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(GWALIOR (M.P.))

# HOME APPLIANCES CONTROL SYSTEM PROJECT

## *DETAILED PROJECT REPORT*

## *(SOFTWARE REQUIREMENTS SPECIFICATION &*

## DOCUMENTATION)

**Project BY:-**

**SAURABH SHARMA (2014 IPG-078)**

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# *1.Introduction*

## *1.1 Purpose*(Project Motivation and need)

This document details the software requirements specification for the **HOME APPLIANCE CONTROL** project. When explaining the details, the IEEE standards for software requirements specification documents are followed. **Home automation systems** provide certain functionalities for variety of devices, but many of them cannot extend their ability to respond technology which changes very quickly. In order to achieve this, a generic set of functionality and support for various **home appliances** needs to be generated. An easy to use, easy to deploy system with an ability to learn and predict home owners' and residents' activities based on previous knowledge will provide a more intelligent way of handling our homes. **HOME APPLIANCE CONTROL** project is intended to serve this purpose and project details will be provided in the following sections.

### *1.1.1 ABSTRACT*

**The abstract of this project is that home appliances can be controlled by Smartphone easily and due to this, we can control all the electrical devices and can make the home as Smart Home by using very economical devices.**

### *1.1.2 OBJECTIVE*

**TO control home appliances through the bluetooth enabled device like smartphone using arduino and bluetooth module.**

## *1.2 Document Conventions*

**HOME APPLIANCE CONTROL** project's aims are currently not strictly defined. Many of the requirement specifications and use cases provided in this version of this document are merely a starting point and will provide a perspective for the intended purpose of this project. Regarding information and sources will be provided in the appendix sections at the end of the document.

## *1.3 Intended Audience and Reading Suggestions*

This Software Requirements document is intended for: −

1.**Developers** who can review project's capabilities and more easily understand where their efforts should be targeted to improve or add more features to it.

2. **Project testers** who can use this document as a base for their testing strategy as some bugs are easier to find using a requirements document.

3. **End users** of this application who wish to know about what this project can do.

## *1.3.1 KEYWORDS (ANALOGY)*

1. **ARDUINO UNO** :- The **Arduino Uno** is a microcontroller board based on the ATmega328 (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.

2. **HC-05** :-**HC-05** module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband.

3. **BREAD BOARD** :- It is a board for making an experimental model of an electric circuit.

4. **SMARTPHONE/ ANDROID** :- It is a user device used for user Interfacing with the hardware with the help of bluetooth module.



5. **BLUETOOTH TERMINAL** :- It is an user interface to control the bluetooth module actions and the appliances through it.

6. **REGISTER** :- A group of cascaded flip flops used to store related bits of information is known as a **register**.

7. **TRANSISTOR** :-A **transistor** is a semiconductor device used to amplify or switch **electronic** signals and electrical power.

8. **LED** :-A light-emitting diode (LED) is a semiconductor device that emits visible light when an electric current passes through it.

9. **MOTOR** :-An electric motor is an electrical machine that converts electrical energy into mechanical energy.

10. **RELAY** :-an electrical device, typically incorporating an electromagnet, which is activated by a current or signal in one circuit to open or close another circuit.

## *1.4 Project Scope*

**HOME APPLIANCE CONTROL project** is a simple but quite versatile home automation system which consists of four tightly connected subsystems.



- Device sensors collection
- Wireless network (Bluetooth Module & SmartPhone)
- User Interface

As home appliances provide various data from their own work conditions and status, sensor collection provided as a generic device analyzes the data and sends it to wireless network . The user sends the control signal as order for the appliances and the appliance works according to that instruction. As well as viewing, user can send orders to the Wireless module in order to change home appliances' activities in **real time.**

## *1.5 References*

1. Project's development and distribution website at **diyhacking.com** repository. It provides the project's basic source code and the necessary files of the project.

2. IEEE Software Requirement Specifications document.

## *1.6 Similar Works*

Project's development and processing is same as the remote control using wifi and wireless communication systems like ESP-8266 wifi module based devices and other remote sensing AC, Coolers etc- but we are using bluetooth for such works.

# 2. Overall Description

## *2.1 Product Perspective*

It is a generic solution for home automation enhanced with machine learning techniques. It uses a well-known wireless device HC-05 for communication between devices and allows you to collect data and control home appliances from a single user interface. Main program running on arduino is open source with a GNU General Public License. In market, there are lots of home automation systems, but they lack the adaptability and generic way of application in variety of home appliances. Moreover, **home appliance control project** is open source; it allows collaboration of developers for new enhancements to the project.

## *2.2 Product Features*

In our home automation system, the user indicates the person **controlling thelights and fans** to take advantage of energy efficiency for his/her home. The user basically has rights to choose a device, turn it on & off, getting & updating the sensor info of the device and adjust it according to the configurations types of the device. Their main functionalities are shown by the below use case diagram.

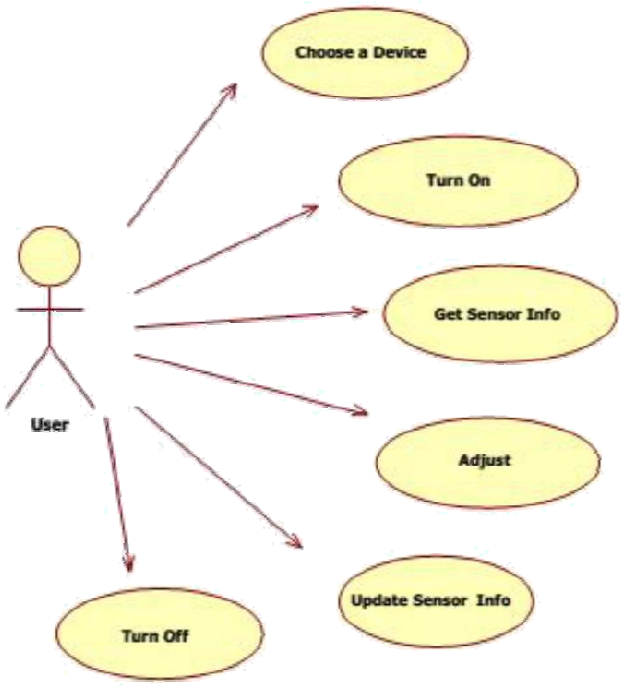



**Figure 1: Block diagram**

## *2.3 State of the Art*

•We will use a source code platform **arduino and Bluetooth module (HC-05)**, for communication between devices which allows us to control home appliances from a single user interface. arduino is an open GNU source code editor and uploader . The development of arduino is motivated to address those applications in which hardware to software interaction is involved. Compared to other wireless communication techniques, arduino and HC-05 possess the following advantages:

• Low power consumption;

• Low cost;

• Flexible reliable, and self-healing network;

• Large number of nodes;

• Fast, easy deployment and security;

• Ability to be used globally;

• Product interoperability .

