Bluetooth based Home Automation using Arduino

A Project Report
Submitted in partial fulfillment of the
Requirements for the award of the Degree of
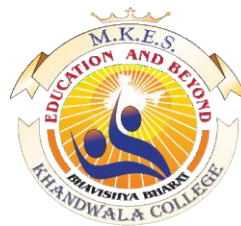
BACHELOR OF SCIENCE (INFORMATION TECHNOLOGY)

By

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558

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NAGINDAS KHANDWALA COLLEGE

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MAHARASHTRA

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<u>CERTIFICATE</u>

This is to certify that the project titled, **"Bluetooth based home automation using Arduino"**, is bonafied work of **Dipen Limbachia** bearing Seat.No:**558**submitted in partial fulfillment of the requirements for the award of degree of BACHELOR OF SCIENCE in INFORMATION TECHNOLOGY from University of Mumbai.

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ABSTRACT

The world is moving fast towards automation. People have less time to handle any work so automation is simple way to handle any device or machine will work to our desire. Modern houses are gradually shifting towards the smart home,means from conventional switches to centralized control.

Even with switches 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.

This paper aim is to develop and design a Home automation using Arduino with Bluetooth module. Home automation system gives a simple and reliable technology with Android application. Home appliances like fan, Bulb, AC, are controlled by Home automation system using Arduino Uno with Bluetooth module.

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 paper mainly focuses on the control of smart home by Android phone.
This paper motive is controlled home appliances in smart home with user friendly, design at low cost, simple installation.

ACKNOWLEDGEMENT

I am very thankful to **Mrs. Ancy Jose**, the principal of Nagindas Khandwala College for her kind co-operation in the completion of my project.

I also Thanks **Mrs. Sindhu.P.M.**Head of IT/CS Department in our college for supporting me.

Itakethisopportunitytoexpressmydeepsenseofgratitudetowardsmyprojectguide **Ms. Vishakha Bhgwe** for her help and letting me work as I wished without putting pressure on me.

I want to express my gratitude and appreciation to all those who gave me the possibility to complete this project. A special thanks to my parents and my brother for providing me with my needs and their stimulating support.

I also thankful to our other staff of our department for facilitating me with the necessary requirements and support and co-operation. My project experience was satisfying, fulfilling acknowledge filled lastly I would like to thank my college Nagindas Khandwala college of commerce, arts and science (autonomous) for providing me with proper ambience and supplying me with the right amenities that has helped me complete this project on time and satisfyingly.

DECLARATION

I here by declare that the project entitled,"**Bluetooth based home automation using Arduino**"doneat**Nagindas Khandwala College**, has not been in any case duplicated to submit to any other university for the award of any degree. To the best of my knowledge other than me, no one has submitted to any other university.

The project is done in partial fulfillment of the requirements for the award of degree of

BACHELOROFSCIENCE(INFORMATIONTECHNOLOGY)to be submitted as final semester project as part of our curriculum.

(Dipen Limbachia)

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Chapter 1
Introduction

1.1. Background

- In 1975, the first general purpose home automation network technology, X10, was developed. It was a communication protocol for electronic devices. It primarily uses electric signal transmission wiring for signalling and control, where the signals involve radio frequencybursts of digital data, and remains the most widely available.By 1978, X10 products included a 16 channel command console, a lamp module, and an appliance module. Soon after came the wall switch module and the first X10 timer.

- History and background of main components used in project

- ARDUINO:

    In 2005, building upon the work of Hernando Barragán (creator of Wiring), Massimo Banzi and David Cuartielles created Arduino, an easy-to-use programmable device for interactive art design projects, at the Interaction Design Institute Ivrea in Ivrea, Italy. David Mellis developed the Arduino software, which was based on Wiring. Before long, Gianluca Martino and Tom Igoe joined the project, and the five are known as the original founders of Arduino.

- BLUETOOTH MODULE:

    HC-05 is a Bluetooth module which is designed for wireless comunication. This module can be used in a master or slave configuration.

    It has range up to <100m which depends upon transmitter and receiver, atmosphere, geographic & urban conditions.

- 2 channel relay module

    It is a 5V 2-Channel Relay Module board, Be able to control various appliances, and other equipment with large current. It can be controlled directly by Microcontroller (RaspberryPi, Arduino, 8051, AVR, PIC, DSP, ARM, ARM, MSP430, TTL logic).

1.2. Objective

- To develop a home automation system using an Arduino UNO board to remotely switch on or off any household appliance.
- Reliable and scalable home automation system.
- Can be used by physically challenged and disabled people
- Comfortable and less complex to use system
- Power saving and improves overall efficiency
- Helpful for elderly people

1.3. Purpose and Scope

1.3.1. Purpose

- The use of Arduino based home automation includes smart control of home appliances using an android device with the help of Bluetooth module.
- The home appliance include fan, lights ,refrigerator, AC,etc
- This system is not only designed to be install in home but this can also be used in offices for which helps to save time, even it can be used in malls, etc

1.3.2. Scope

- The project aims at designing a system for controlling the home appliances that can be controlled wirelessly via an application. An application is run on android device. The system can be used in an range of 10 meters due to HC-05 BLUETOOTH MODULE .The system integrated with different features can be applied in the following fields:-
- The system can be used in home, small offices, malls.
- For remote access of appliances via Bluetooth.
- For the development of technology friendly environment.
- The system incorporates the use of technology and making smart home automation. By the use of day to day gadgets we can utilize them for different prospective.

