HOME AUTOMATION USING BLUETOOTH

Final Year Project

Bachelor of Science (Electronics)

Submitted by

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Declaration

I hereby declare that the project titled "Home Automation System Using Bluetooth" submitted to the department of Electronics, Faculty of Natural Sciences, Quaid -i-Azam Islamabad for the award of degree of Bachelor of Science in Electronics (BS-Electronics) is carried out by Rizwan Majeed under the supervision of Dr. Mussarat Abbas.

Rizwan Majeed

Date: August 05, 2019.

Approval Certificate

This is certified that the project titled "**Home Automation Using Bluetooth"** submitted by Rizwan Majeed to the Department of Electronics, Faculty of Natural Sciences, Quaid-i- Azam University Islamabad, Pakistan is accepted in its present form.This work satisfies the requirements for awarding the degree of Bachelor of Science in Electronics (BS Electronics).

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I would like to thank lab. Instructor Mr. Musharraf Raza for his expert support during the execution of my project. His continuous guidance helped me in achieving my goal.

Abbreviations

ADC	Analog to Digital Converter
AREF	Analog Refrence
MISO	Master In Slave Out
MOSI	Master Out Slave In
PWM	Pulse Width Modulation
TTL	Transistor-Transistor Logic
SCK	Serial Clock
Rx and Tx	Receive and Transmit
SPI	Serial Peripheral Interface
SS	Save Select
RTC	Real Time Clock
SDA	Serial Data

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Abstract

From day one scientists, engineers and researchers are trying to upgrade the living standard of human beings by their inventions which are taking place each day in every corner of the world. Due to these innovations the world has become a global village so this project is about Home Automation which means home appliances are controlled by the mobile phone. An android based application has been developed to control all the appliances with the help of Bluetooth device.This Bluetooth device is connected with Arduino Uno. A four channel relay module for both AC and DC loads is connected with Arduino UNO. MIT APP. INVENTOR has been used to design the android application. Arduino IDE software has been used for coding of Arduino board .This code is useful for establishing a link between the android application and the hardware for controlling home appliances.

This project may be helpful for old people or people who can.t walk to control the home appliances for ON/OFF using Bluetooth of their mobile.

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CHAPTER 1

INTRODUCTON

1.1 Introduction

In the era of science and technology where everything is getting fast and portable so everyone is working on the use of cheap and effective resources in less time. This project is related to home automation using Arduino UNO board and Bluetooth module. Day by day advancement in technology has given benefit to human and task related to him. It has helped the society in every field of life like medicine, engineering, agriculture etc. All the appliances used in daily life may be turned on or off through Bluetooth module which is very beneficial for all people who are handicap, old or lazy. This idea is also useful to save the time by developing most of the appliances remote controlled whether it's a toy car, AC or TV etc.

1.2 Types of Home Automation

For controlling the appliances in home or in any building the system is installed there. As the technology is improving day by day, the automation systems are available as follows;

- Automation via Bluetooth
- Automation via GSM
- Automation via ESP

On the basis of requirement any one of these systems may be used to control electric appliances which are very helpful to control just by one click.

1.3 Motivation

Everything now a days is just on a click and looking on the upcoming generation which has got many things portable it will be very helpful as there will be no need to go to switch ON/OFF the fan, light bulb etc. It is also very dangerous as switches get spark or damaged whether they are used of good quality or not.

1.4 Home Automation The New Trend

As the time passes everything is getting automatic and the old technology is being

replaced by the new one which is improving the lifestyle of human day by day. Home automation is one of the fine steps which are for the betterment and easiness in life as time is short and everyone tries to make more advantage in less time.

1.5 Importance

Home automation is mainly used to reduce the human labor but in early time it was only used in industry which is now in approach to common people .It not only saves time but also different, diligent and make less error so are easy to use for senior citizens and handicaps.

1.6 Bluetooth VS Other Systems

Using of Bluetooth module based home automation is good as it has fast speed while it also depend upon the kind of Bluetooth module model which is being used i.e. device which is being in this project have a range of 10m to 100m and the speed of Bluetooth can be up to 3Mbps.

1.7 Management

The management of the system is very important but easy as it will be controlled by user mobile phone and of course Bluetooth which has a specific range.

1.8 Goals

The focus of the project is the controlling of the appliances by using a simple application which makes all the system

- Efficient
- Time saving
- Easy to handle
- Flexibility to get updated

1.9 Thesis Overview

Coming towards the first chapter which only gives introduction of the project while in second chapter gives details of the components used. Coming towards third chapter which describes working while forth chapter comprises of the implementation of the designed circuit and in the last there will be conclusion and future work of the described project.

CHAPTER 2

HARDWARE AND CONFIGURATION

2.1 Overview

The system under discussion is divided into two parts namely hardware having Arduino UNO board, Bluetooth module and mobile application software. The first part which is the hardware portion is interfaced/linked with software part to make the system robust, user friendly and low cost.

2.2 Components Required

- Arduino UNO R3
- Bluetooth module
- Breadboard
- Connecting wires
- DC supply card
- Channel relays
- 9volt battery

2.3 Arduino UNO R3

Arduino is an open source electronic board or platform which provides user ease to use hardware and software. Arduino receives signals from mobile phone through Bluetooth module by running the application software on the mobile to control hardware circuits This Arduino UNO board has the following items

- ATmega 328
- USB port
- 16U2 Microcontroller other than 328
- 14 digital input/output pins
- Analog input pins
- 16Mhz Oscillator
- One ICSP
- ICSP Header\
- Input voltages 7-12v
- Flash memory (32Kb)

2.4 Pin Configuration of The Board

2.4.1 Power Pins:

Voltage to Arduino is supplied by external source i.e. AC to DC adaptor. Voltage supply is maintained between 7-12 volts which is ideal operating voltage for Arduino Uno board, because there are chances that extra voltages may burn Arduino board or effect the results. If supplied voltage is less than the operating voltages

i.e. less than 7 volts there are chances that the pin of 5 volts would supply less than 5 volts and Arduino may not work properly. User can supply power by using pin Vin connected to battery. there are 5 pins supply power namely

- Vin
- 5v
- GND
- GND
- 3.3v

Vin: Battery is used as a source to supply power to the Arduino board through this pin.

5 volt :This pin provides 5volts uniformly to the connected components and microcontroller.

2 (ground pins) pins: These pins are used for ground connection

3.3 volt : Through this pin stable voltage is provided to components which operates at low voltages i.e. 3.3v.

The 14 digital input output pins can be configured as input or output pin as per requirement. By default all these pins are configured as input mode. User can declare each pin using the built-in function “digitalWrite”, “PinMode”(9,OUTPUT) and “DigitalRead”(4,INPUT),digitalWrite(3,LOW). Each pin can handle the current of 40mA. These pins are used to read both analog and digital signals.

Pin 0 and 1: Used as serial pins i.e. 0 as Rx and 1 as Tx.

Pin 2 and 3 : Used for external interface .which are helpful in triggering a cut low voltage and other purposes.

Pin 4(Serial Data) and pin 5 (Serial Clock): These pins are need Two wire interface(TWI) correspondence utilizing wire it is used. Pulse width modulation.

Pins 3,5,6,9 and 11:

Which give 8bit Pulse width modulation yield utilizing the analog Write() work.

SPI Pins 10(SS), 11(MOSI), 12(MISO) and 13(SCK):

They are needed for Serial Phase Interface correspondence.

Built in Drove Pin 13: Pin 13 high if drove is lit and pin 13 is low it is associated with an inside driven on the off chance that is shut.

AREF:

This pins give reference voltage to simple contribution with analogRefrence() work.

Reset pin:

It is used for Resetting

The size of flash memory is 32 Kilo bytes while boot loader shares 0.5Kilo byte.

Clock speed is 16 MHz

EEPROM is of 1KB.

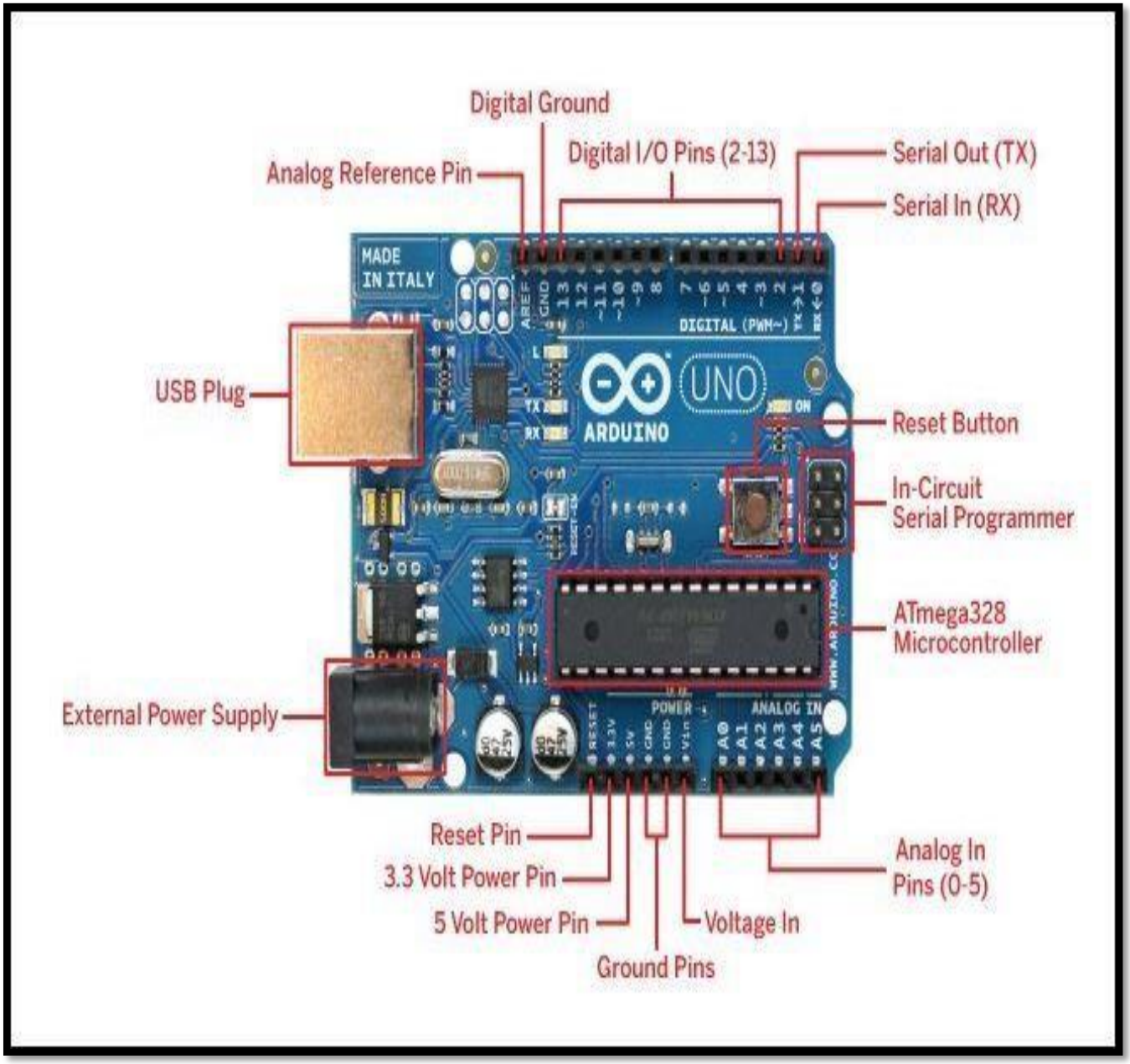


Figure 2.1 Arduino UNO[1]

2.5 Coding of Arduino UNO

Arduino UNO is coded by its Arduino IDE software. Arduino software is a kind of compiler which helps to write, compile, save and run the code and by this software we can also burn the code in the Arduino microcontroller. Arduino coding language is almost same as C and C++ and is used to work with every type of Arduino.