## *2.4 User Classes and Characteristics*

This project is intended to be used by various of user classes. These classes can be listed as follows:

1. **Home owners**: − User interface provided by HOME APPLIANCES CONTROL SYSTEM is easy-to-use and user friendly, in turn allows an average computer user to control home appliances they own.

2. **Open source software developers and contributors**: − People with good knowledge of C/C++ programming language can contribute to the main program which runs on arduino.

## 2.5 Operating Environment

In this project, HC-05 Bluetooth network devices would be used to obtain a wireless communication between a master controller and home appliances as well as various sensors to control from home environment. A master controller software working on arduino Based Board will be developed. arduino Microcontroller Board would also be used to simulate home appliances within the development process by imitating the response of home devices.

## 2.6 Design and Implementation Constraints

This system is a platform dependent. Embedded C/C++ working on a arduinoBoard device or PC with Windows OS is a necessity. - Work products such as documents will be in compliance with IEEE standards.

# 3. RequirementsSpecification And Work Details

## *3.1 Interface Requirements*

At the beginning of the application, the Bluetooth connection is required for the users. This connection (secured or unsecured) process is same for all users. In the below sections, user interface overview is described in a general manner.

**3.1.1 Connect to PC :-** When the Home Appliance user page is opened, the user will face with this screen.

**3.1.2 Select the Bluetooth device :-** After the authentication process explained above, the user is waited for Bluetooth device selection. If the user clicks on one of the links below the icons, the user will be redirected to new interface .

**3.1.3 Give Command :-** For each appliance, it is required to have a command as number. For illustrative purposes, the above screenshot shows an example configuration panel of light . The user should be able to control them by giving the numbers as commands to operate one thing.

**3.1.4 Sign Out:-**It is also required to have a sign out window to provide continuity. If the user simply off this app, he will be simply signed out.

## *3.2 Non-functional Requirements*

**3.2.1 Performance requirements:-** The resulting home automation system should perform on home appliances and various sensors having the ability of compatibility more than the ones in the market. Additionally a more general communication protocol and wireless controller hardware should be used to make the system perform on much more devices. The system should access data in reasonable time. The data transfers between the devices such as actuators and sensors with master controller should not exceed the time limit of 3 seconds and lie under the throughput of 250 Kbps. Additionally, the system should service with the 7 days / 24 hours availability. The system should work smoothly with other existing connection networks at home.

**3.2.2 Design constraints:-**The reporting of the project should be in IEEE standards and its diagrams should be drawn in UML standards. The interface between the system components should be well described to make the user control easier. Moreover, there is another constraint on wireless communication protocol. In this system, HC-05 wireless protocol should be used to make the devices communicate.

**3.2.3 Security constraints:-** Security is another design constraint. The system should encrypt/decrypt the data transmitted between the devices.

## *3.3 Functional Requirements*

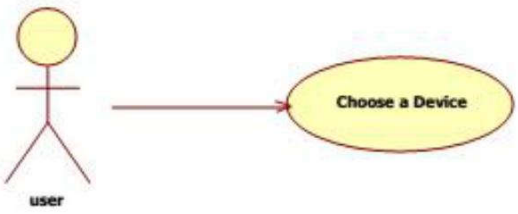
In order to make the user manipulate the system, we need some general functions working on a home appliance included in the home automation system with the help of sensors and required connections. Each function is explained with the use cases below.

### 3.3.1 Choose a Device

***3.3.1.1 Background Information:-*** There will be different kinds of home appliances included in the home automation system.

***3.3.1.2 Action/Response Sequences:-***

3.3.1.2.1 Diagram-



3.3.1.2.2 Description-

| | |
|---|---|
| Actor | User |
| Purpose | The aim of this function to enable the user to choose a device from the context. |
| Precondition | The system should be on mode and the user should start the application. |
| Trigger | The user should choose a device from the menu by clicking on it. |

**3.3.1.2.3 Normal Flow of Events-**

1. The user selects the device and sees its current condition.

2. The user can manipulate the appliance with given commands.

**3.3.1.2.4 Alternative Flow of Events-**

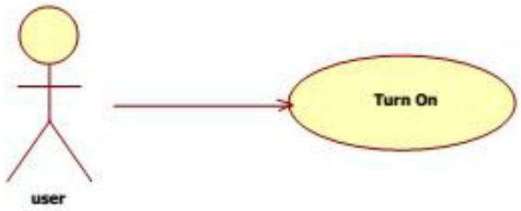
The user tries to use other functions before choosing a device.

## 3.3.2 Turn On:-

***3.3.2.1 Background Information:-*** There will be a selected device to perform the action on before the user requests this action.

### *3.3.2.2 Action/Response Sequences:-*

3.3.2.2.1 Diagram




3.3.2.2.2 Description

The aim of this function to enable the user to turn on the chosen device. Precondition The user should select a device. The user should give the specified number as command assigned for that appliance.

**3.3.2.2.3 Normal Flow of Events**

1. The user gives the specified number as command assigned for that appliance

2. The user turns on the appliance with the default adjustments.

### 3.3.2.2.4 Alternative Flow of Events

1. The user tries to turn off or wants to make adjustments on the device before using this functionality.

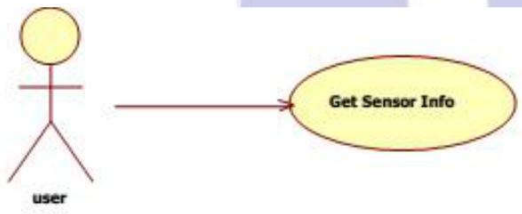
2. The system makes a request to make the user turn on the device, initially.

## 3.3.3 Get Sensor Info

***3.3.3.1 Background Information:-*** There will be sensors placed into the home appliances to perform this action.

***3.3.3.2 Action/Response Sequences:-***

3.3.2.3.1 Diagram




3.3.2.3.2 Description - The aim of this function to enable the user to learn info about the device from the sensors. Precondition The device should have a truely working sensor connected to the system. Trigger The user should click on the Connect to a device button.

### 3.3.2.3.3 Normal Flow of Events

1. After clicking on the above mentioned button, the system starts to communicate with a device.

2. A window appears on the screen to make the user learn the condition of the device(Secured or unsecured).

### 3.3.2.3.4 Alternative Flow of Events

1. The sensor data may not be transferred properly.

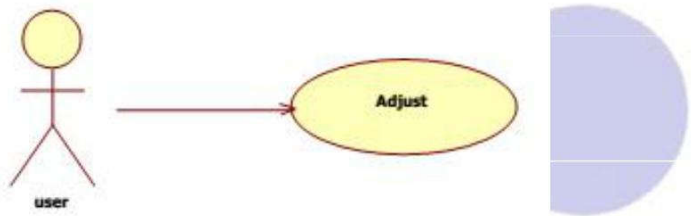
2. A warning should appear on the screen indicating that the info could not be reached by the system and request the user to try again.