1.3.3. Applications

- "Home automation" this title itself define its applicability in different fields.

- This system does not consist of variety of applicability.

- Arduino based Bluetooth home automation can be used in small as well as big home as a centralized control, which can remotely control appliances of home through an android device.

- This device makes a use of Bluetooth module to connect through android device due to which it has an range of 10 meters

- This system can also be used in old age home and at house for physically challenged people because it is many time very tedious task for elderly people to go to the switch board and switch things on and off.

1.4.   Achievements

- This project is helped me to understand that how a home automation system actually works.

- After finishing this project I came across many things that I didn't knew before.

- First of all it helped me learn Arduino UNO board and how it can be used as a link between hardware and software, also I learned how to code for Arduino UNO and how to upload the code in the chip.

- Then come the Bluetooth module we are using Bluetooth in our devices from many years but after using HC-05 I understood the proper working of Bluetooth.

- Relay module help me understand how an electrical switch works on commands does.

- Bread board and jumper cables were the one which helped me to understand the connections between Arduino, Bluetooth and relay.

1.5. Organization of the Report

Thereportisdividedintosevenchapters.Chapter1givesabriefintroductionoftheproject   covered. It contains the basics of a Radar and the other tools and components used for completion of thisproject.

Chapter1aimsattheliteraturesurveyoftheprojectconsistingofthebasicideaoftheproject, and how we got the idea to make this project, all the help like websites, journals etc. also it gives brief introduction about theproject.

Chapter2coversthelistofthecomponentsusedintheprojectsandhowtousethem.Thetime taken for completing the project is alsoincluded

Chapter 3 shows the all types of diagram like logic diagram, block diagram, flowchartetc.

Chapter 4 include testcases.

Chapter 5 includes the test report.

Finally, Chapter 6 deals with the present as well as the future scope of the project, like how we can make use of this project for the betterment of the mankind.

Chapter 2
System Analysis

2.1. Existing System

- The history of radar started with experiments by Heinrich Hertz in 19th century that acknowledge that radio waves were reflected by metallicobjects.

- In 20th century that systems able to use these principles were becoming widely available, and it was a German investor who first used them to build a simple ship detection device set to help avoid collisions in environment likefog.

- Multiplesimilarsystems,whichprovideddirectionalinformationtoobjectsovershortranges, were developed over the next twodecades.

- Radar contributed very little to theory, which was largely known since the daysof Mr .Maxwell andHertz.

2.2. Proposed System

- So many existing software are available.

- The home automation system is also available but not in such a cheap cost.

- In this we need to improve the change like huge range of connectivity with android device, with the help of wifi module.

- It is also very easy to use interface so that it can be used by elderly people.

2.3. Requirement Analysis

Requirements analysis is very critical to the success of a development project. Requirements can be actionable, measurable, testable, related to identified business needs or opportunity, and defined to a level of detail sufficient for system design. Requirements can be functional and non-functional.

Functional Requirements

Functional requirements explain what has to be done by identifying the necessary task, activity that must be accomplished .Functional requirements analysis will be used as the high- level functions for functional analysis

Non-Functional Requirements

Non-Functional requirements are requirements that specify criteria that can be used to judge the operation of a system, than specific behaviors.

Performance is main key factor for any process as it focuses on how efficiently my system will work.

Execution is principle key factor for any procedure as it centers on how productively my framework will function.

Planning &Scheduling
Gantt Chart

	A	B	C	D	E
1	**Task Mode**	**Task Name**	**Duration(Days)**	**Start**	**Finish**
2	Task 1	Requirement Gathering	25	6/1/2020	6/26/2020
3	Task 2	Analysis	30	6/28/2020	7/28/2020
4	Task 3	Design	35	8/1/2020	9/5/2020
5	Task 4	Coding	80	10/1/2020	12/20/2020
6	Task 5	Testing	30	12/21/2020	1/20/2021
7	Task 6	Installation	25	1/21/2021	2/15/2021