2.6 Connecting Arduino with Computer

Arduino is connected to computer by USB cable. Arduino board is plug n play board. After connecting Arduino, it is better to find the port number to which its Arduino is connected to avoid any ambiguity. It is done by using device manager and then going to ports. After checking ports, user need to open it's code that want to upload. Similarly, serial ports can also be verified. After all these checks now, user is ready to upload the program. User will not get any errors in uploading if all these steps which are explained above are perfectly followed. Arduino IDE software tab buttons are explained in Fig. 2.3. There are different buttons e.g. for verification, uploading, saving etc.

2.7 Atmega 328

It is powerful and high performance 28 pin microcontroller which is widely used in Arduino and follows the RISC Architecture which has a base of AVR.

Features

- External oscillator ranges from 0 to 4 MHz.
- Pulse width modulation channels are 6 in number.
- It operates with in the voltage range of 1.8 volts to 5.5 volts.

2.8 Applications of Atmega 328P

- In embedded systems projects it is widely used.
- It is also used in robots.
- Projects like small aeroplane can be made by using it.
- It is also used in motor control systems and display units.

2.9 Bluetooth Transceiver Module HC06

For transparent serial communication, Bluetooth module is used. This module is used to connect to other devices which can be mobile, computer etc. It uses serial input for receiving data which is transmitted over air and it exactly sends the received data same as it was received by it .It needs 3.6 - 6volt to operate while the RXD Pin has logic level of 3.3 volts not 5volts.Other features include its ISM band frequency which is 2.4 GHz,

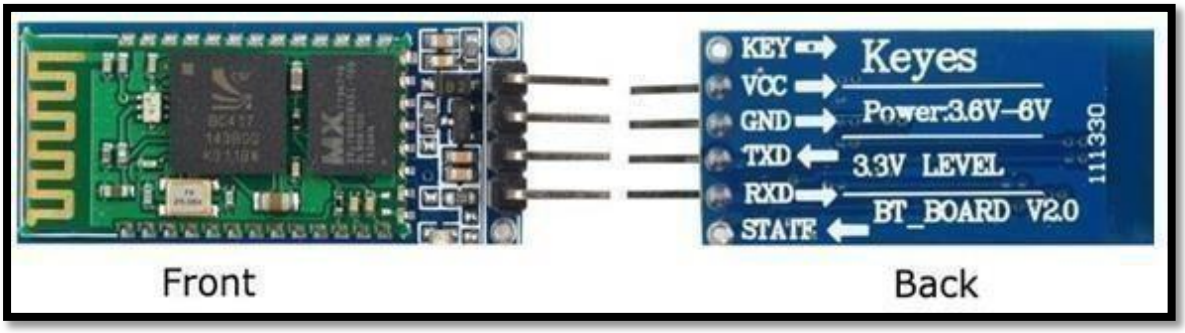


Figure 2.3 Front and Rare view of Bluetooth Module HC-06 Pin Description [2]

At its Vcc 5 volts are given while GND is attached to ground pin of Arduino and its TXD to RXD of Arduino UNO and vice versa.

2.10 Connecting of Arduino with Bluetooth

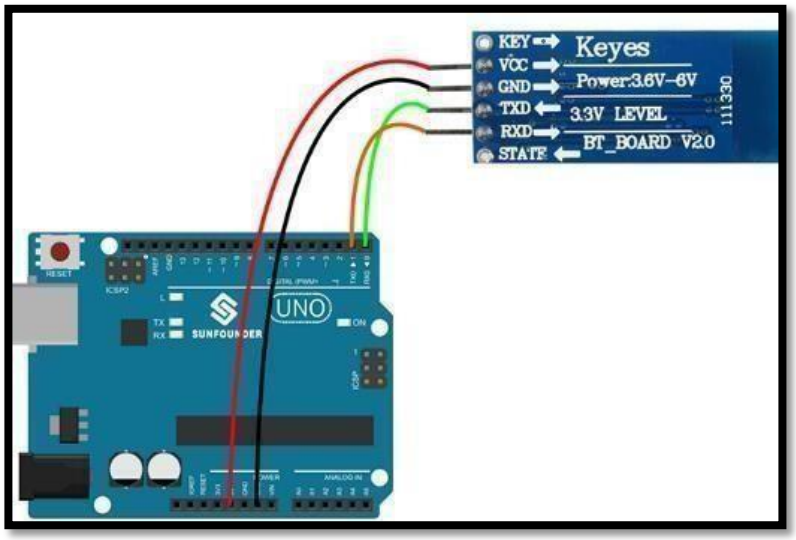


Figure 2.4 Connection of Arduino with Bluetooth [3]

2.11 Power Supply Board

Power supply board has 2 power ports on the left side of it i.e. DC port and USB port. A jumper is there at top due to which it can have a range of 3.3- 5 volts while the USB port gives 5volts only. So, when user is using USB port as power supplying the jumper port should be at 5volts; otherwise there will be no power. It has a range of voltage i.e. 6.5Volts to 12Volts and if input is DC, it has a range of of 3.3volts to 5volts.

Figure 2.4 Power Supply Board

Product Features

- Its max. output current is 700mili.Amp.
- Power indicator is in the form of a LED.
- Voltage as an input has a range of 6.5 volts to 12 volts while as output it continues from 3.3 volts to 5 volts.

2.12 Connecting With Arduino

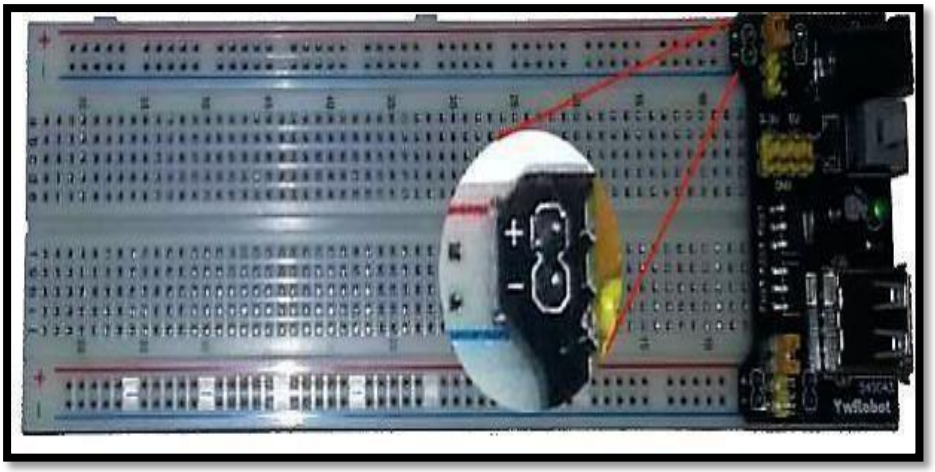


Figure 2.5 Power supply connections with ARDUINO UNO

In making connections with Arduino the important thing to be remember is that the positive (+) is aligned with the red line while negative (-) is aligned with blue line of Arduino otherwise it can cause power failure.

2.13 4 Channel Relay Module

Relays are very important component in world of electronics. These are normally used to control AC or DC loads. It can be replaced by transistor and FETs but they are not convenient to use. It is also reliable to use for driving of high power motors.

Figure 2.6 4 Channel Relay Module [4]

SPECIFICATIONS

- 4 channel relay interface board which has current range of 15mA to 20mA
- Input voltage can be 5volts or 12 volts.
- Status of relay output can be shown inform of built in LED.

Description of Pins

Vcc is its power pin and is given 5V DC
GND is connected to ground.
In#1:Single pin, connected with Arduino and control relay no. 1
In#2:Single pin,connected with Arduino and control relay no.2
In#3:Single pin,connected with Arduino and control relay no.3
In#4:Single pin,connected with Arduino and control relay no.4
COM:Common pin,attached to ground.
NO:It is normally open.
NC:It is normally close.

C:Which is attached with the power for the load

2.14 Adapter

It’s input voltage varies from 110 volts to 240 volts and AC Frequency ranges from 50Hz to 60Hz.

Max. output current is 1 ampere while Output voltage are 9 volts.

Figure 2.7 DC Adapter[5]

CHAPTER 3

INTERFACING OF COMPONENTS AND IMPLEMENTATION

3.1 Arduino IDE

The Arduino Programming Environment or Arduino Software (IDE) not only composes code but also gives message for contents being supported. It communicates with Arduino boards to verify programs and to burn these programs on Arduino Board.

3.2 Initial Setup

This is the Arduino IDE initial setup, once it is opened, it opens into a clear sketch where user can begin programming right away. To start with, user ought to arrange the board and port settings to enable it to transfer code. Arduino board is connected to the computer with the help of USB link.

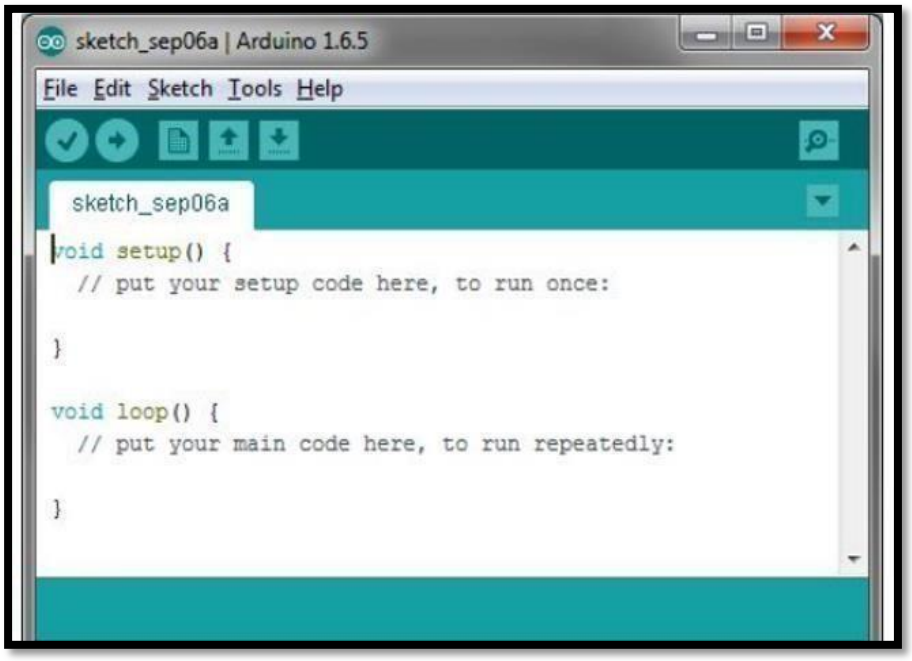


Figure 3.1 Arduino IDE Default Window[6]

3.3 Board Setup

User need to tell the Arduino IDE which board is connected to. Click the tools button and go to Board. This run down gives you option of a lot of Arduinos then select any one e.g. Arduino Uno and if user is working on another board/clone, select that board.