## 3.3.4 Adjust

***3.3.4.1 Background Information:-*** Well described adjustment panels on the interface will be provided for each device included in the system.

### *3.3.4.2 Action/Response Sequences:-*

3.2.2.4.1 Diagram




3.3.2.4.2 Description- The aim of this function is to enable the user to make the adjustments according to the device capabilities. Precondition The system should switch on the true adjustment menu according to the chosen device and make sure that sensor info is not obsolete by updating the sensor info. The user should pair with the device accordingly.

**3.3.2.4.3 Normal Flow of Events-**

1. This functionality is device dependent, so generally it can be stated that the user should connect to the Android.

2. The device dependent command panel appears on the screen.

### 3.3.2.4.4 Alternative Flow of Events

1. The user can enter ambiguous adjustments into the panel.

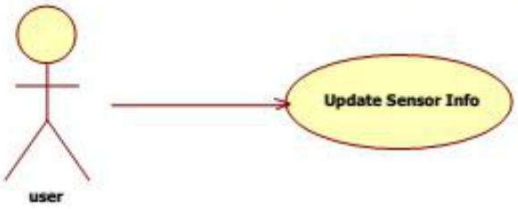
2. The system should give a warning, and continues with the previous adjustments.

## 3.3.5 Update Sensor Info:-

***3.3.4.1 Background Information:-*** There will be sensors placed into the home appliances to perform this action.

***3.3.4.2 Action/Response Sequences:-***

3.3.2.4.1 Diagram-




3.3.2.4.2 Description- The aim of this function is to enable the user to update the sensor info anytime she/he wants. Precondition The device should have a truely working sensor connected to the system. Trigger The user should click on the connect to device button.

### 3.3.2.4.3 Normal Flow of Events-

1. The user clicks on the connect to device button.

2. The system updates the sensor info beside the periodic updating times of the system.

### 3.3.2.4.4 Alternative Flow of Events-

1. This command can conflict with the periodic update times.

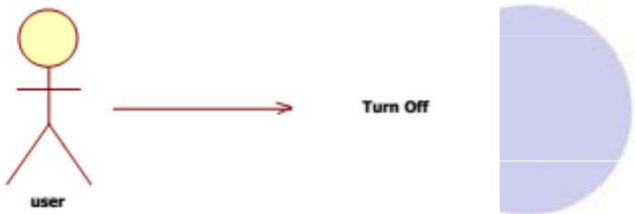
2. The system continues with the periodic updating without making extra function call.

## 3.3.6 Turn Off:-

***3.3.4.1 Background Information*** :-There will be a selected and powered on device to perform the action on before the user requests this action.

### *3.3.4.2 Action/Response Sequences:-*

3.3.2.4.1 Diagram-




3.3.2.4.2 Description- The aim of this function is to stop the working of the chosen home appliance. Precondition The device should be turned on. Trigger The user should give the command as number assigned to turn off all the appliances or can simply turn off the machine.

#### 3.3.2.4.3 Normal Flow of Events-

1. The user gives the command as number assigned to turn off that appliance.

2. The system powers the device down.

#### 3.3.2.4.4 Alternative Flow of Events-

1. The user can try to turn off a device without turning on it before.

2.User switches off the device.

## *3.4 Software development Requirements and Limitations*

For software development process, we require softwares :-

1.Arduino UNO IDE- For coding purpose

2.Bluetooth terminal application- For interfacing and commanding purpose

The **limitations** of these softwares are:-

1. These software can be operated by specific operating systems.

2. For big projects the code may become complex.

## ***3.5 Hardware development Requirements and Limitations***

For hardware development process, we require softwares :-

1.Arduino microcontroller kit- For input/ output (analog or digital) purpose

2.Bluetooth Module (HC-05)- For interfacing and wireless communication purpose

The **limitations** of these hardwares are:-

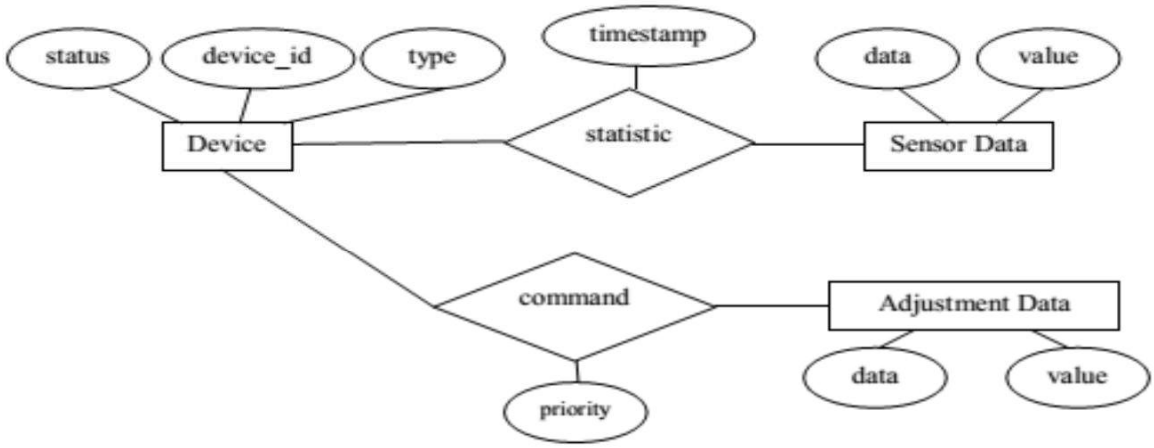
1.These hardware can be operated by specific operating systems.

2.For big projects these may become costly.

# 4. Data Model and Description

***4.1 Device*** :-Abstract entity of a home appliance. Here smartphone is used as device. It will collect the commands which are given to the kit or appliances to be operated accordingly. But it real time and non statistical as well as not stored too.

***4.2 Commands Collection*** :-The commands(numbers) will be temporarily stored in the device.




(figure: ER Diagram)