Figure 2. 1 Gantt chart1
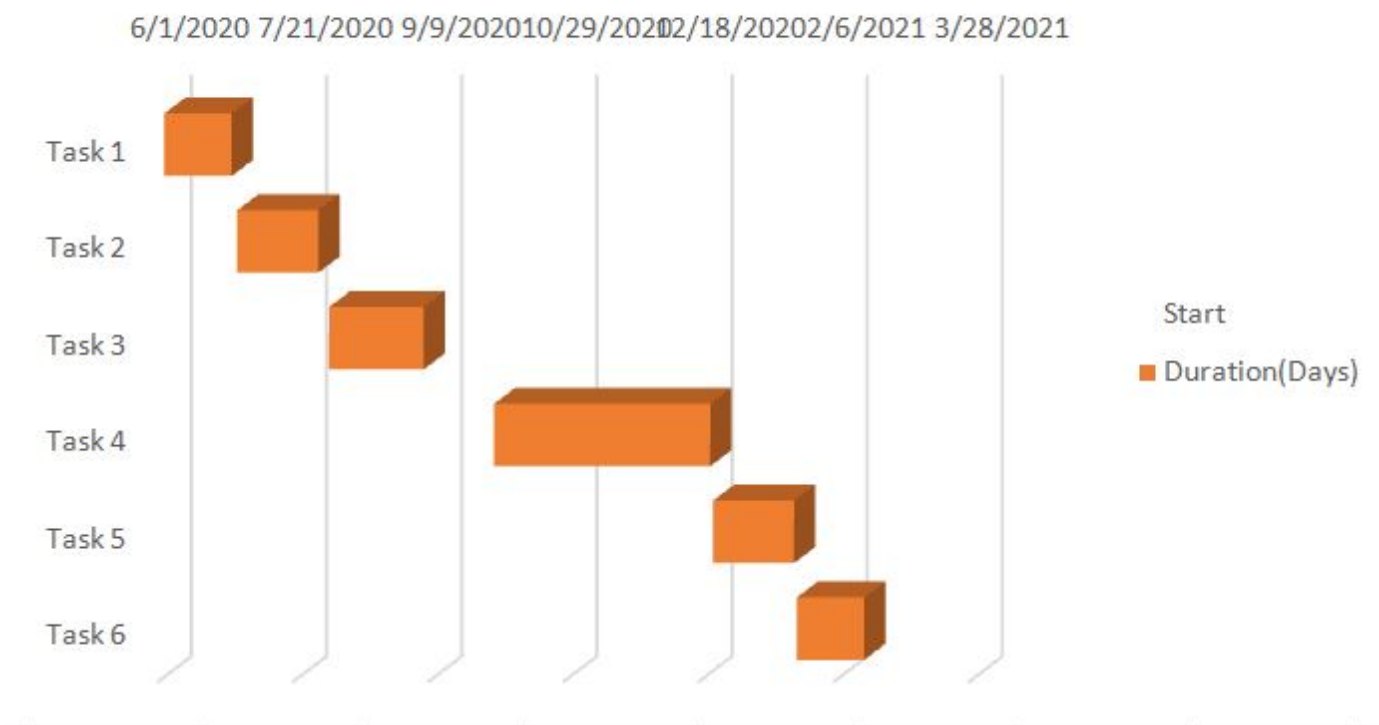
Figure 2. 2 Gantt chart2

LOCMetrics

Figure 2. 3 Loc metrics

Cocomo modal

YOUR BASIC COCOMO RESULTS!!								
MODE	"A" variable	"B" variable	"C" variable	"D" variable	KLOC	EFFORT, (in person/months)	DURATION, (in months)	STAFFING, (recommended)
organic	2.4	1.05	2.5	0.38	29	82.3624277351544	13.363403494317382	6.163282263397792

Explanation: The coefficients are set according to the project mode selected on the previous page, (as per Boehm,81). The final estimates are determined in the following manner:

effort $=a*KLOC^b$, in person/months, with KLOC = lines of code, (in the thousands), and:

duration $=c*effort^d$, finally:

staffing $=$ effort/duration

For further reading, see Boehm, "Software Engineering Econimics",(81)

WARNING: If you see "NaN" in any field above, you have entered an **INVALID** value for KLOC!! Hit the "BACK" button on your browser, hit the "RESET" button, and enter a **DECIMAL NUMBER** in the KLOC input text box!

Thank you, and happy software engineering!

Figure 2. 4 Cocomo modal

Cost Analysis

- ArduinoUNO–   450Rs
- Bluetooth module   208Rs
- 2 channel relay module   231Rs
- Jumper Wires (MtoF)-   80Rs
- Bread board   87Rs
- Wire   10Rs
- bulb with holder   150Rs

- **Total-**   **1,216Rs**

2.4. HardwareRequirements

Arduino UNO

It is a single board microcontroller used to control the function of servo motor and ultrasonic sensor. It sends the angular information to servo motor on which the motor rotates and sensor works as per that directions.
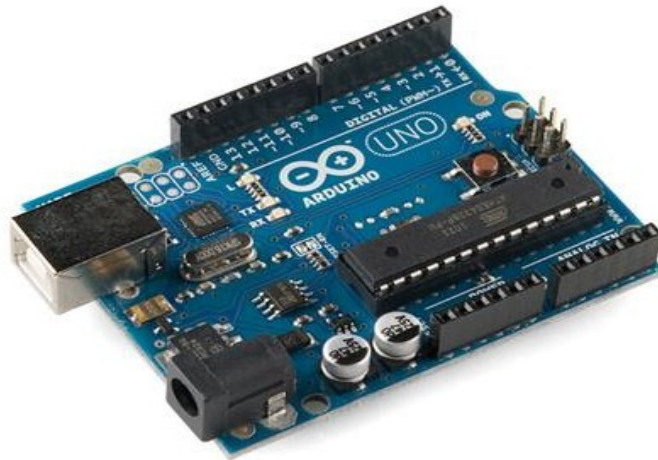