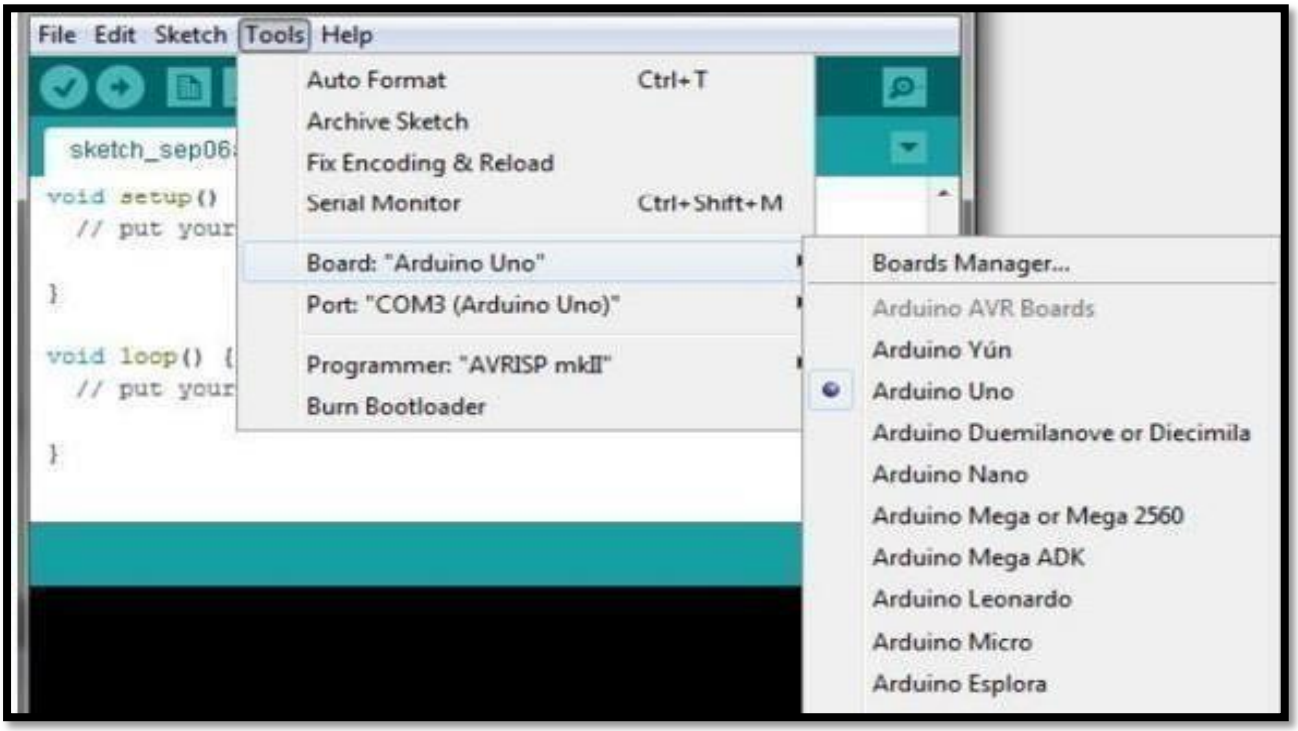


Figure 3.2 Board Setup

3.4 IDE Com Port Setup

In the event when user downloaded the Arduino IDE, before connecting user Arduino board it is important to add the USB driver. The latest Arduino IDE ought to perceive associated sheets and mark them with which COM port they are utilizing. Select the Tools pull down menu and then Port to see the list of all open COM ports.

Note: The Arduino Uno normally access COM1, it won't generally be COM3.

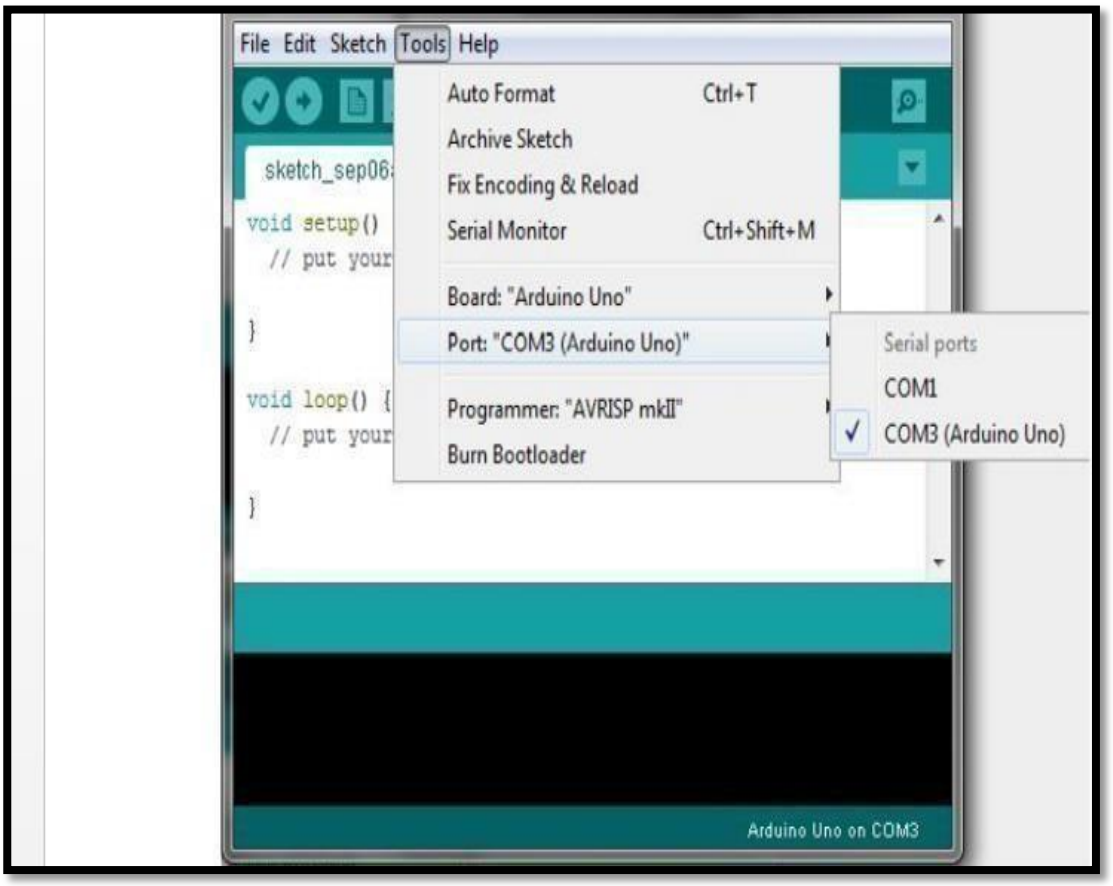


Figure 3.3 Arduino IDE, COM Port Setup

3.5 Programming with Arduino

For programming of Arduino, 80% of the programming instructions are same as C++.

Its projects are generally called sketches which have 2 main functions i.e. void setup() which runs one time only and void loop() which runs more than one time or repeatedly.

3.6 Parts of IDE Main Screen

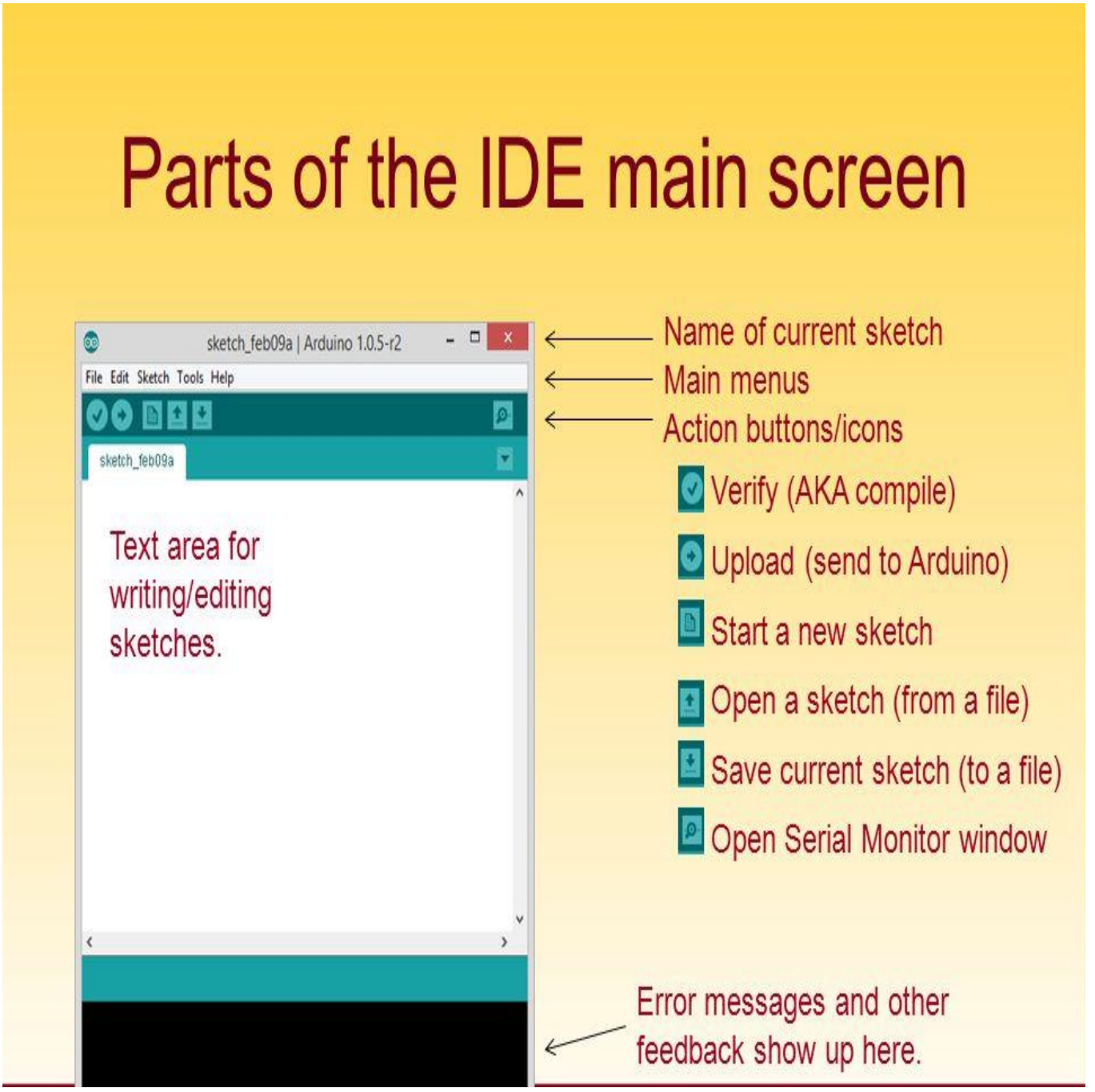
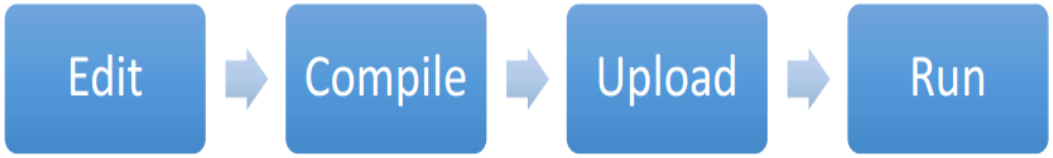