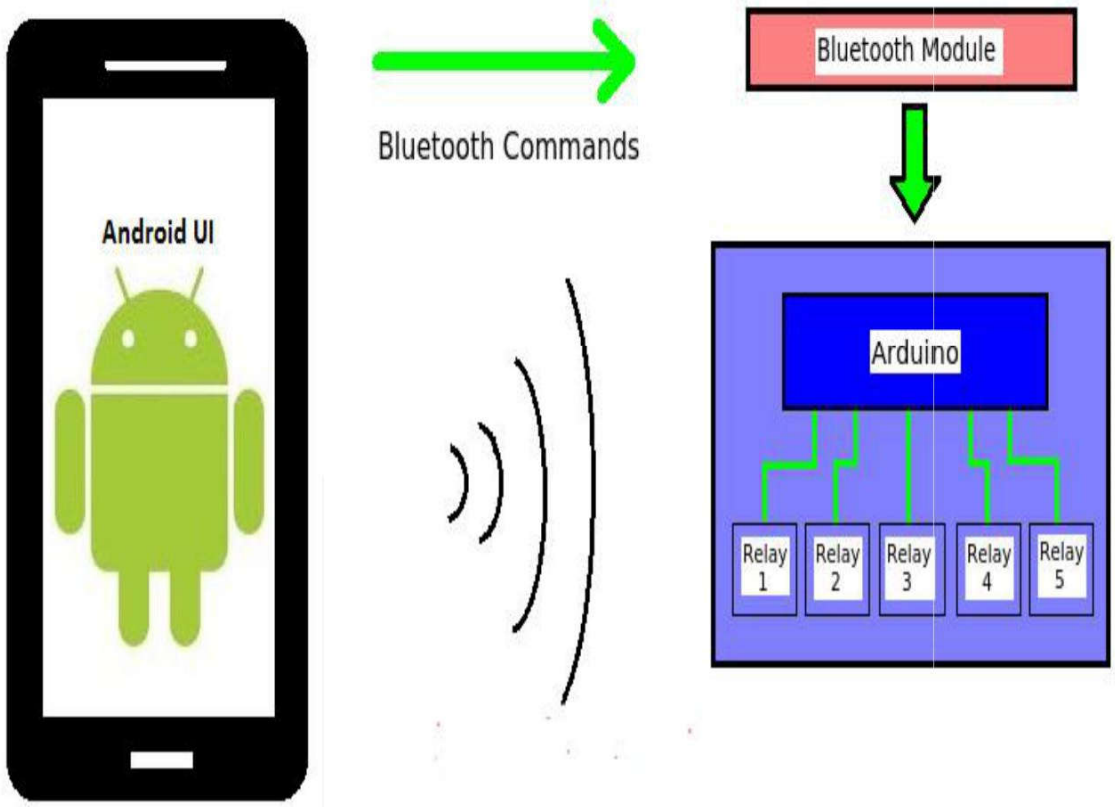
At first the device will be connected to HC-05 and paired with it. After that the Bluetooth terminal will be connected to it . As we will give the numbers as command, It will perform the operation assigned to that number.

# 5. Behavioral Model and Description

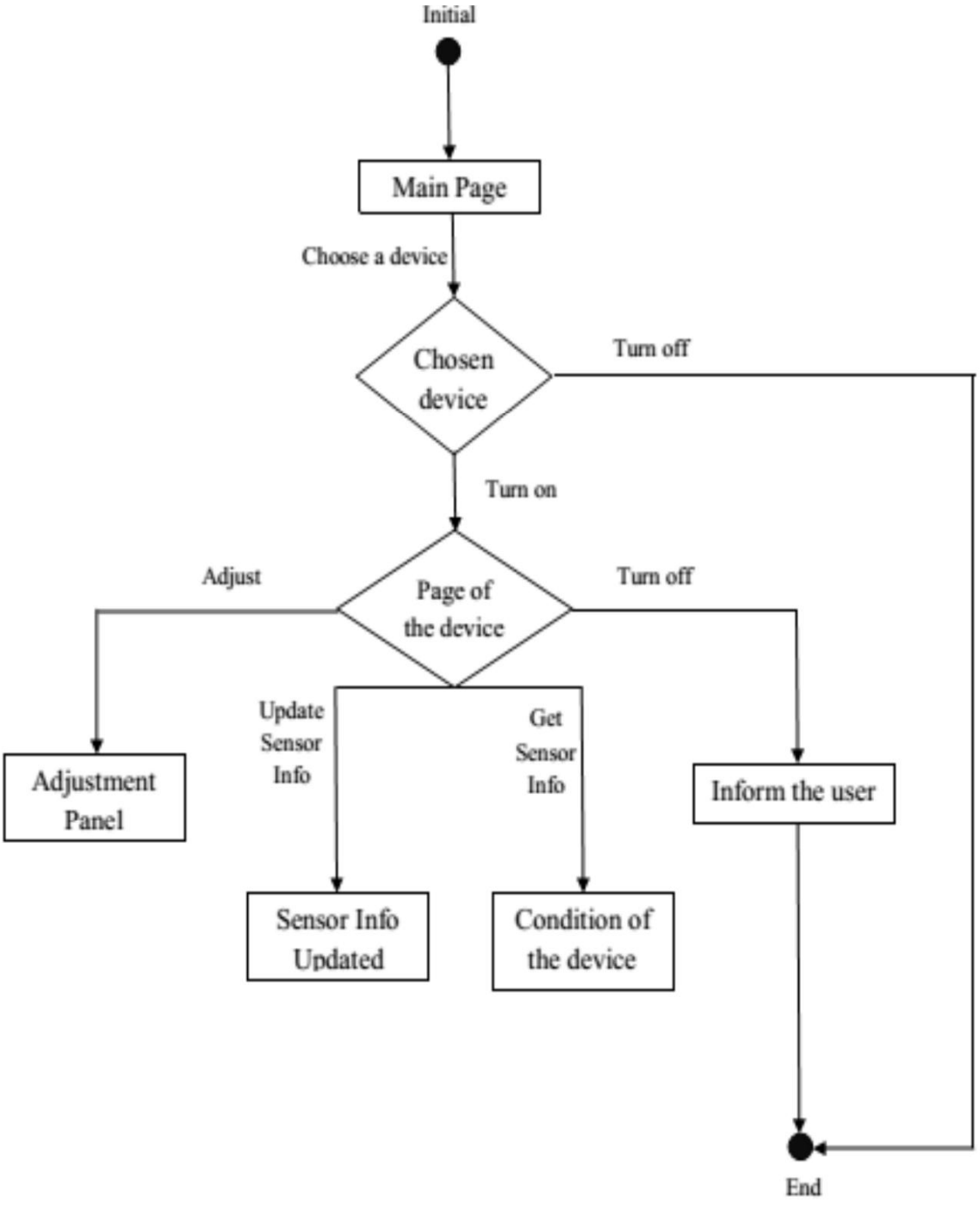
## *5.1 Description for Software Behavior*

When user opens the GUI from a browser window, he/she sees a main page with a list of devices connected to the HC-05, with few limited details about their current status. From this list, user can select the device he/she wants to control or view and reach a detailed page for that specific device. Every home appliance has different features which can be controlled and monitored through this system, and all of these applicable information will be provided in the subpage of the selected device. After a device is selected, user can see interface for control instructions as numbers. After a reasonable time for data sending/receiving protocols (around 3 seconds in a bluetooth network), the device to be controlled will respond to these changes and sensor information will be updated.