Figure 2. 5 Arduino UNO

Bluetooth module HC-05

The Bluetooth module HC-05 is a MASTER/SLAVE module.By default the factory setting is SLAVE.The Role of the module (Master or Slave) can be configured only by AT COMMANDSThe slave modules cannot initiate a connection to another Bluetooth device, but can accept connections.Master module can initiate a connection to other devices.The user can use it simply for a serial port replacement to establish connection between MCU and GPS, PC to your embedded project, etc.
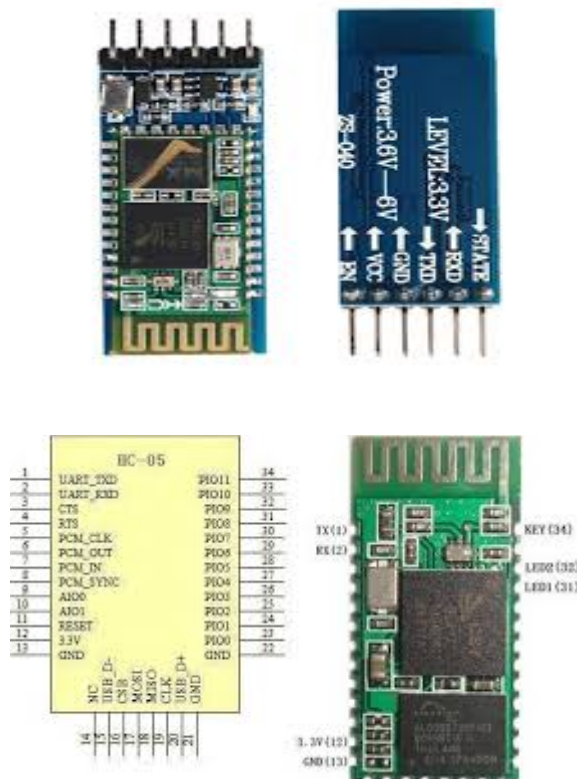

Figure 2. 6 HC05 Bluetooth module

Pin Description:-

The HC-05 Bluetooth Module has 6pins. 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 onand 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 paired 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.

BUTTON SWITCH:
This is used to switch the module into AT command mode.To enable AT command mode,press the button switch for a second.With the help of AT commands,the user can change the parameters of this module but only when the module is not paired with any other

BT device.
Ifthe module is connected to any other bluetooth device, it starts to communicate with that device and fails to work in AT command mode.
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

Relay Module:
 Overview

Relay is an electromagnetic switch which is used to defer two circuits electrically and connect magnetically. When Arduino transmit the signal then relay driver receive signal and start its work.They are frequently used to interface an electronic circuit (working at low voltage) to an electrical circuit which works at extremely high voltage. For instance, a hand-off can make a 5V DC battery circuit to switch 230V AC mains circuit. In this way a little sensor circuit can drive, say, a fan or an electric knob. A transfer switch can be separated into two sections: information and yield. The info area has a loop which creates attractive field when a little voltage from an electronic circuit is connected to it. This voltage is known as the working voltage. Generally utilized transfers are accessible in various arrangement ofworking voltages like 6V, 9V, 12v, 24V and so on.In a basic hand-off there are three contactors: ordinarily shut (NC), regularly open (NO) and normal (COM). At no info express, the COM is associated with NC. At the point when the working voltage is connected the transfer curl gets charged and the COM changes contact to NO. Diverse transfer setups are accessible like SPDT and DPDT which have distinctive number of changeover contacts. By utilizing legitimate blend of contactors, the electrical circuit can be turned on and off. Relay circuit shown in fig2.7
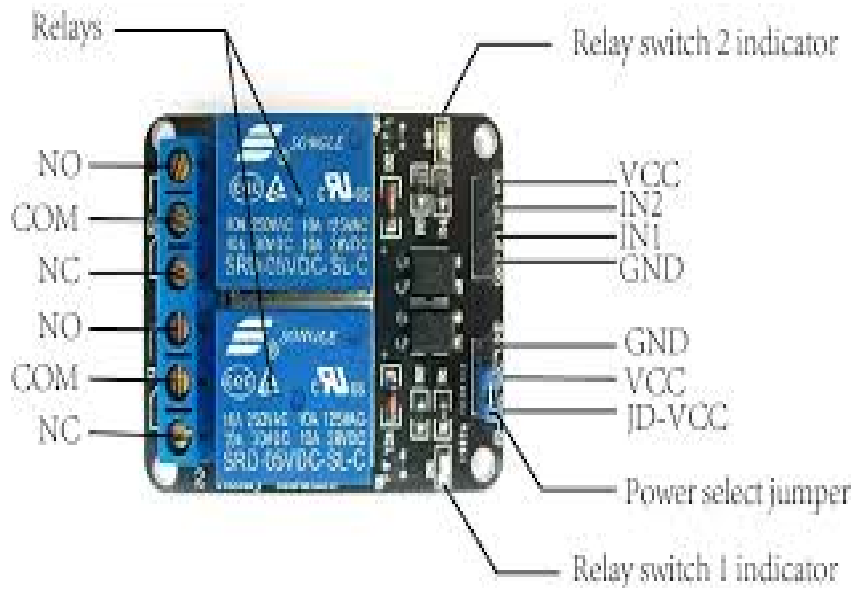
Figure 2. 7 relay module