Figure 3.4 IDE Main Screen

Development cycle is divided into 4 steps



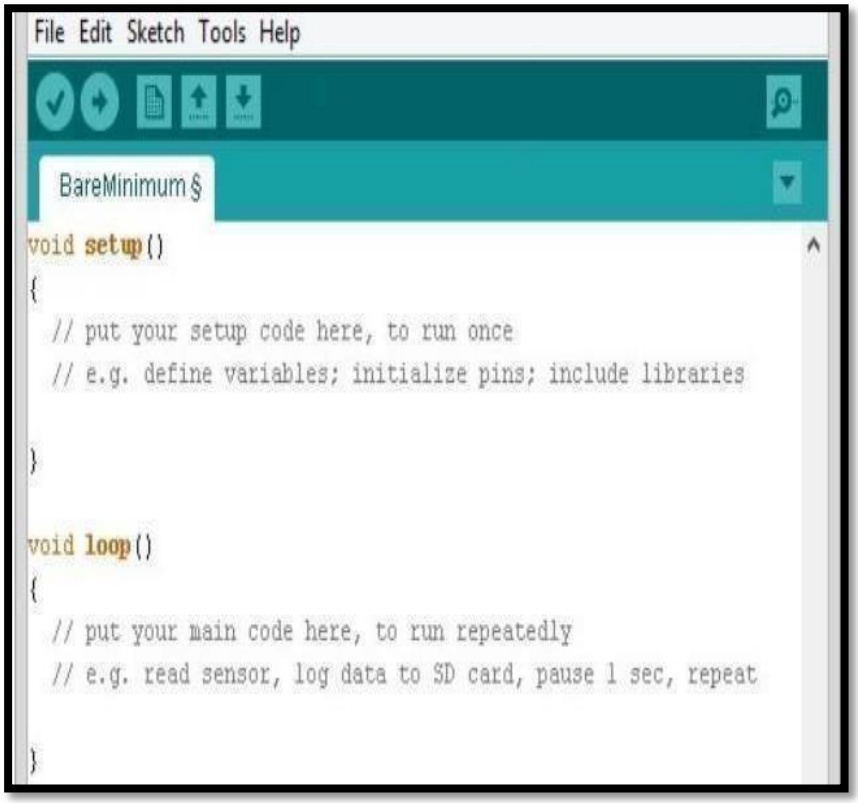


Figure 3.5 New Project of IDE

3.7 How to Add Libraries

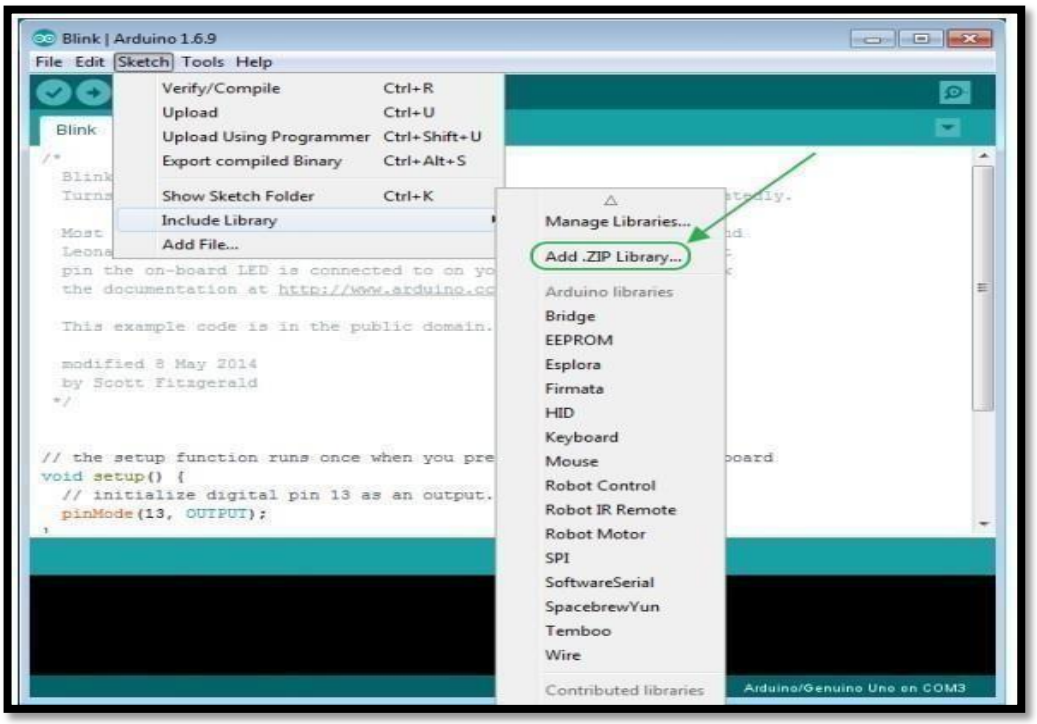


Figure 3.6 Adding Libraries [8]

Basically there are 2 ways to add library which are not in the proteus, firstly user search i.e. Manage libraries if mentioned library is there, it appears if not then it searches online itself and give list of library and shows Add .ZIP Library which user opt.

LED Blinking as an Example

To check Arduino is working properly and code is burning. For this user select file then examples then Basics and afterward select Blink.

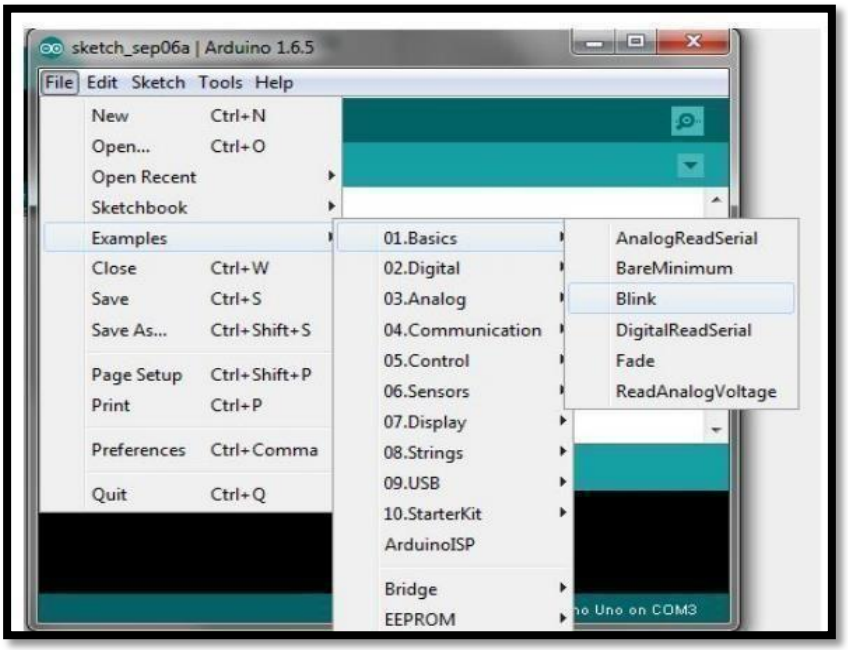


Figure 3.7 Arduino IDE LED Blinking Search

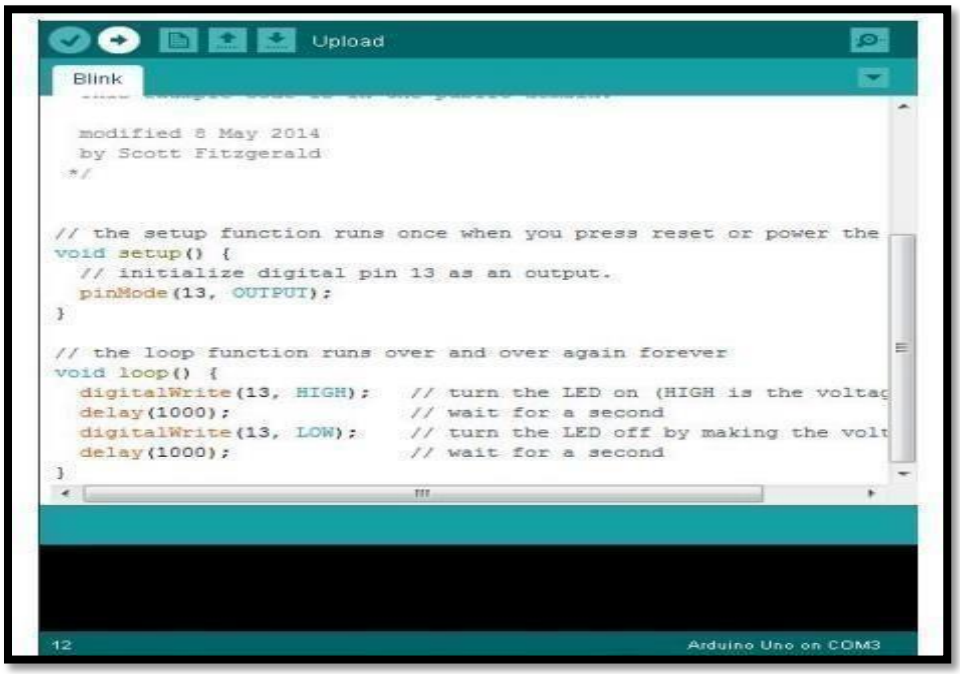


Figure 3.8 Code of Led Blinking

3.8 MIT Application Inventor for Android

3.8.1 Application Inventor

MIT App Inventor is free online development tool software with visual programming surroundings. By using MIT APP. INVENTOR one can build absolutely practical applications for smart telephones and tablets. The user friendly environment of this software can be used to develop high effects applications in drastically less time than the conventional programming environment.

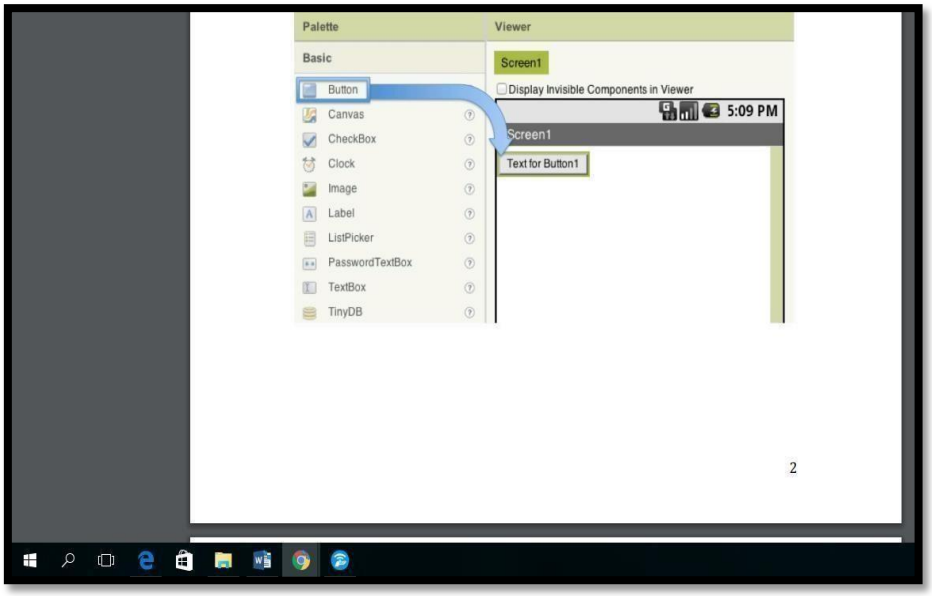


Figure 3.9 Starting Screen of MIT Application Inventor [9]

Its block based tools empowers all the users to develop pretty and user friendly applications which can be easily used with a android telephone. Briefly here is explained the working environment of MIT Application Inventor.

3.8.2 How to Add A Button

A button on the application screen is added by dragging it down on the screen from the menu bar available on left side.

Figure 3.10 Screen to Add Button[10]

3.8.3 Changing Properties of Button

The properties of the button can be changed by going on the right side which further gives option of text, color filling etc.