## *5.2 DATA FLOW MODEL:-* **(Figure 2: Data Flow Model)**

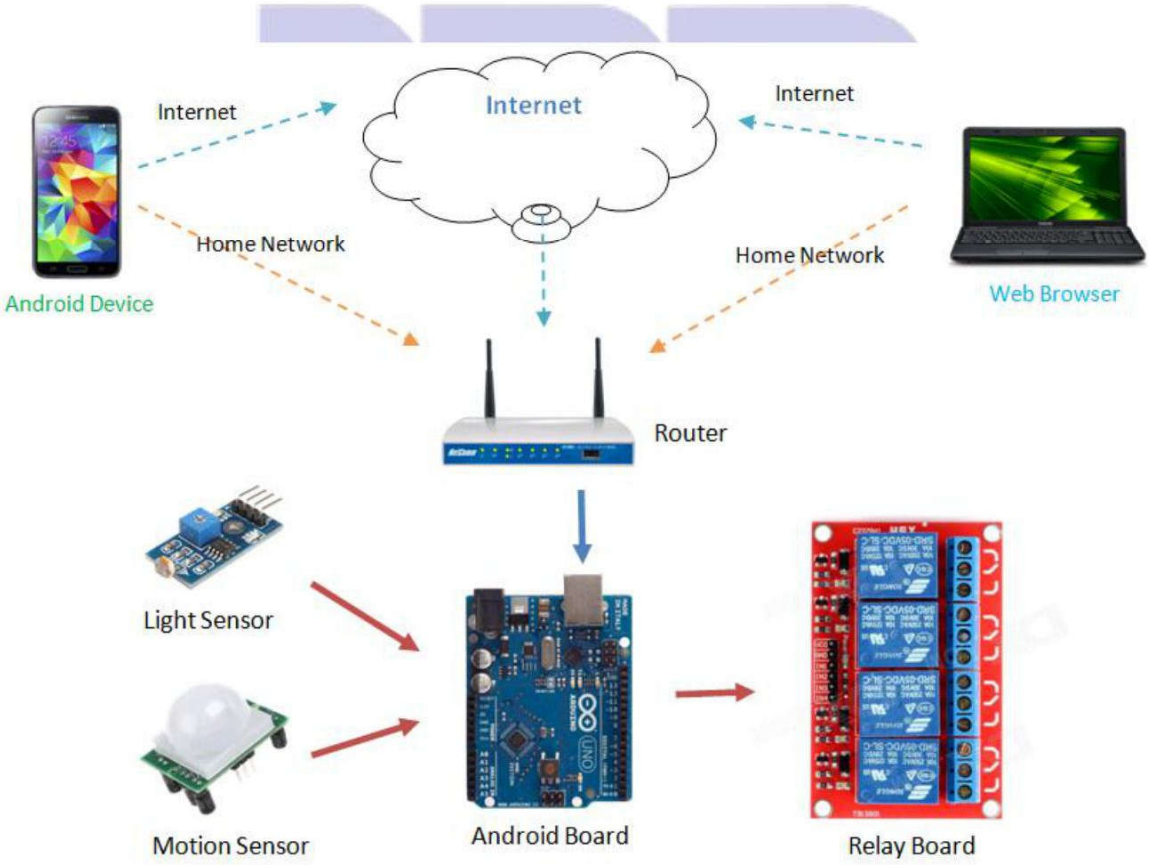


**This can be understood by the following data flow diagram :-**



## 5.3. Description of Controller

As controller we are using PIC powered development board in order to control the appliances. On this control board you can adjust the appliances according to your needs. There are buttons in order to start or stop the appliances and reset it too. It can be controlled by smartphone by user interface Bluetooth Terminal by simply giving instructions as numbers.



# 6. Planning

## *6.1 Team Structure(Distinction of work)*

Since project has interdependent hardware parts that can be combined after certain development phases the responsibilities should be as follows:

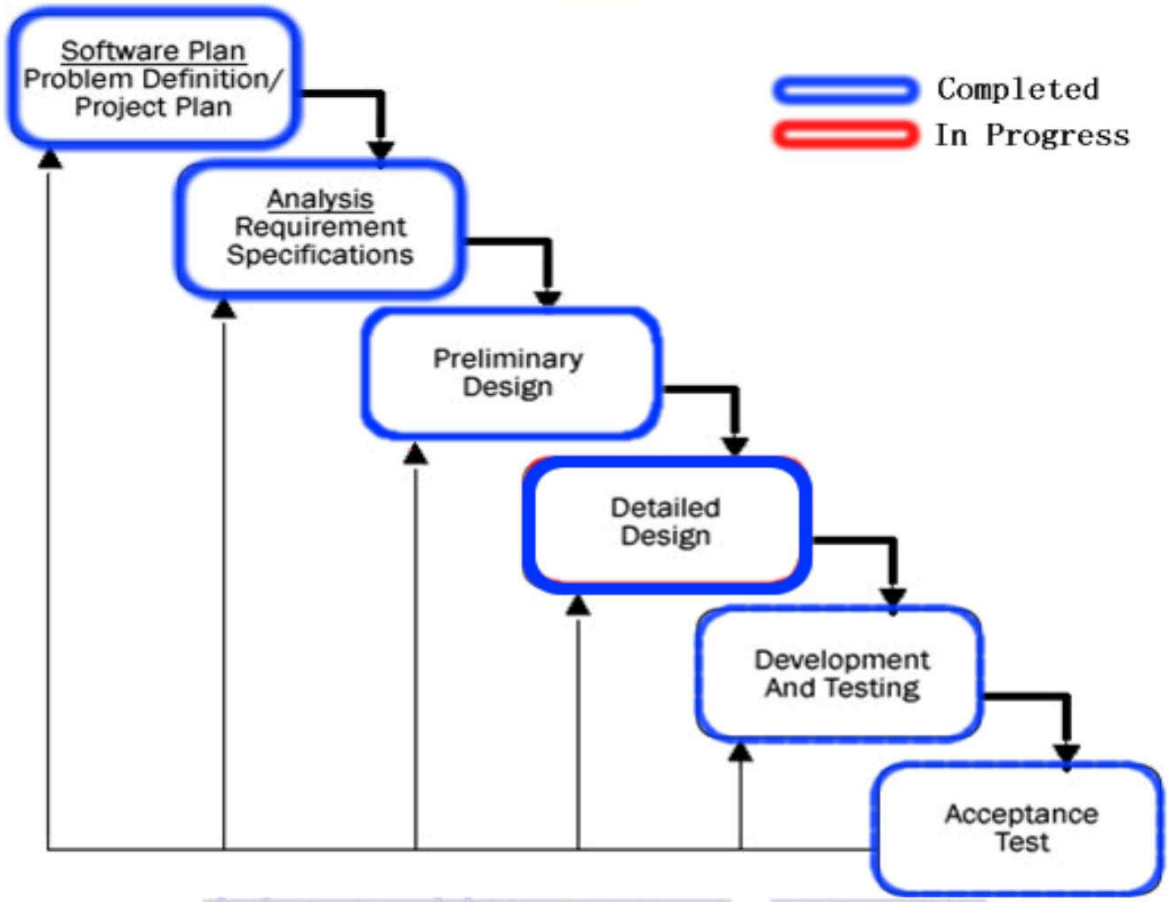
- – Hardware Connection, coding and software interfacing
- – Framework and Client base in Windows
- –Server Base in Android, coding and documentation
- – End user analysis and hardware gathering

## *6.2 Process Flow Model*

**Main model we will use for process flow in this project is Waterfall Lifecycle**. First we have done research about market and currently developed home automation systems. Discussing their pros and cons, we decided on extra features we may add to come up with an interesting design. According to Waterfall model, Requirements Analysis and Specification was the next step. After the completion of the first version of this SRS document we came to end of second step and got started to design process. As many of the project's design choices were not clear, we

decided to leave behavioral and data model definitions to be next step in our process model. After design phase, we will continue with implementation. When implementation of two subparts of the project becomes near completion, we will deal with combining, maintenance and testing of full set of requirements in this document.