Male to Female Jumper Wire

A jumper wire is an electrical wire, or bunch of them in a cable, with a connector or pin at each end, which is normally used to interconnect the components of a breadboard or other test circuit, internally or with other components, without soldering.
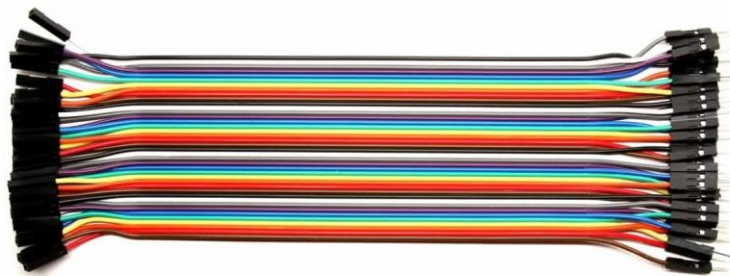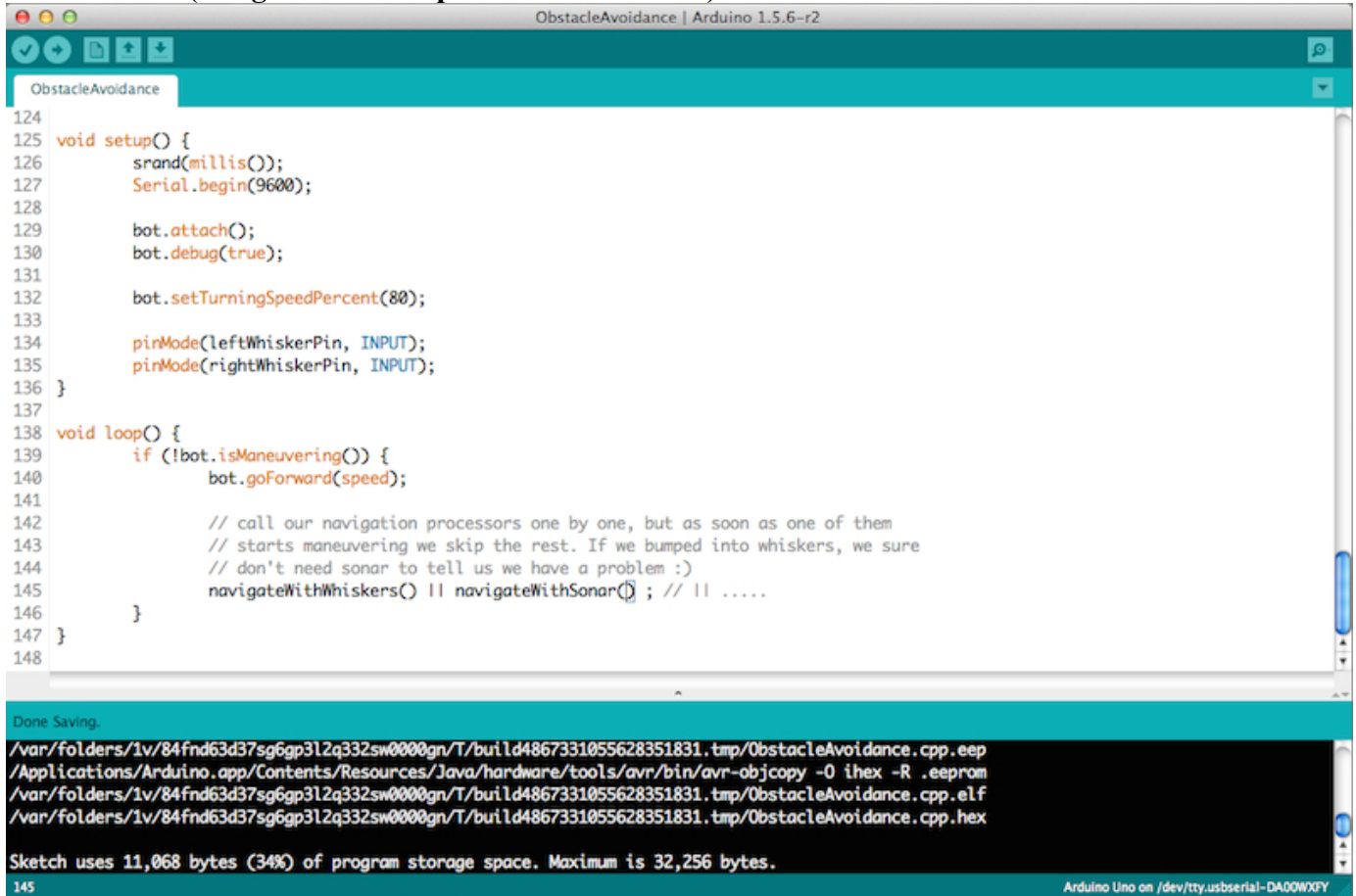