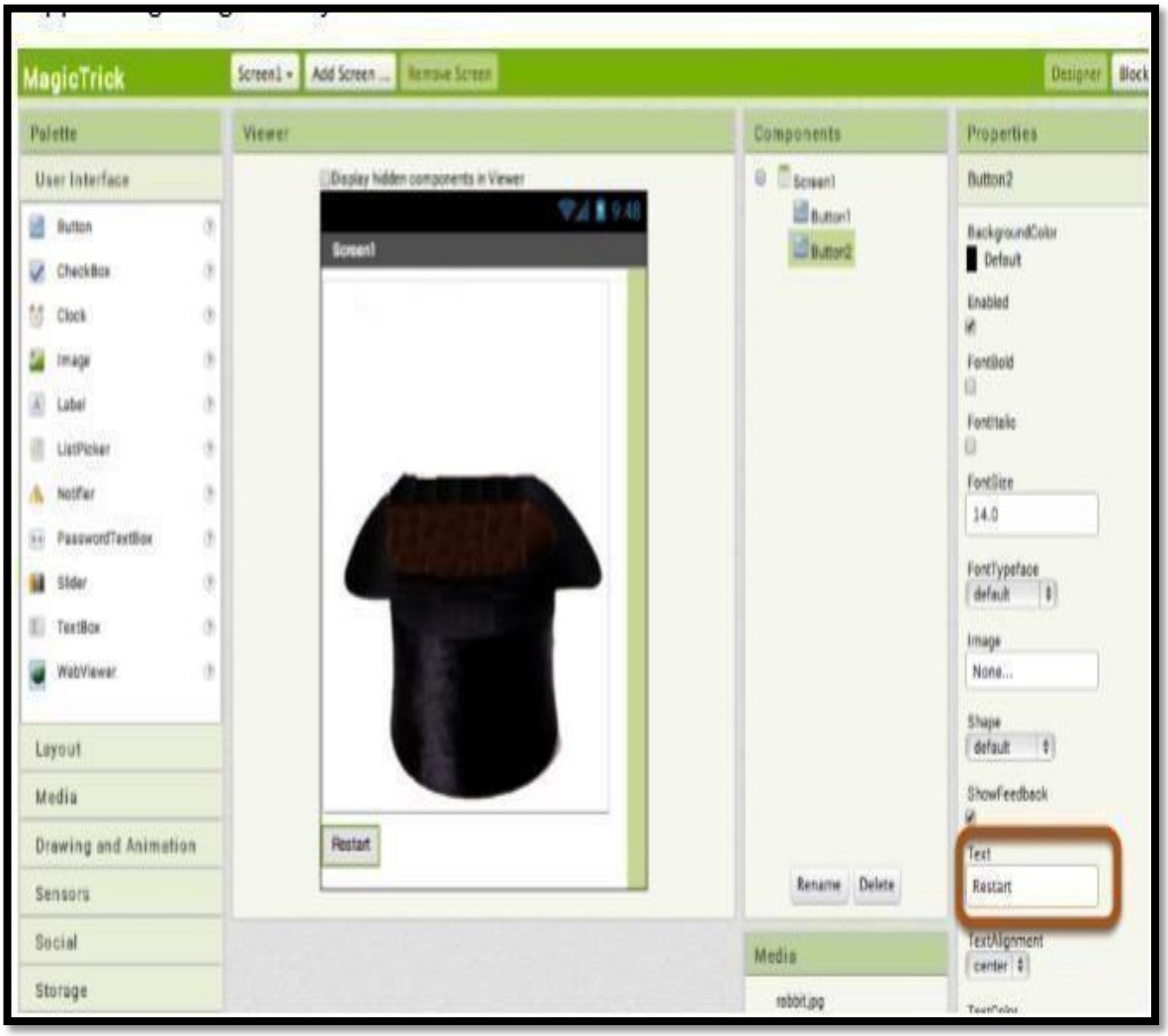


Figure 3.11 Changing Properties of Button

3.8.3 Changing Names

It is often confusing when user has more than one kind of the identical name issues i.e. the same button name for more than 1 buttons. This issue can be resolved by renaming the button names by using the rename facility of the MIT APP. INVERTOR.

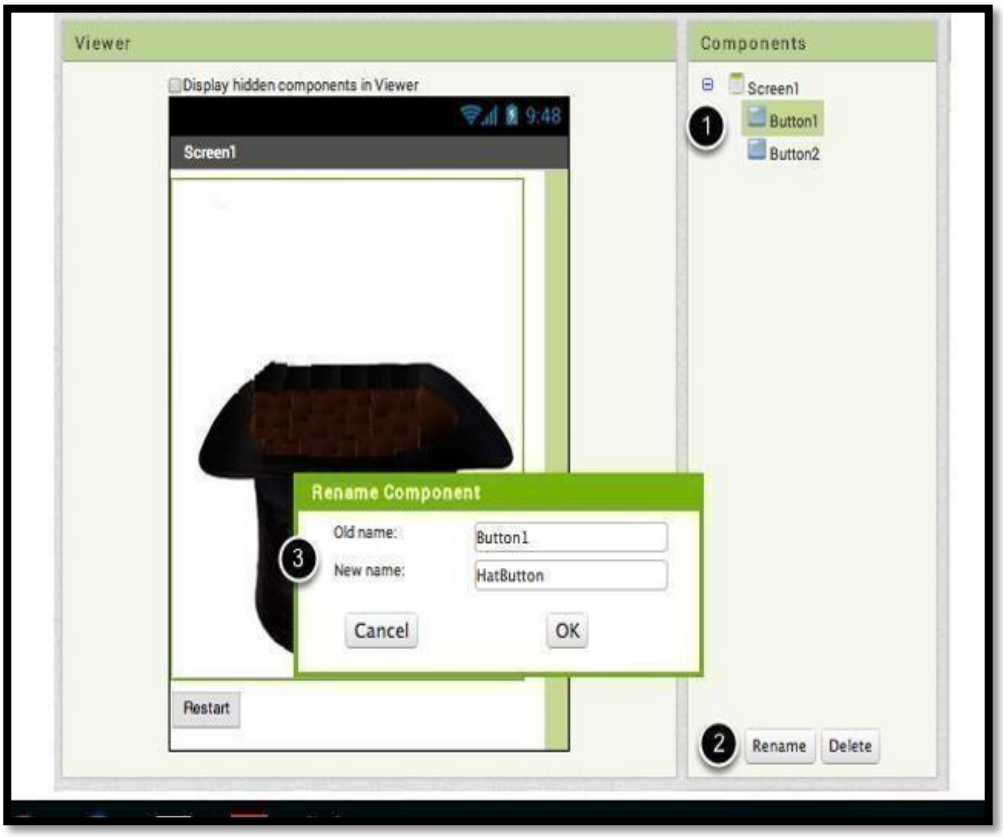


Figure 3.12 Naming the Button

3.9 Interfacing of Components

3.9.1 Bluetooth Module HC-06 with Arduino

To check the hardware and proper working of the interface a simple program of LED blinking is tested as follow.

- Code for Arduino UNO is written in IDE environment.

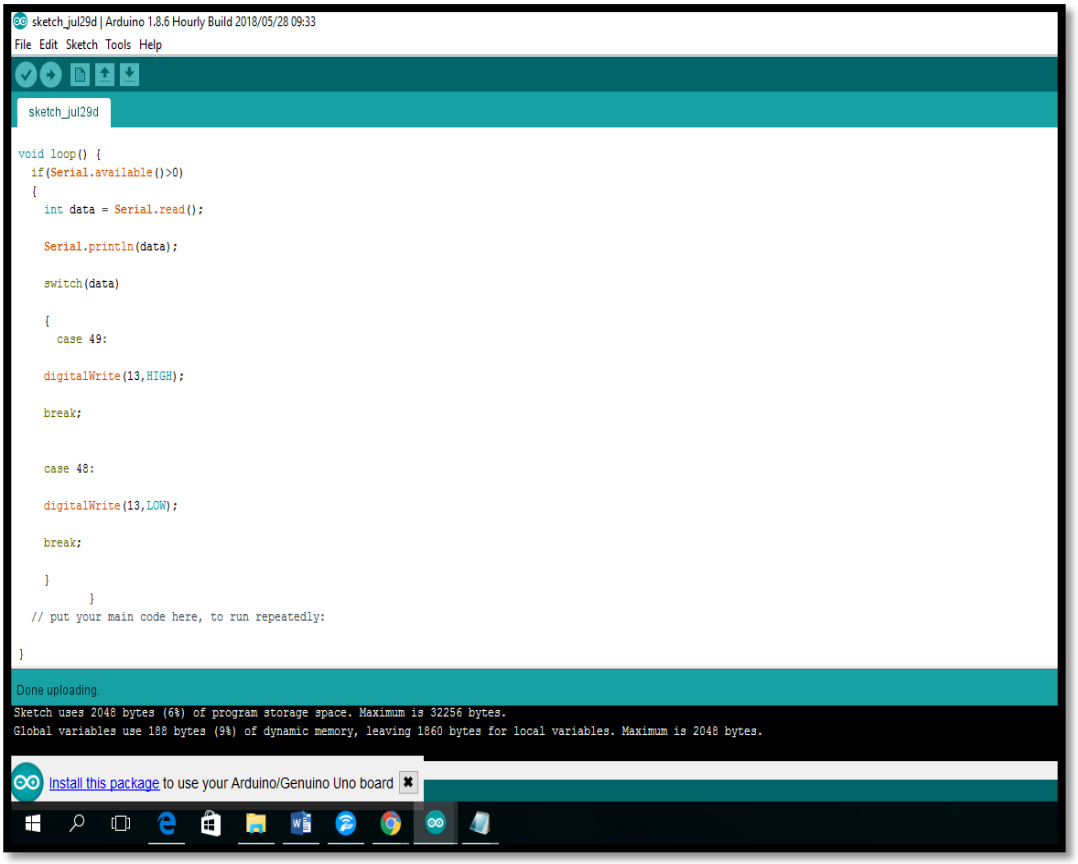
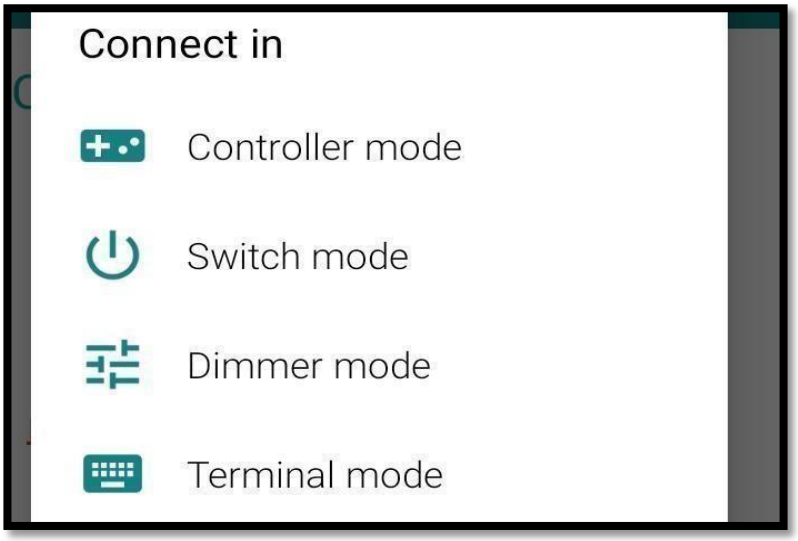


Figure 3.13 Code for Interfacing Bluetooth

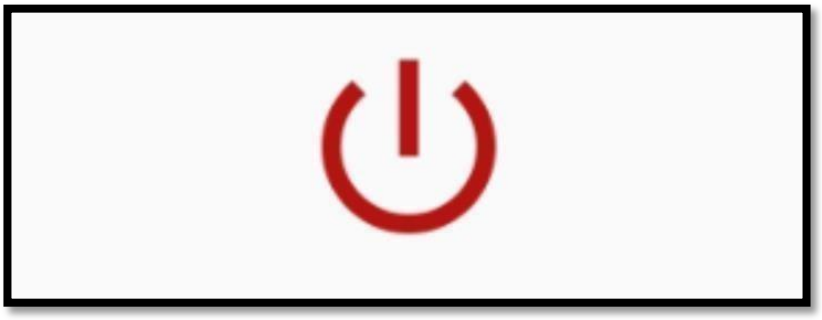
- Then this code is uploaded on the board.
- The Tx and Rx pins are plugged out to avoid error message.
- The led is connected with 13 pin of Arduino UNO.
- With the help of Arduino Bluetooth Control Application, the LED can be controlled in 3 different modes that are given here.