**Figure4: Waterfall Model**



# 7.Coding :-

Here the code is only used in case of **HARDWARE. The** code is given below :-

```
/*

CREATED BY-


SAURABH SHARMA (IPG_2014078)

HOME APPLIANCES CONTROL DEVICES(LED'S ETC),INTERNET OF THINGS,PROJECT,2016;

SUBMIITED TO- DR. VINAY SINGH

*/

int state;

int pin1=8;

int pin2=9;

int pin3=10;
```

```
int pin4=11;

int pin5=12;

int timer = 100;

void setup(){

pinMode(8, OUTPUT);

pinMode(9, OUTPUT);

pinMode(10, OUTPUT);

pinMode(11, OUTPUT);

pinMode(12, OUTPUT);

Serial.begin(9600);

}

void loop(){

if(Serial.available()>=0)

{

state = Serial.read();

if(state == '1')
```

```
{

digitalWrite(8, HIGH);

delay(1000);

state=0;

}



if(state == '2')

{

digitalWrite(9, HIGH);

delay(1000);

state=0;

}

if(state == '3')

{

digitalWrite(10, HIGH);

delay(1000);
```

```
state=0;

}

if(state == '4')

{

digitalWrite(11, HIGH);

delay(1000);

state=0;

}

if(state == '5')

{

digitalWrite(12, HIGH);

delay(1000);

state=0;

}

if(state=='13')

{
```

```
digitalWrite(13,HIGH);

delay(1000);

state=0;

}

if(state=='6')

{

int i=10;

while(i--)

{

// loop from the lowest pin to the highest:

for (int thisPin = 8; thisPin < 13; thisPin++)

{

// turn the pin on:

digitalWrite(thisPin, HIGH);

delay(timer);

// turn the pin off:
```

```
digitalWrite(thisPin, LOW);

}



// loop from the highest pin to the lowest:

for(int thisPin = 12; thisPin > 9; thisPin--)

{

// turn the pin on:

digitalWrite(thisPin, HIGH);

delay(timer);

// turn the pin off:

digitalWrite(thisPin, LOW);

}



}

}

if(state=='7')
```

```
{
digitalWrite(8,LOW);
}
if(state=='8')
{
digitalWrite(9,LOW);
}
if(state=='9')
{
digitalWrite(10,LOW);
}
if(state=='10')
{
digitalWrite(11,LOW);
}
if(state=='11')
```

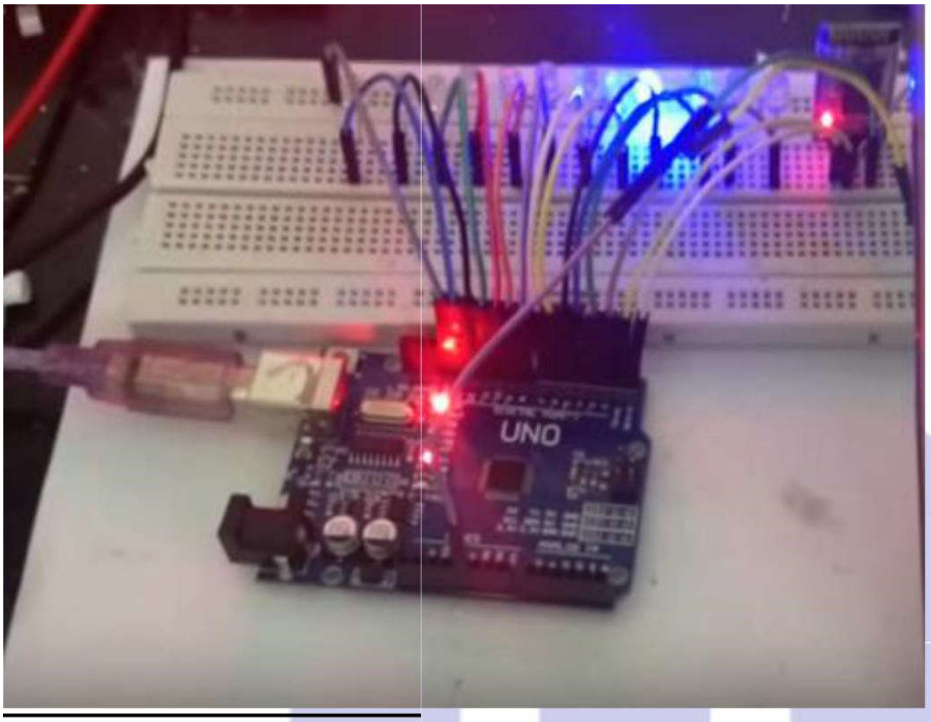
```
{

digitalWrite(12,LOW);

}

}

}
```

---

We can also expand code for more appliances like the above code.