Figure 2. 8 Jumper wires

2.5. SoftwareRequirements

Arduino IDE (Integrated Development Environment)


```
ObstacleAvoidance | Arduino 1.5.6-r2

ObstacleAvoidance

124
125   void setup() {
126           srand(millis());
127           Serial.begin(9600);
128
129           bot.attach();
130           bot.debug(true);
131
132           bot.setTurningSpeedPercent(80);
133
134           pinMode(leftWhiskerPin, INPUT);
135           pinMode(rightWhiskerPin, INPUT);
136   }
137
138   void loop() {
139           if (!bot.isManeuvering()) {
140                   bot.goForward(speed);
141
142                   // call our navigation processors one by one, but as soon as one of them
143                   // starts maneuvering we skip the rest. If we bumped into whiskers, we sure
144                   // don't need sonar to tell us we have a problem :)
145                   navigateWithWhiskers() || navigateWithSonar() ; // || .....
146           }
147   }
148

Done Saving.
/var/folders/1v/84fnd63d37sg6gp3l2q332sw0000gn/T/build4867331055628351831.tmp/ObstacleAvoidance.cpp.eep
/Applications/Arduino.app/Contents/Resources/Java/hardware/tools/avr/bin/avr-objcopy -O ihex -R .eeprom
/var/folders/1v/84fnd63d37sg6gp3l2q332sw0000gn/T/build4867331055628351831.tmp/ObstacleAvoidance.cpp.elf
/var/folders/1v/84fnd63d37sg6gp3l2q332sw0000gn/T/build4867331055628351831.tmp/ObstacleAvoidance.cpp.hex

Sketch uses 11,068 bytes (34%) of program storage space. Maximum is 32,256 bytes.

145                                                          Arduino Uno on /dev/tty.usbserial-DA00WXFY
```
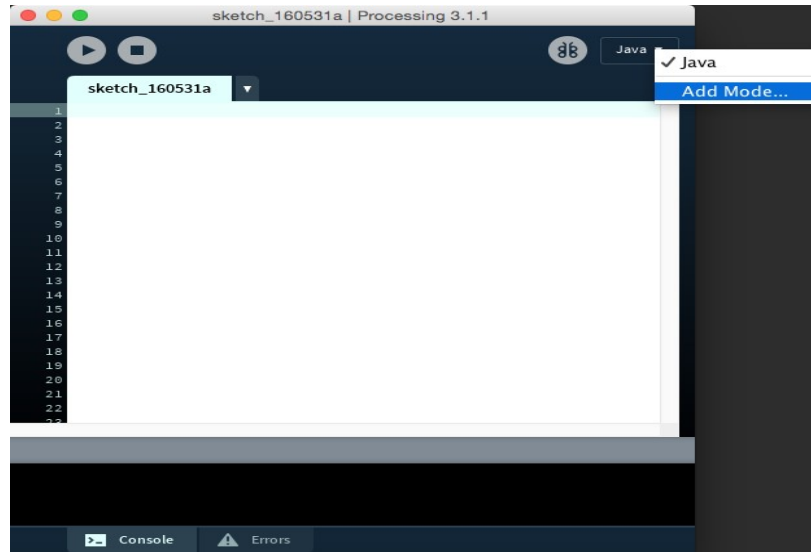
Figure 2. 9 Arduino IDE

Processing Software

Figure 2. 10 Processing interface

2.6. Justification of selection ofTechnology

- The Arduino Uno used in this project is acting as the microcontroller which controls all the input output components. Here the input is provided from the android device which is connected with the Bluetooth module, android device is used to give the command of switch ON and OFF to the appliance connected with relay. TheArduino will generate an appropriate output with the help of processing software..

- ForuploadingthecodetotheArduinoweneedanIDE.Inthisproject,Arduinohasitsown Integrated Development Environment (IDE) known as Arduino IDE which provides an interface where the user develops the code and uploads it to the Arduino. The programming language used in this approach is C or embedded C. The Arduino programming language is very simple which makes it easy to understand and isportable.

- **<u>Bluetooth Modules</u>**

- Bluetooth Modules come pre-certified with Bluetooth, FCC, IC, CE and other required certifications.

- Bluetooth module HC-05 can be very easily connected with Arduino UNO board.

- **2 channel realy module**

  - Brand new and high quality.

  - Standard interface that can be controlled directly by microcontroller (Arduino , 8051, AVR, PIC, DSP, ARM)]

  - Wide range of controllable voltages.

  - Being able to control high load current, which can reach 250V, 10A or 125V, 15A

  - With a normally-open (NO) contact and a normally-closed (NC) contact.

  - Around the board with 4 mounting holes, easy installation and fixing

  - It has a common end, a beginning, a closed-end

Chapter 3
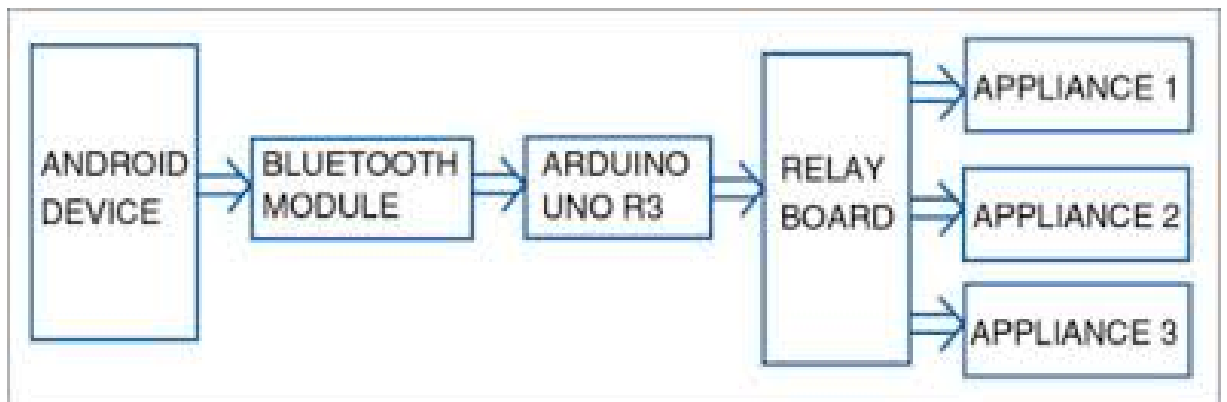# System Design

3.1. DataDesign
3.1.1. SchemaDesign

Figure 3. 1 Block Diagram

- Thenthemaincomponentofproject(Bluetooth based home automation using Arduino) isArduino UNO Board,TheArduinoUnoisanopen- source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino. The board has 14 Digital pins, 6 Analog pins, and programmable with the Arduino IDE via a type B USBcable.