- 

1.Switch Mode

When the user clicks on the switch mode the following two options appear on the screen. Any of these two options may be selected i.e. Green for on and Red for off.

A. It gets on when this window appear



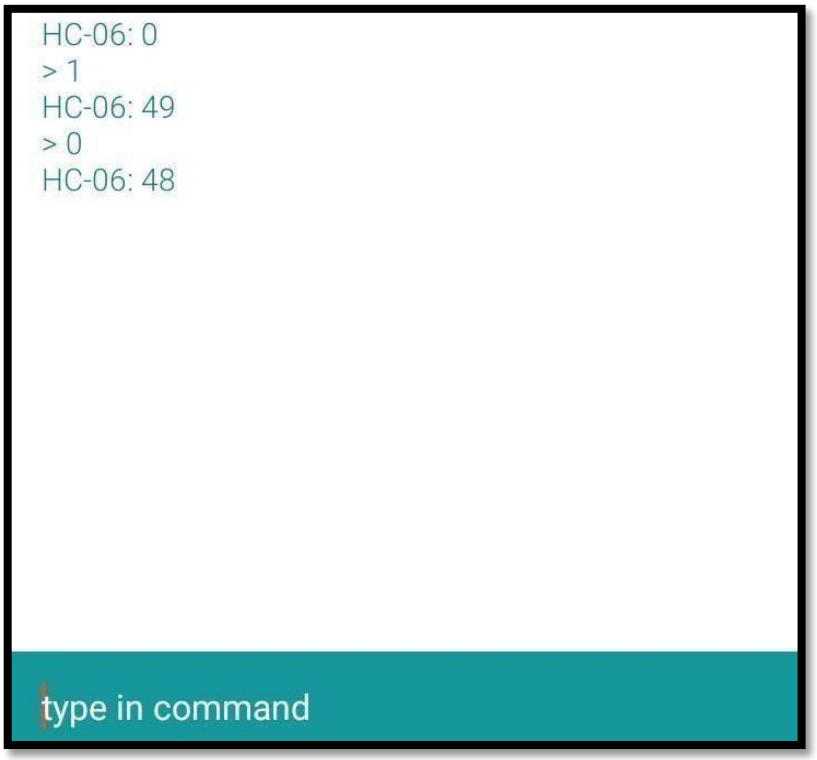
B. It gets off when this window appears**.**

2. Terminal Mode

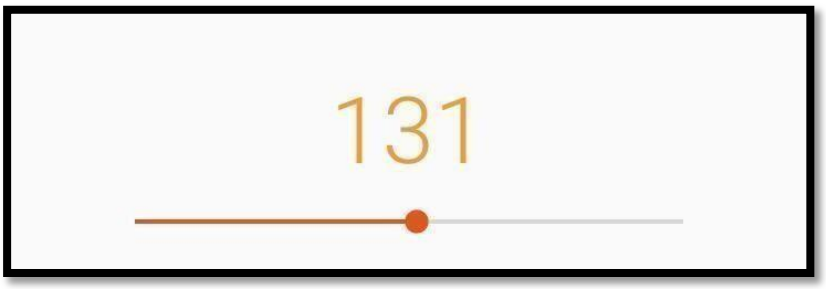
In this mode when user gives 1 then LED gets ON

And the screen looks like this

Similarly when user give 0 LED gets off and the window appears like this

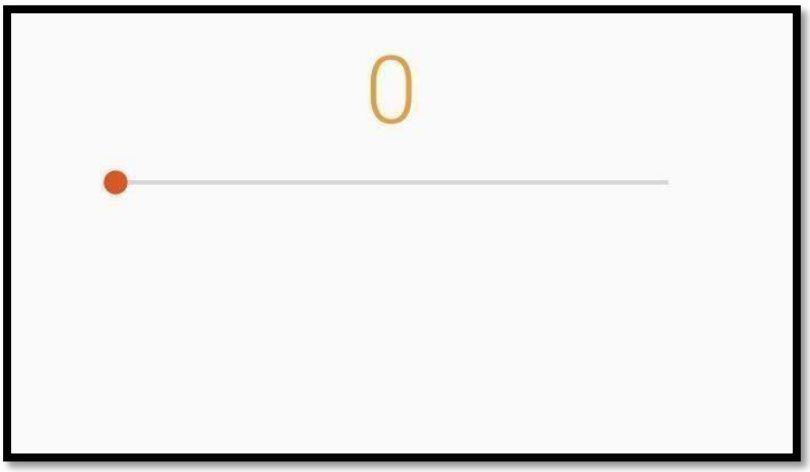


3. Dimmer Mode



This mode is used to control the intensity of the LED which is increased or decreased by dragging the button towards right or left.

Which shows the intensityof led which increases i..e OFF When this window appears



3.10 Interfacing of 4 Channel Relay Module

To check the proper working of relay module, each relay is checked one by one by adding delay between them. The code for delay is shown in the following window.

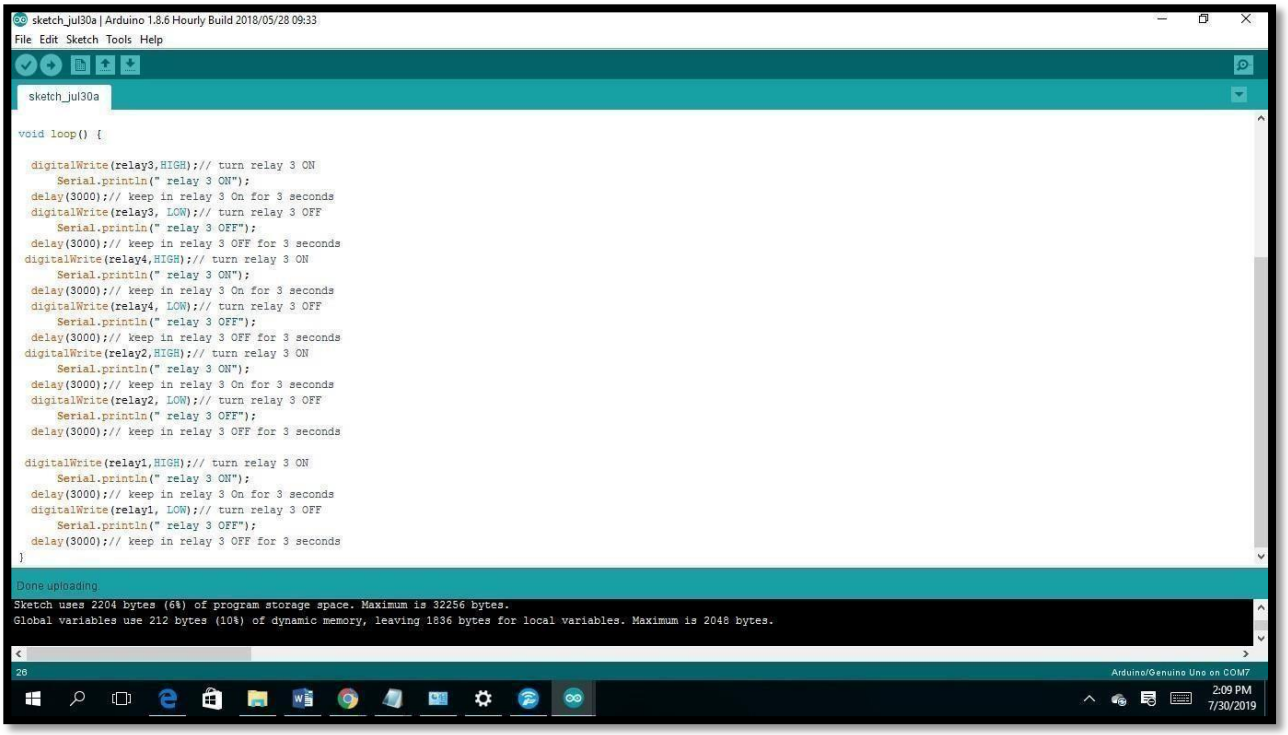


Figure 3.14 Coding for 4 Channel Relay Module

The execution of this code causes firstly relay 3 to get off for 3 seconds and then gets on and then relay 4 to get on for 3 seconds and then gets off and then relay 2 to get on for 3 seconds and gets off and the last relay 1 to get on for 3 seconds. The same process repeats itself again and again.

CHAPTER 4

WORKING OF THE SYSTEM

4.1 WORKING

The working of the system is very simple. All the necessary components of the system discussed in chapter second are connected with each other to complete the hardware of project as shown in diagram.

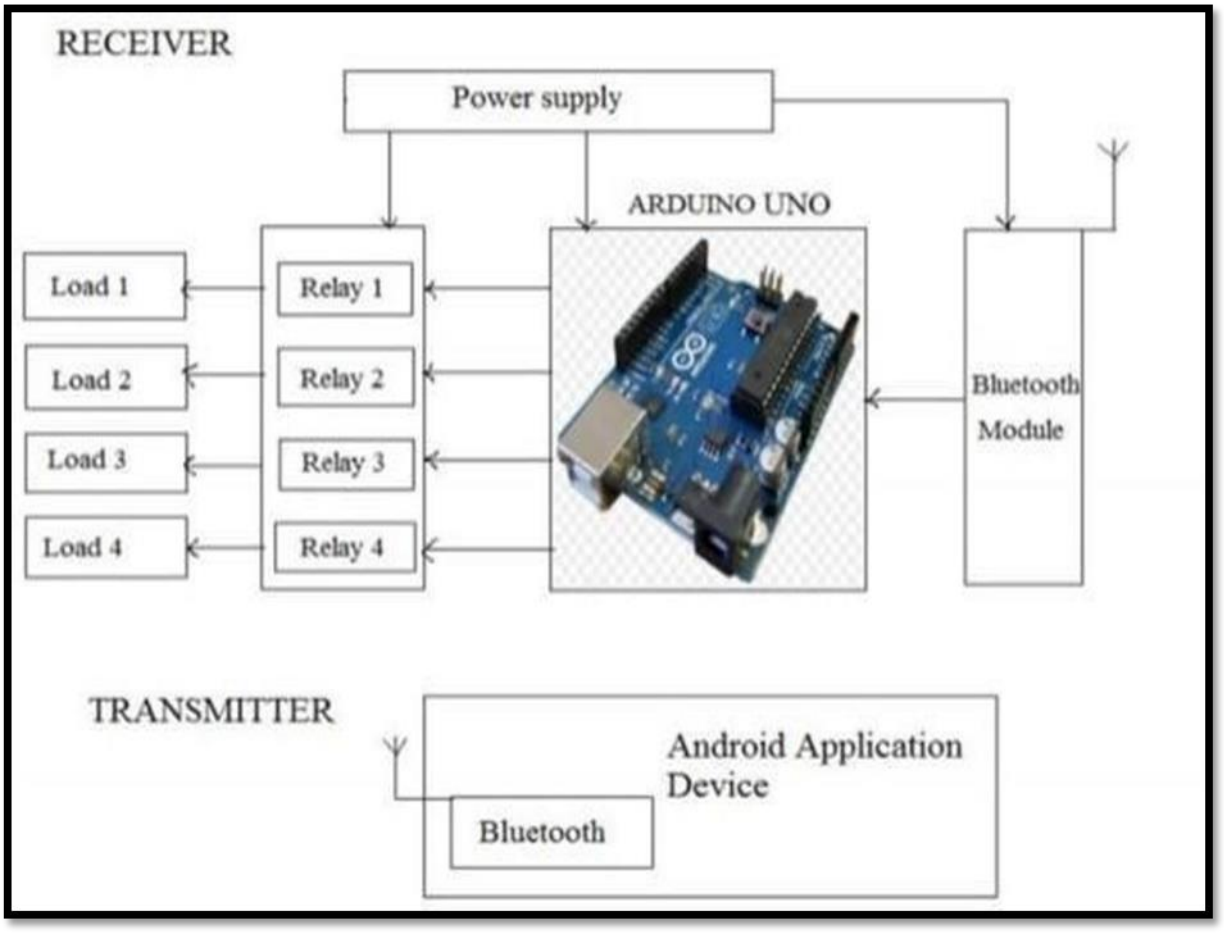


Figure 4.1 Block Diagram of Project[11]

After making the connections it comes to running of the project. Bluetooth module is used to connect the devices and the appliances to be controlled within the range of the Bluetooth of mobile phone.