## 8.Project's Input and Output Interface :-

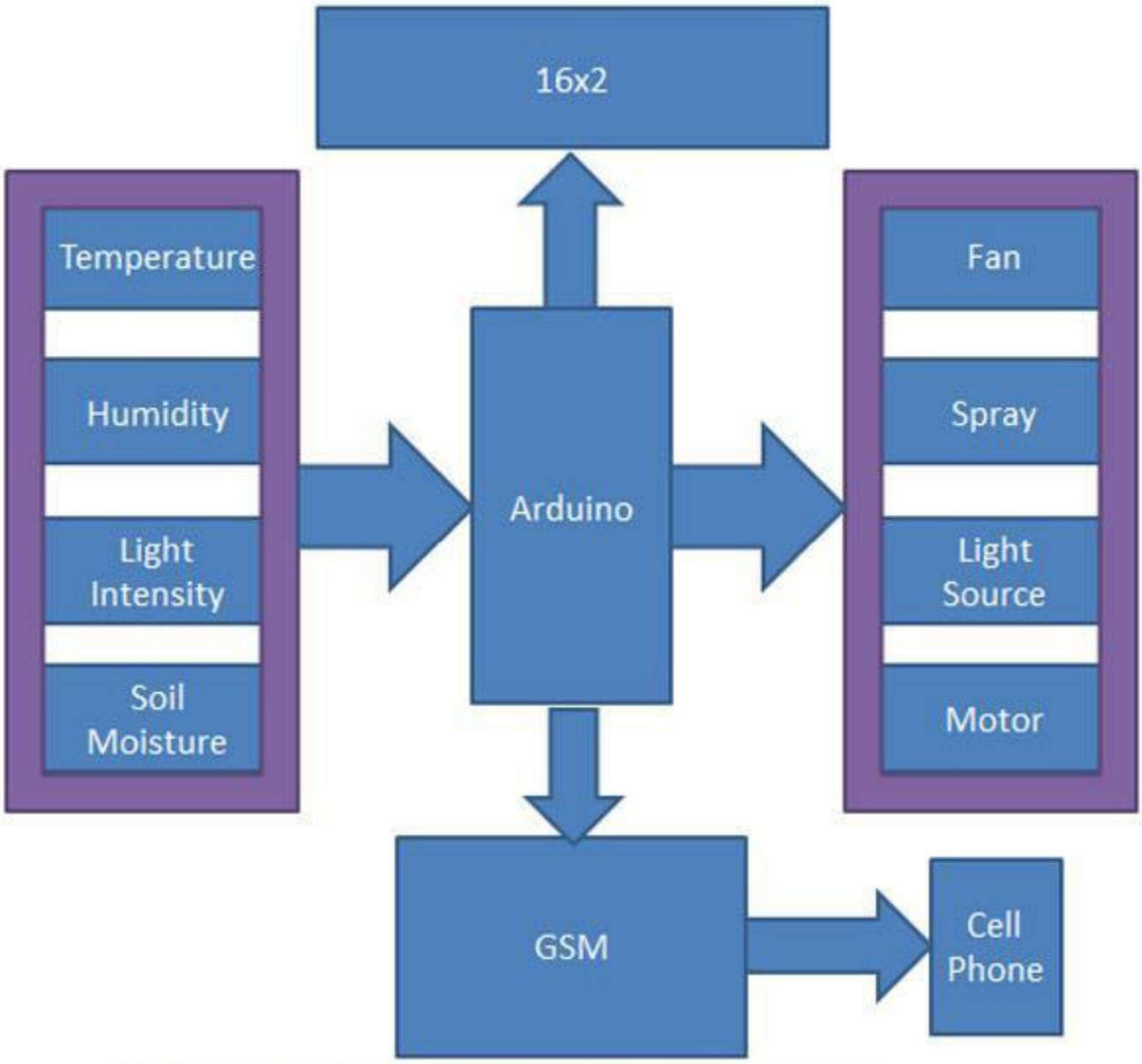
The overall interface of the project loooks like this :-




In this interface, the ardu ino analog output port is connected to LEDs and other appliances and one electrode of the appliances are grounded.

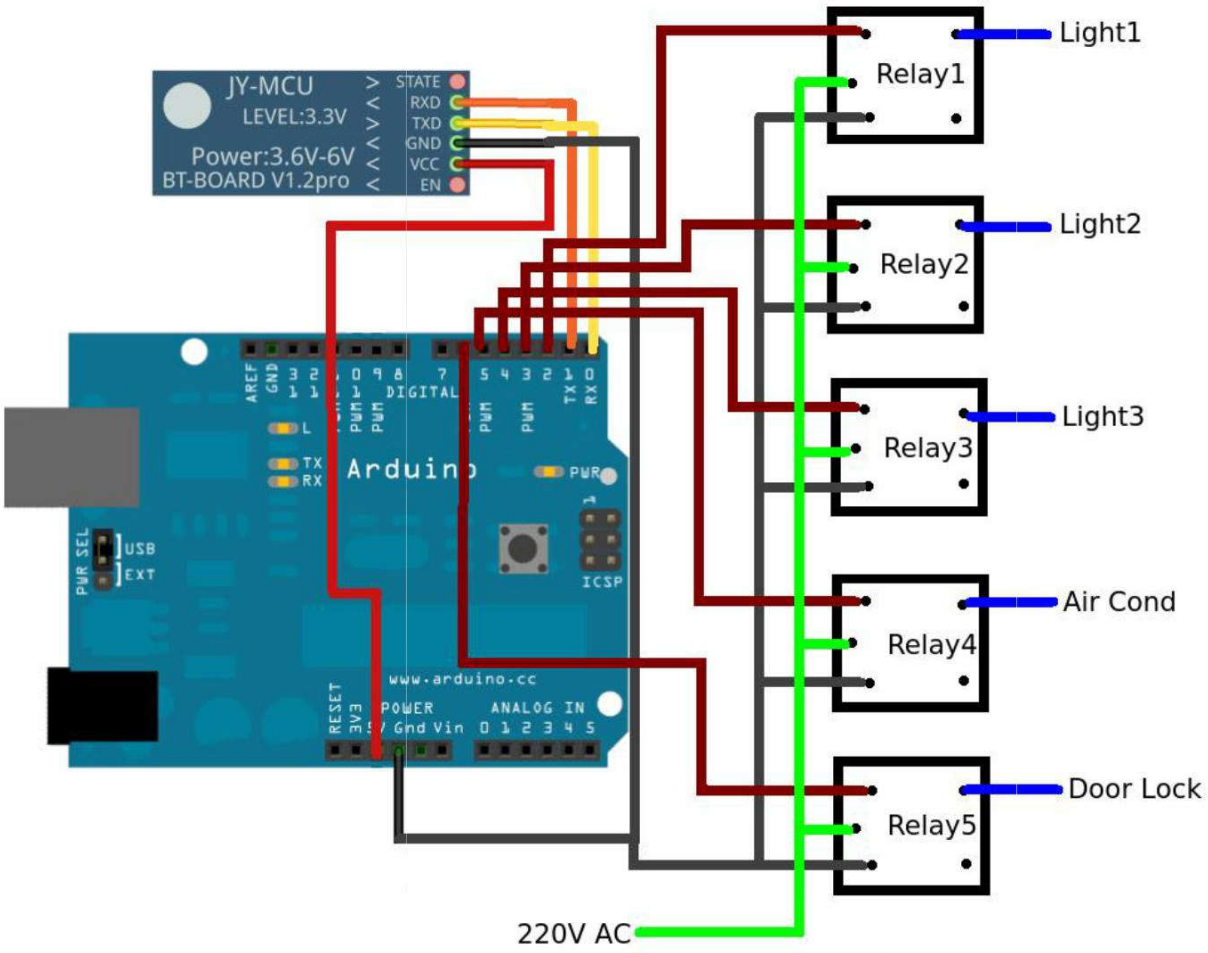
The USB power port is used for power supply and the digital port is connected to bluetooth module. As the data from mobile is sent, the bluetooth module acceptts it and arduino microcontroller converts it into analog signal and the analog output port gives the instruction to that appliance to perform task.