- The Above Block Diagram shows the general schematic of component or parts of the complex project or process. As you can see, I have used one Bluetooth module (HC-05) which is used to connect with the android device within a range of 10 meters.

- Next component shown in the diagram is the Relay (2 channel relay module) which is an electrical switch controlled with the help of arduino. 5v relay module is used in this project.

- As shown in fig(3.1)Relay module plays an important role in switching ON and OFF the appliance connected to the relay module.

- The last component show in the fig(3.1) named application 1,2 and 3 are the number of application such as bulb, fan, AC etc.
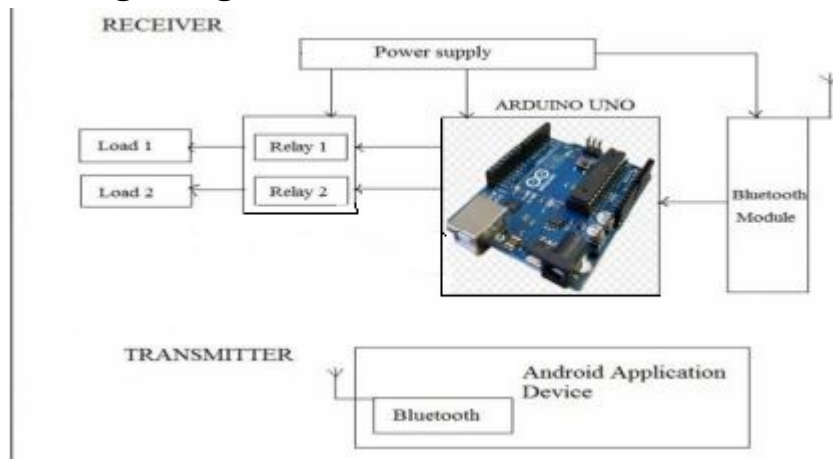
3.2. ProceduralDesign
3.2.1. LogicDiagram

Figure 3. 2 Logic diagram

- Logical diagram shows the overall logic of the proposed system. Like the overall view of project it is easy to understand by thisdiagram.

- The logic behind this project as shown in fig(3.2) is :
  First we need to code in arduino uno chip through laptop and arduino IDE, then the command given in the code is processed by arduino and transferred to relay module which gets command of turning the appliance On and Off from the Bluetooth module which then gets connected with the customers android device

- The requirements like pc or laptop, Arduino uno, Bluetooth, 2 channel relay ,etc.

- Arduino is connected to system it can be anything like laptop, Bluetooth module.

- The number of relay depends on the number of applications you want to controll with bluetooth.

- A relay is an electrical switch which works same as an normal switch but relay performs task specified in the code or command. It is also connected to Arduino.

- The relay module is connected to Bluetooth module and arduino for power supply and commands.
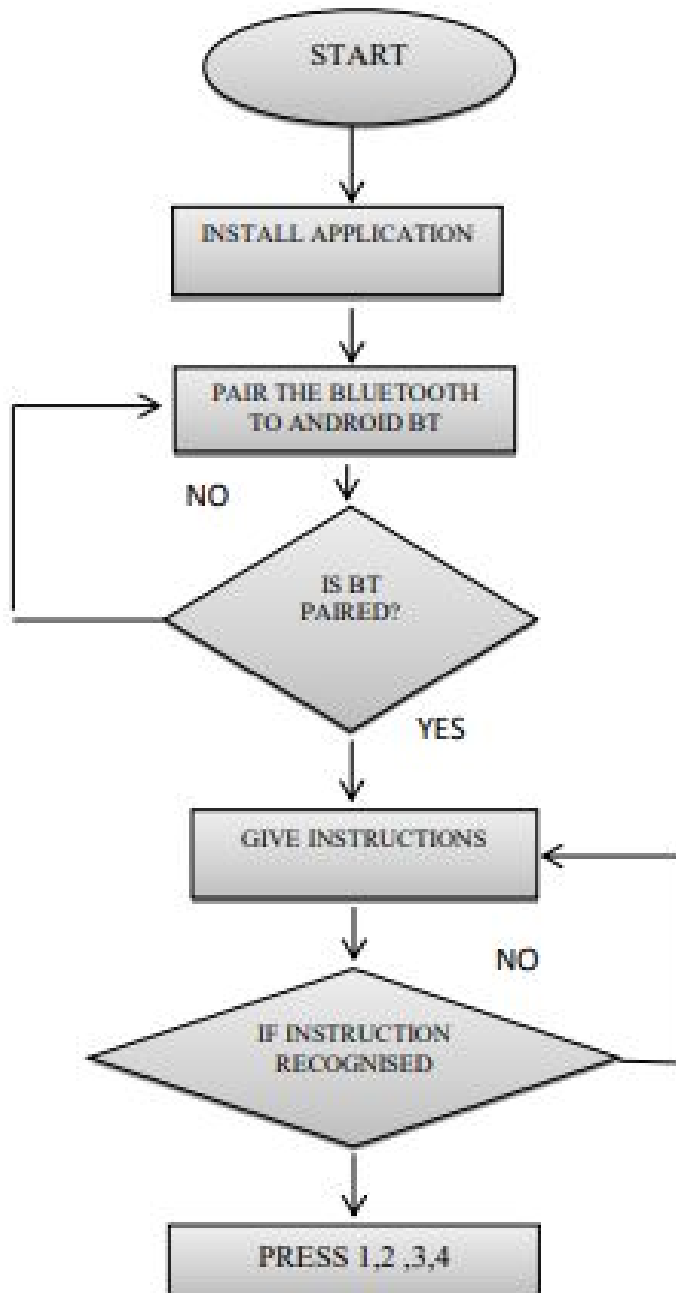
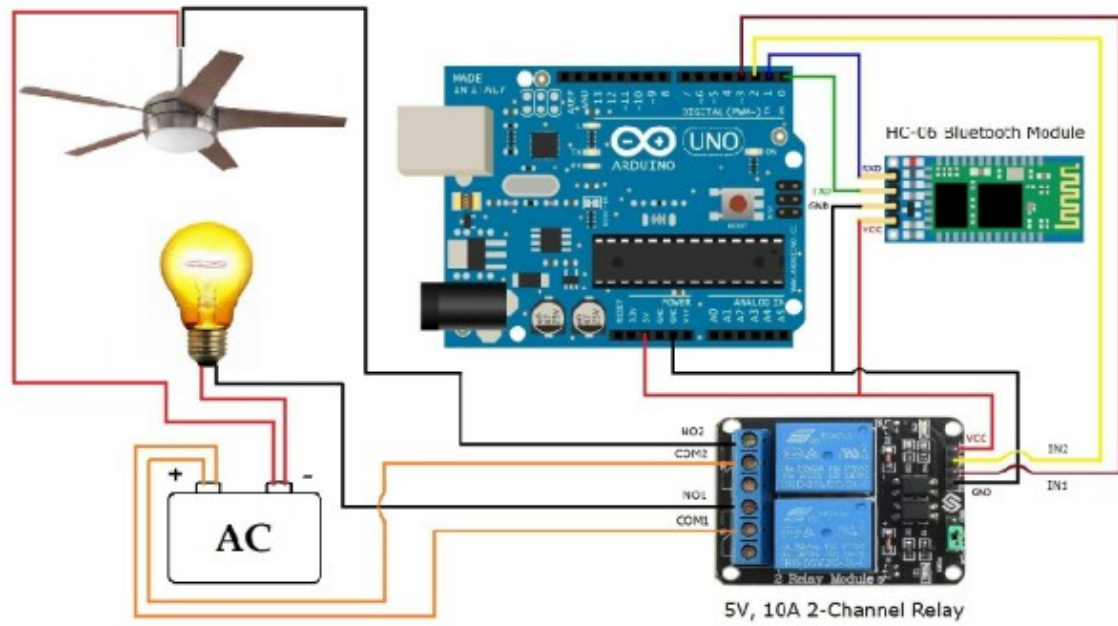### 3.2.2. FlowChart

