME AUTOMATION project, the final outcome is shown below and for functionality we will give our live demonstration of the Working model.

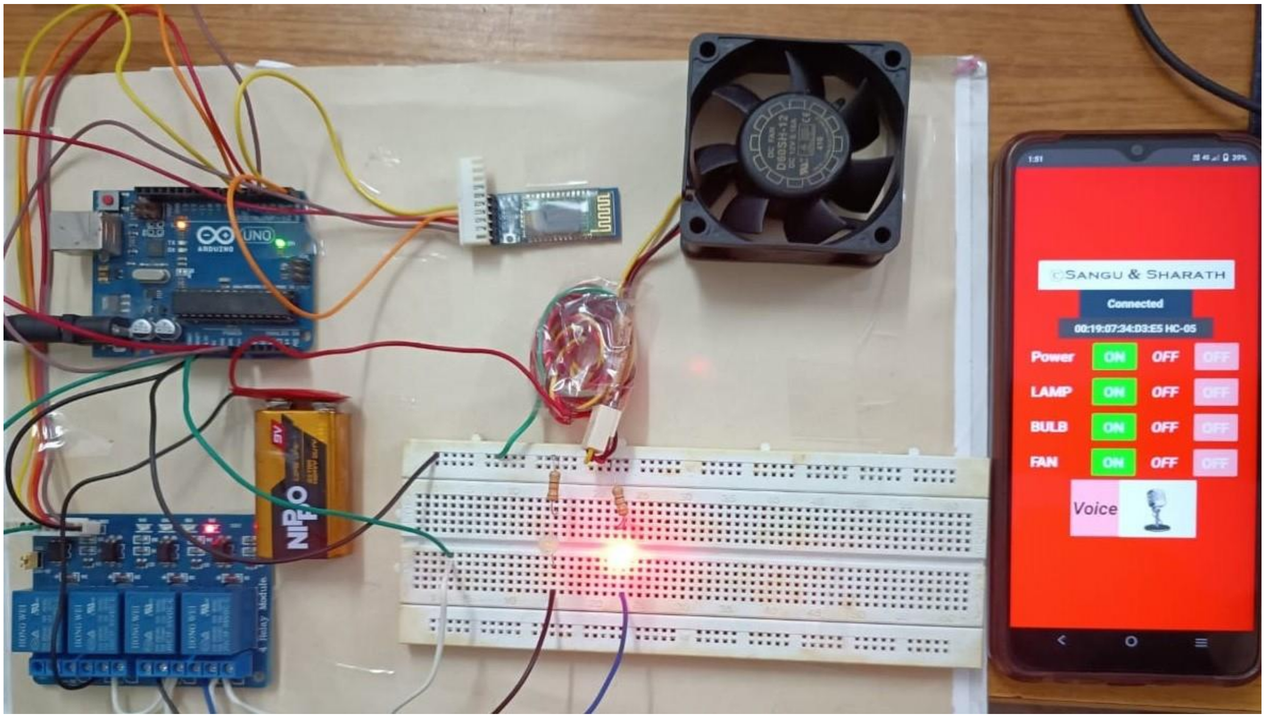


Fig: Outcome Model of the project

Advantages of Home Automation

The automation system of a smart home integrates all elements into the same network, which allows the user to take control and centralize the equipment with a single installation. The main benefits of having an automated home is:

1) Energy savings and efficiency
2) Simplicity and commodity
3) Voice control
4) Prevention and reduction of damages
5)User Friendly
6)Looks Modernized

CONCLUSION

Overall, the mini project on home automation has demonstrated the transformative power of technology in improving our living spaces. While going through this project we have gone through the working of microcontroller, Bluetooth module, relay module and explored more on managing the power supply.

Furthermore, the project has highlighted the potential for future advancements in home automation. As technology continues to evolve, we can expect even more sophisticated and interconnected systems. Integration with artificial intelligence and voice assistants, for instance, can further streamline and personalize our home automation experience.

We are very grateful for working on this mini project and will be looking forward for more such projects.

Thank You