In the case of input interface, the computer is attached with arduino and code is uploaded and then bluetoth terminal application is connected to HC-05.



# 9.INPUT SETS AN D SOURCE (Data and fact Sheet):-

All the inputs are given by Android phone or smart phone by which the bluetooth module is connected and arduino is controlled. It uses a software named Bluetooth terminal for user interfacing. The overall device structure is as follows :-



The input set can be manipulated by coding but here the standard number assigned for an action is given **(Data and fact on components)** :-

1. Switch on light 1.
2. Switch on light 2.
3. Switch on light 3.
4. Switch on light 4.
5. Switch on lights alternately .
6. Switch on the fan.
7. Switch off light 1.
8. Switch off light 2.
9. Switch off light 3.
10. Switch off light 4.
11. Switch off lights alternately .
12. Switch off the fan.

13-no. of commands given :- Switch on/off the appliances.

## 10.Targeted Output Set:-

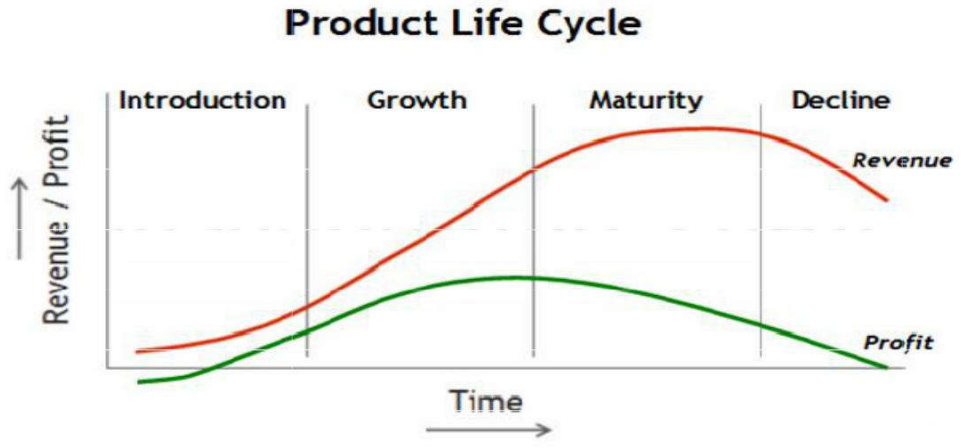
The output set includes all the home appliances like :-

1. Lights
2. Fans
3. Refrigerator
4. Cooler
5. Air Conditioner
6. Television
7. Other Home Appliances operated through electricity.

# 11.Project Life and Maintenance

Fully integrated custom systems are expensive and ofteen require a consultant to install them, and structural changes to the home, both costs of course tacked on to the price of the system itself. Systemms range may become outside the range of the average consumer. Similarly, this project also is expensive if it is used on big scale. So, maintenance in regular interval is necessary for it as the middle class family can't bear the expense of the whole project again. The time of repetative maintenance will change according to the appliances and the scale of project.

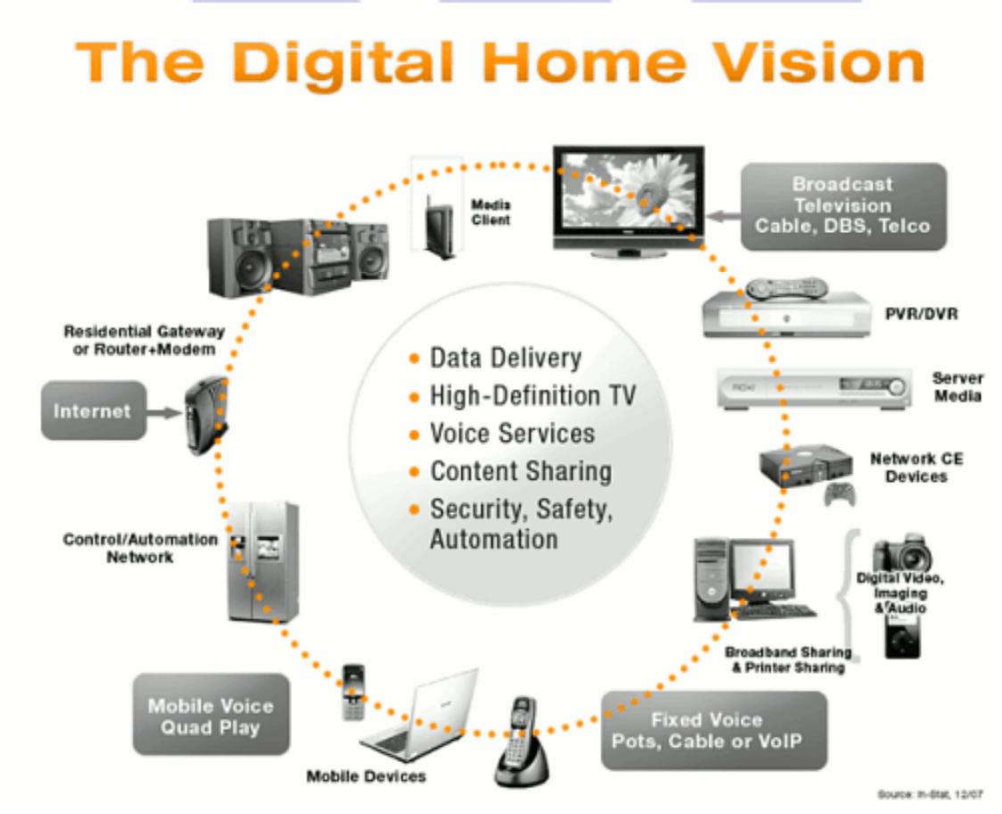
The project life will be so long as the arduino and hc-05 life. It will also depend upon the previously described concerns.



# 12.Future Works and Timeline

**HOME APPLIANCES CONTROL** project can lead the next generation I.e. 5G to control anything from the place where he/ she is present at that time. It will lead the world towards Smart Homes and the project can also benefit the DIGITAL INDIA PROJECT.

At the beginning the people will accept it with some doubts . At the time of growth it will grow like mobile phones growth in INDIA as it is very economical and at the maturity it can lead the world market too. It may be the timeline for its deployment.



# 13.Conclusion

This SRS document gives information about the HOME APPLIANCES CONTROL project which is an easy to deploy home automation system enhanced with machine learning features. At the beginning of this document, problem is defined and similar products in market are compared with our product. Afterwards, functionality of the application, requirements of the application, performance, attributes and design constraints are clarified in following subsections. In the overall description part, all of the functions that this application will perform are explained in detail for developers and future contributors. In the previous part, approximate plan of the project's progress is described tentatively. This document will hopefully constitute the base of design, development, and testing phases of the **HOME APPLIANCES CONTROL** project.

END OF PROJECT REPORT

THANK YOU