It is important for the working of Bluetooth module connected with the electric

appliances that it must be within the range of Bluetooth of mobile phone. The Arduino UNO board is used to receive the signals from Bluetooth device to control the relays. The four relays used here are to attach the loads. The switching of each relay may be noted by the working of LED attach with it.

By using MIT application software, application software has been developed for android. This application software has been developed to define the connections of relays with their respective loads. The user can use this android application to turn on/off different electrical appliances in pre-defined manner.

The working of the project depends upon the software application being used by the user to control different appliances. The programming at the back end of the application decides for the relay connection to be connected with the load. The phone application also controls the time of switching of the appliances.

4.2 Flow Chart of Hardware

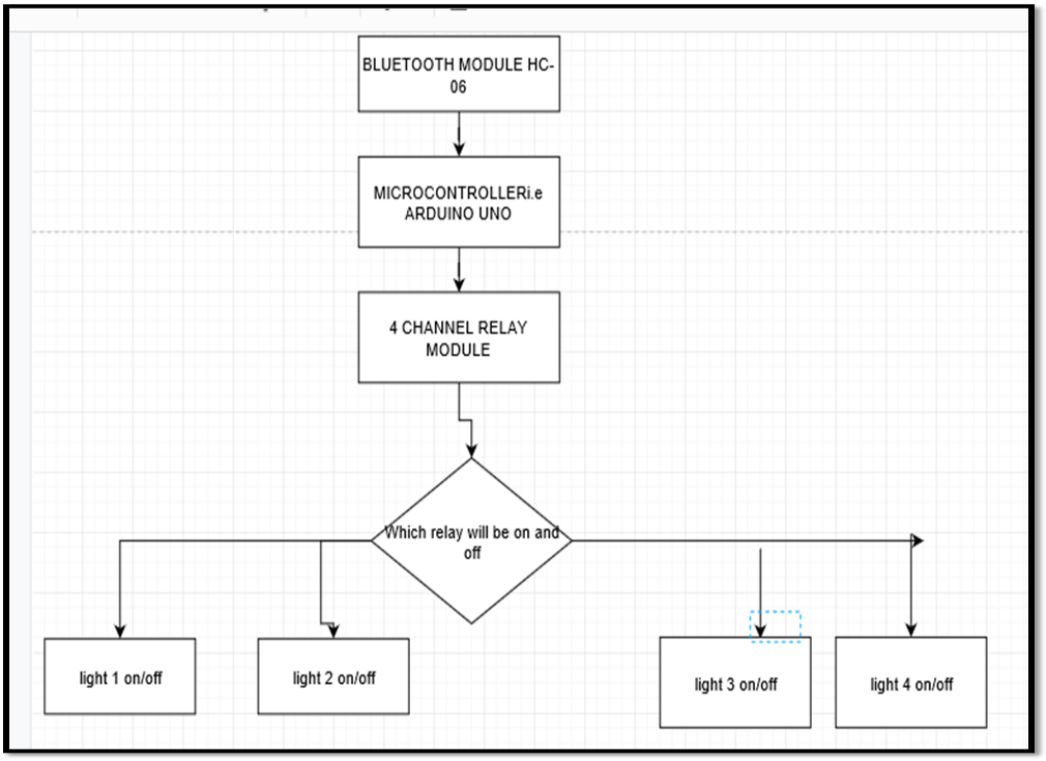


Figure 4.2 Flowchart of Hardware

4.3 Flow Chart of Application Software

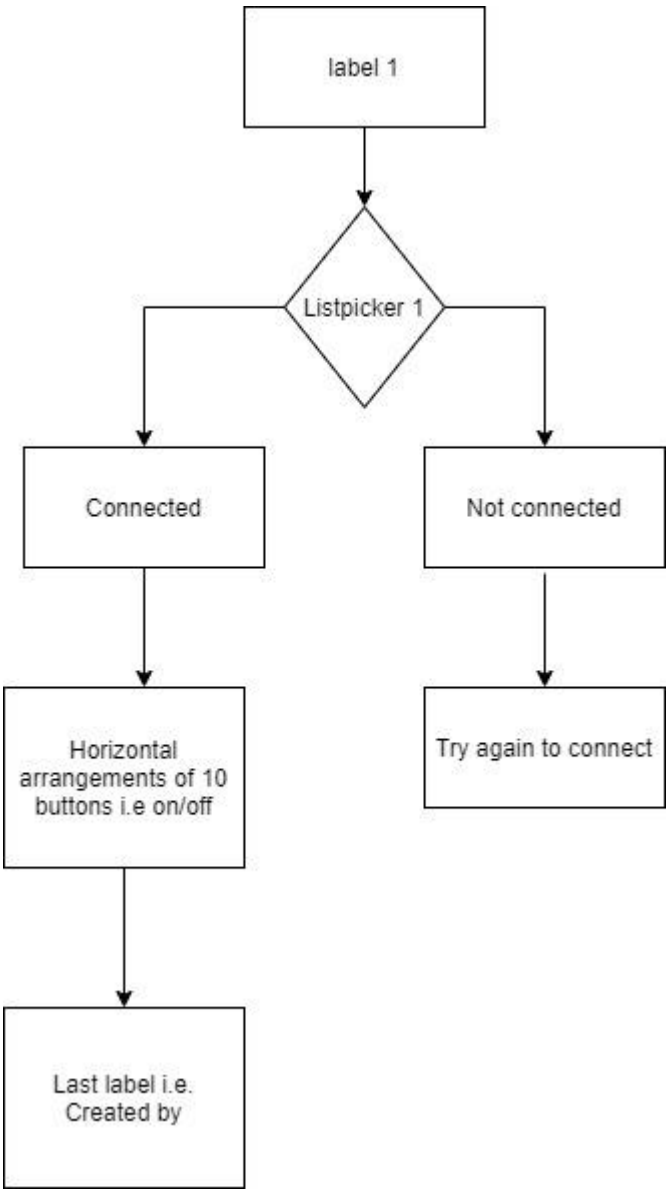


Figure 4.3 Flow Chart of Software Section

4.4 Back End of Application Software

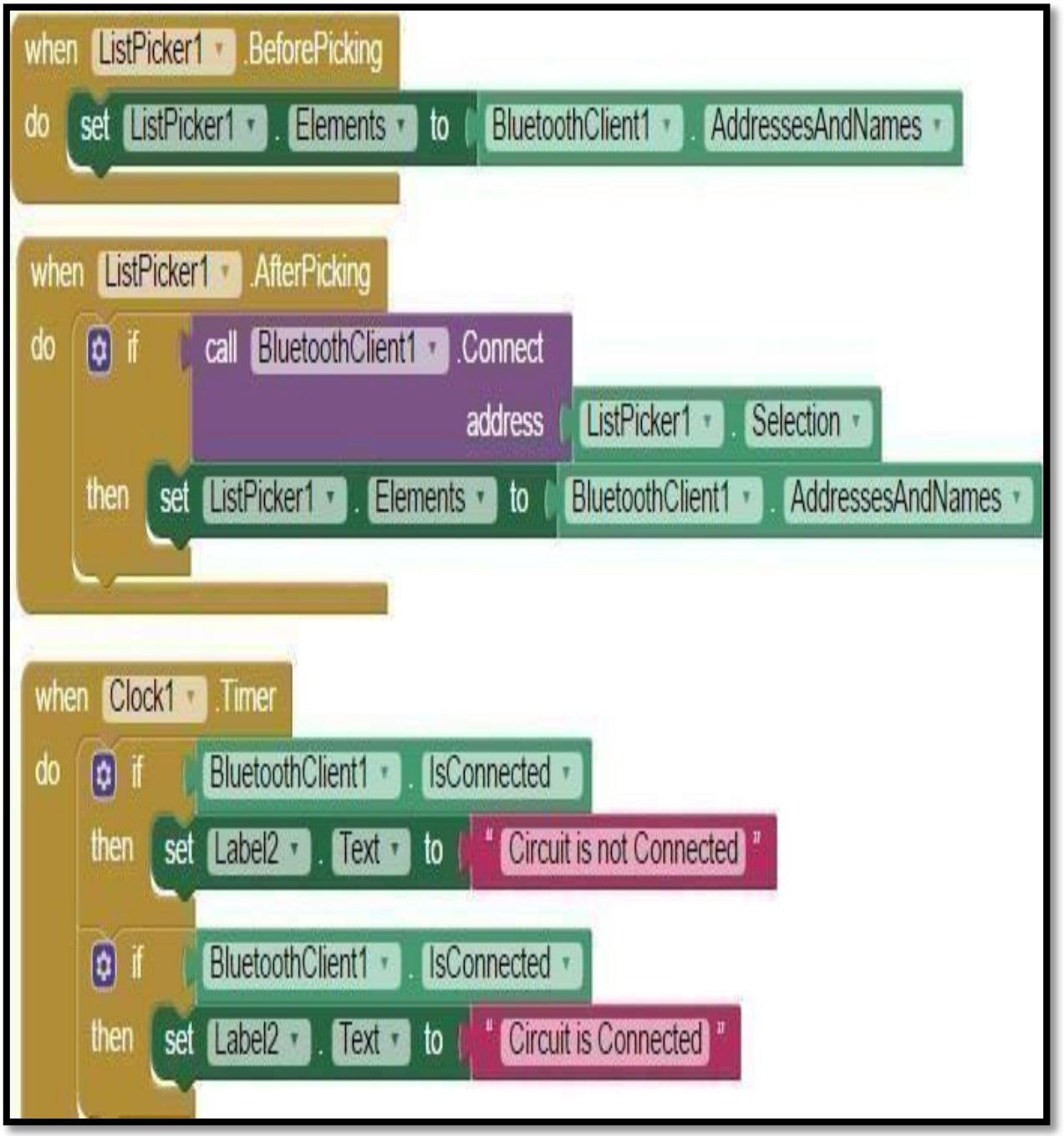


Figure 4.3 Back End of MIT APP.

This is the backend designing of application on the MIT APP. INVENTOR software which has some basic things to be understood to design user's own application

1. So coming towards block 1 by which designing starts is List picker 1 before picking to Bluetooth client 1 which simply add our Label 1 at the top and gives the Bluetooth a name and address of course address for communication.