Figure 3. 3 Flow chart

Figure 3. 4 circuit diagram

Chapter 4
Implementation and Testing

4.1. Code andImplementation

4.1.1. Code forArduino

```
char val;


void setup() {
  pinMode(13, OUTPUT);
  pinMode(12,OUTPUT);
  Serial.begin(9600);

}

void loop() {
  if (Serial.available()) {
    val = Serial.read();
    Serial.println();
  }
  if (val == '1')
  { digitalWrite(13, HIGH);

  }
  else if (val == '2')
  {
    digitalWrite(13, LOW);
  }
  else if (val == '3')
```

```
 {
   digitalWrite(12, HIGH);
 }
 else if (val == '4')
 {
   digitalWrite(12, LOW);
 }

 delay(100);
}
```

4.2.TestingApproaches

4.2.1. UnitTesting

- Unit testing is a level of software testing where individual components of a softwares are tested.
- The intent is to verify that each unit of the software performs as designed.
- A unit is the smallest testable (try) part of any software. It normally has one or a few inputs and usually a single output.
- Unit testing is a first level of software testing and it is performed prior to integration testing.
- Unit testing increases confidence in changing and maintaining the code.
- It is performed by white-box testing method.
- In unit testing code are easier to reuse.

4.2.2.   IntegratedTesting

- Integration Testing is a level of software testing where individual units are combined and tested as a group.
- The purpose of this level of testing is to find mistakes in the interaction between integrated units.
- Test drivers and test stubs are used to help in Integration Testing.
- A typical software project consists of many software modules, coded by so many different

programmers.

- Integration Testing focuses on checking data communication amongst these various modules.

- Integrated testing is handy for small system.

- The disadvantage of integration testing is Fault Localization is difficult.

4.2.3. Beta Testing

- BetaTesting isoneoftheacceptancetestingtypes,whichaddsvaluetotheproductasthe end-user which is also called as intended real user, validates the product for functionality, usability, reliability and compatibility.

- Beta testing is also named as field testing.

- Testing is preferred by the client, stakeholder,end-users.

- Beta testing is known as black boxtesting.

- Beta Testing is predate by Alpha testing and followed by the release of the final product.

Test approach table:

Test Id	Description	Expected Result	Actual Result	Remark
TC1	Check for Arduino	Connection Work	Connection Working	Pass
TC2	Check for Bluetooth module	Connected with Bluetooth module	Connected with Bluetooth module	Pass
TC3	Check for relay	Relay should switch ON and OFF the appliances	Relay controls the appliances	Pass
TC4	Check Bluetooth connectivity range of >10 meters	Gets connected with android device	Not connected	Fail
TC5	Check Bluetooth connectivity range of <10 meters	Gets connected with android device	Gets connected with android device	pass

Table 4. 1 Testing approach table