2. Label 2 is kept blank and label 3 is made i.e. connect which is accordingto name and address of our module which users are using it after picking

3. The clock block is mentioned here which gives clock and text or message appears on the screen that device is connected or not.

4.5 Back End of Horizontal Arrangement of Buttons

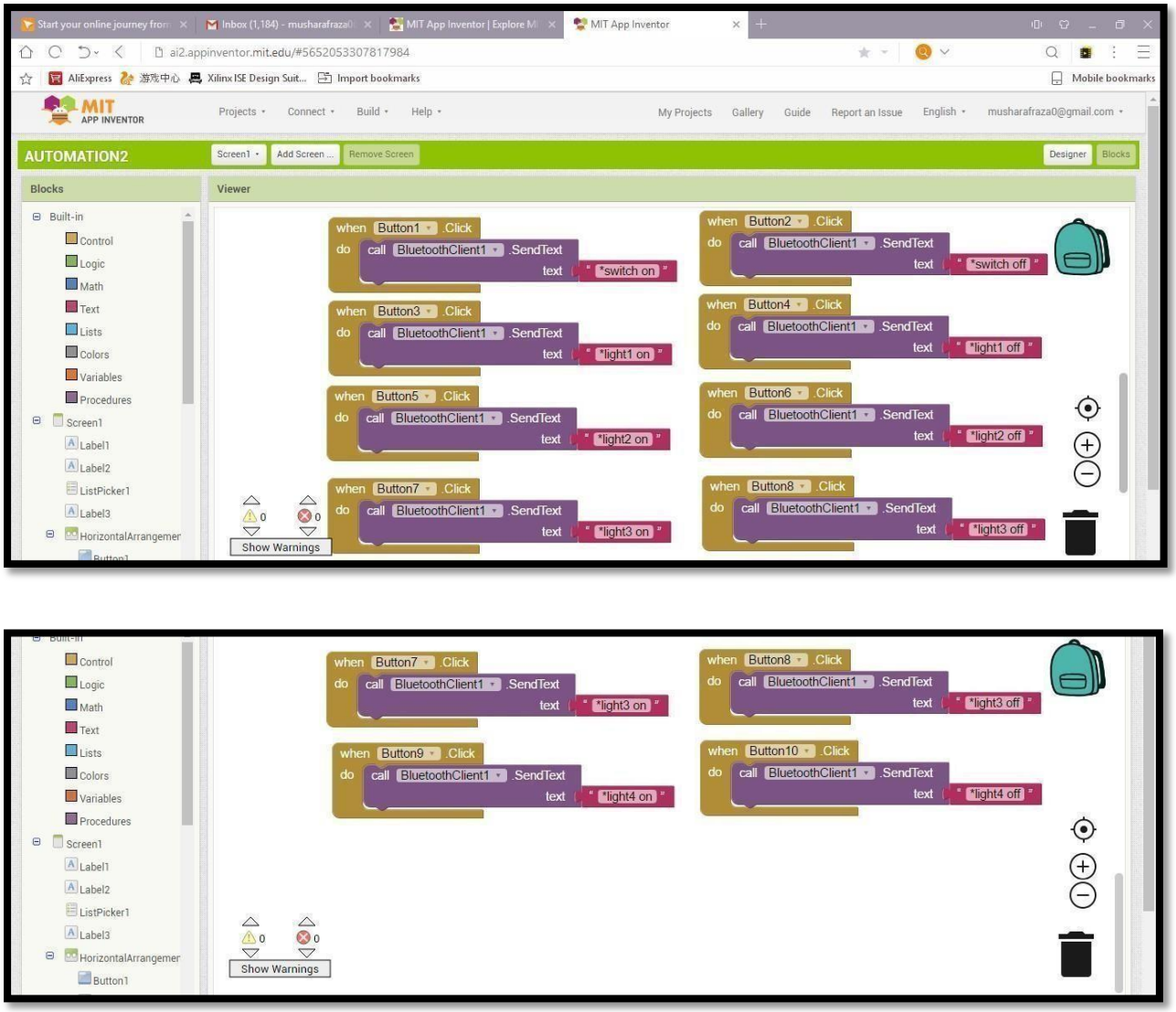


Figure 4.4 Arrangements of Button

BUTTON 1: Actually works on the condition set in the code that when all lights are to be ON then user press this.

BUTTON 2: It is handy when the user wants to close all lights.

BUTTON 3 and 4: Are used for light 1 ON/OFF.

BUTTON 5 and 6: Are used for light 2 ON/OFF.

BUTTON 7 and 8: Are sed for light 3 ON/OFF

BUTTON 9 and 10: Are used for light 4 ON/OFF.

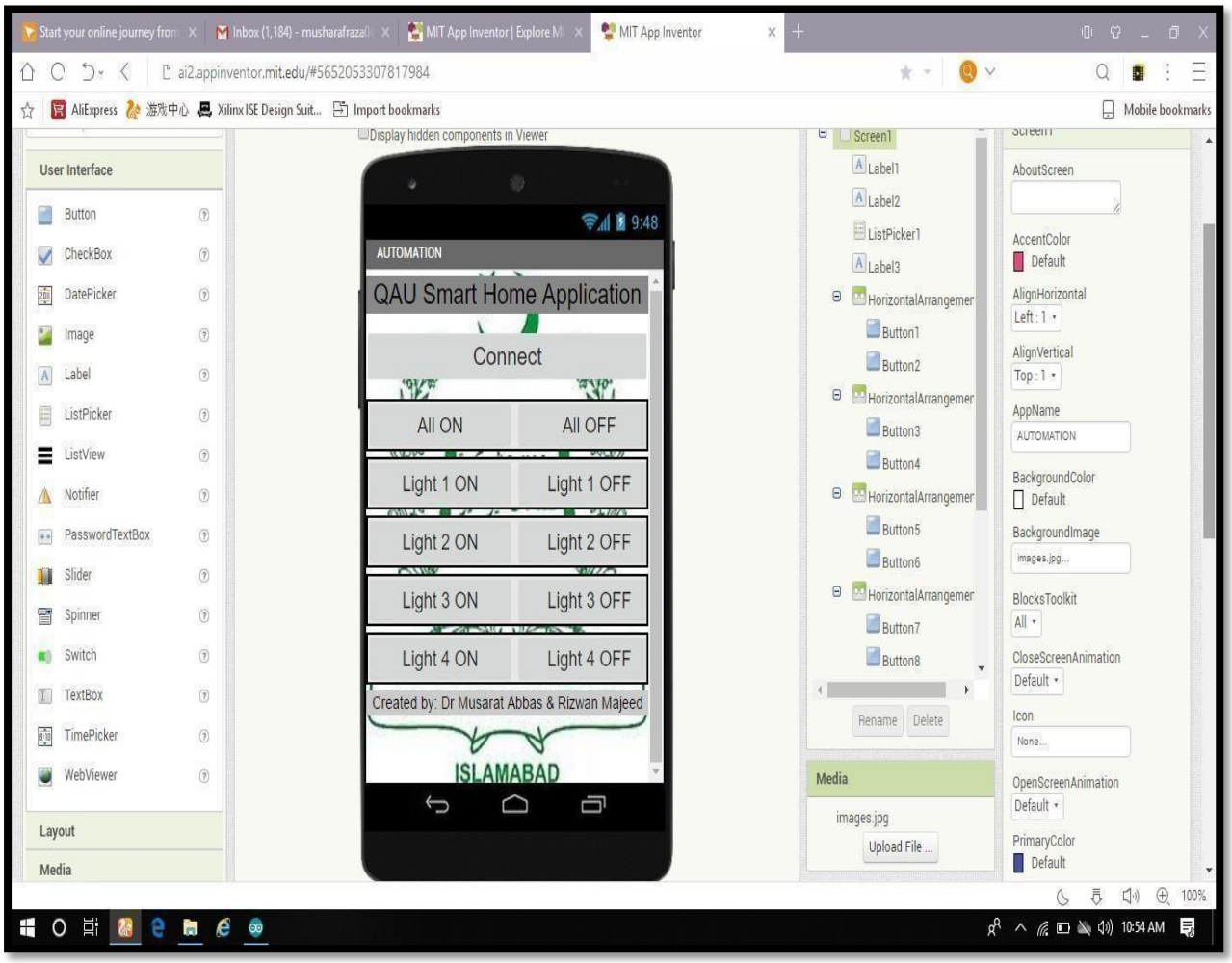


Figure 4.5 Main Screen of Application

4.6 Main Screen of Android Application

This main screen of user application is shown here with name QAU Smart Home Application. The Main Screen is divided in five rows with two columns. The specific name on the software buttons are reserved for specific appliance being controlled. All of the ten buttons are horizontally arranged and center aligned.

4.7 Code of The Project

```
String readString;
#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 void setup()
{
Serial.begin(9600);        //Set rate for communicating with phone pinMode(relay1, OUTPUT);      //Set
relay1 as an output pinMode(relay2, OUTPUT);
pinMode(relay3, OUTPUT);      //Set relay2 as an output pinMode(relay4, OUTPUT);
digitalWrite(relay1, HIGH); //Switch relay1 off digitalWrite(relay2, HIGH); //Swtich relay2 off
digitalWrite(relay3, HIGH); //Switch relay1 off digitalWrite(relay4, HIGH); //Swtich relay2 off
}
void loop()
{
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
}
readString += c;//Means readString = readString + c
}
if (readString.length() >0)
{
Serial.println(readString); if(readString == "*switch on"){ switchallon();
}
else if(readString == "*switch off"){ switchalloff();
}
else if(readString == "*light1 on"){ digitalWrite(relay1, LOW);
}
else if(readString == "*light1 off"){ digitalWrite(relay1, HIGH);
}
else if(readString == "*light2 on"){

digitalWrite(relay2, LOW);
}
else if(readString == "*light2 off"){ digitalWrite(relay2, HIGH);
}
else if(readString == "*light3 on"){ digitalWrite(relay3, LOW);
}
else if(readString == "*light3 off"){ digitalWrite(relay3, HIGH);
}
else if(readString == "*light4 on"){ digitalWrite(relay4, LOW);
}
else if(readString == "*light4 off"){ digitalWrite(relay4, HIGH);
}
readString="";
}
}
void switchalloff()         //Function for turning OFF all relays
{
digitalWrite(relay1, HIGH); digitalWrite(relay2, HIGH); digitalWrite(relay3, HIGH); digitalWrite(relay4,
HIGH);
}
void switchallon()         //Function for turning ON all relays
{
digitalWrite(relay1, LOW); digitalWrite(relay2, LOW); digitalWrite(relay3, LOW); digitalWrite(relay4,
LOW);
}
```

CHAPTER 5

CONCLUSION AND FUTURE WORKS

5.1 Conclusion

After the implementation of the project it becomes very easy to control the appliances by a simple click on the application installed in the mobile. This is user's choice which appliances user want to control by the application and according to that one develops its application i.e. in this user have just controlled 4 lights but can control fans and other appliances like AC. For doing this Arduino is attached to Bluetooth module HC- 06 and 4 channels relay whose output is shown on the relay or when implemented the loads get ON/OFF which can be any device whose voltage readings match with the relay module. The system designed as a result of this will be low cost, reliable and flexible and more importantly it is very easy to control or use so there is no need of user manual for it.

5.2 Future Works

The completion of this home automation project led us to extend this work on large scale, specially it may be extended for industries. The status of the power failure can be examined if a memory module is attached here with this project. Secondly real time clock appliances may be used to turn on/off automatically in offices etc.

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