

# **Chapter 1: Project Overview**

## **1.1 Introduction**

Home Automation is automation of home, housework or household activity. In other words it refers to use of IT/computer to control home appliances. It integrates electrical devices in a house with each other. For example: It can include centralized control of lighting, appliances, security lock of gates & doors to provide improved convenience, comfort, energy, efficiency and safety.

In today's IT world, home automation is being popular due to easiness, flexible means of viewing/monitoring and controlling the appliances and other things according to users comfort and needs. The challenging part lies in simplicity and cost of installing them in home and varies with increasing number of services to be monitored and controlled. This project named 'HOME AUTOMATION' is idea of home automation using android.

The popularity of home automation has been increasing greatly in recent years due to considerable affordability and simplicity through smartphone and tablet connectivity. A home automation system integrates electrical devices in a house with each other. The techniques employed in home automation include those in building automation as well as the control of domestic activities, such as lighting control system, and the use of other electrical appliances. Devices may be connected through a home network to allow control by a personal computer, and may allow remote access from the internet. Through the integration of information technologies with the home environment, systems and appliances can communicate in an integrated manner which results in convenience, energy efficiency, and safety benefits.

Due to the advancement of wireless technology, there are several different of connections are introduced such as GSM, WIFI, and Bluetooth. Each of the connection has their own unique specifications and applications. Among the four popular wireless connections that often implemented in HA project, WIFI is being chosen with its suitable capability. The capabilities of WIFI are more than enough to be implemented in the design. Also, most of the current laptop/notebook or Smartphone come with built-in WIFI adapter. It will indirectly reduce the cost of this system.

This project forwards the design of home automation and security system using Raspberry pi, a credit sized computer. Raspberry pi provides the features of a mini computer, additional with its GPIO pins where other components and devices can be connected. GPIO registers of raspberry pi are used for the output purposes. We need to design a power strip that can be easily connected to GPIO Pins of the Raspberry pi. The home appliances are connected to the input/output ports of Raspberry pi along with the power strip and their status is passed to the raspberry pi. The android running OS in any phone connected to a network can access the status of the home appliances via an application. It presents the design and implementation of automation system that can monitor and control home appliances via android phone or tablet.

## **1.2 Problem Statement**

There is a great energy crisis in current situation of our country. Moreover, people have become negligent in proper utilization of the available energy. People often forget to turn off the light sources and other home appliance while staying out from home. Even in those situations, application of home automation makes it possible to control them from a distant place in easy way with our smartphone.

People are constantly running from place to place, working to accomplish everything on our never-ending “to-do” list. Because of the home automation system, we never have to worry about opening the door, switching off the appliances and so on. In short, we can save precious time and experience more daily productivity.

## **1.3 Objectives**

The main objectives of our project are as follows:

- i. To remotely control home appliances and monitor them.
- ii. To save time and utilize the energy efficiently.

## **1.4 Applications**

The application includes remote controlling of home appliances and lighting systems in an easy way. Also, home security and monitoring can be achieved.

## **1.5 Project Features**

The features of our project can be highlighted in following points:

- i. Remote control of home appliances from anywhere using app.
- ii. Continuous monitoring and security of home with camera module.
- iii. Considerable reduction in electricity bills with efficient energy utilization.

## **1.6 Feasibility Analysis**

This project can be implemented using affordable electronic and software technology making it economically, technically and operationally feasible.

### **1.6.1 Economic Feasibility**

This project is based on android phone based and few electronic components like Raspberry Pi microprocessor, camera modules, relay switches etc. which are affordable, making it economically feasible to implement.

### **1.6.2 Technical Feasibility**

This project is based on wireless technology and embedded system which are reasonably in phase with currently used technology. Therefore, it is very much favoured by the technology.

### **1.6.3 Operational Feasibility**

This software will have very easy to use, user friendly interface so it will be pretty much operable by anyone having little experience of using android phone. It could be helpful for physically disabled person too, controlling home appliances with the click of a button. So it is operationally feasible.

## **1.7 System Requirements**

### **1.7.1 Hardware Requirements**

#### **Control electronics**

- Raspberry Pi as the controller for its processing power and large developer community.
- Relays to connect electrical appliances to low voltage control of Raspberry Pi.
- GPIO pins are connected to transistor. Transistors are used as switch.
- Wi-Fi dongle to connect Raspberry Pi to the internet/LAN.
- Android phone with minimum android version 4.2 Jellybean to run the HA app.
  - \* Details about related hardware can be found on cost estimation section.

### **1.7.2 Software Requirements**

#### **1. Android Development Tools (ADT)**

- To build the android application to send the control signals to control the HA system and to receive the live video feed from the camera.

#### **2. IDLE**

- IDE for Python programming used to code the server side program.

#### **3. Raspbian OS**

- Linux based OS for Raspberry Pi

#### **4. RPI-GPIO library**

- GPIO interface library for the Raspberry Pi.

#### **5. Apache server and MySQL server**

- For hosting the webserver and MySQL database in Raspberry Pi

#### **6. Ffmpeg encoder/decoder**

- To stream the video to YouTube live stream server.

## Chapter 2: Literature Review

As per our survey, there exist many systems that can control home appliances using android based phones/tablets. Each system has its unique features. Currently certain companies are officially registered and are working to provide better home automation system features. Following models describes the work being performed by others.

N. Sriskanthan [1] explained the model for home automation using Bluetooth via PC. But unfortunately the system lacks to support mobile technology.

Muhammad Izhar Ramli [2] designed a prototype electrical device control system using Web. They also set the server with auto restart if the server condition is currently down.

Hasan [3] has developed a telephone and PIC remote controlled device for controlling the devices pin check algorithm has been introduced where it was with cable network but not wireless communication.

Amul Jadhav [4] developed an application in a universal XML format which can be easily ported to any other mobile devices rather than targeting a single platform.

Pratik Gadtaula of Telemark University College, Faculty of Technology has done a Master's thesis on "Home Automation" [5]. This project of his is quite interesting and challenging on the other hand. The author has developed a home automation system which is quite similar to the concept we're trying to implement in our project. His H.A system has got Raspberry pi tied together with Arduino controller for the controlling of a number of devices, unlike ours. Similarly, his project has conceptualized to integrate both the LAN network and Internet for two different aspect of the same project idea, however has not managed to do so. Also, he uses a website based user side application for controlling the home appliances through a web browser, this is striking difference between his project and what we're trying to do.

Next project we looked up to, was "Android Controlled Home Automation" [6], a project performed by Sabin Adhikari and co. from Kathmandu Engineering College, Electronics faculty. What they've succeeded to do is built a home automation system which is controlled by an android app, much like ours, and has Google based voice command system. Their hardware requirements are closely related to ours. Their work includes video streaming from an IP camera to the android device and other home appliances control system. Their project is entirely based on local network connection using Wi-Fi. This is also a point where our project seems to improve by integrating

both local network and Internet connection, to allow remotely control of home appliances.

Each of these system has their own unique features and on comparison to one another lacks some advancement.

Apart from the actual projects we consulted, we also did some research on the background of this field, studied about the basics and foundations necessary to carry out this project. For instance, we went through the book “Raspberry Pi Home Automation with Arduino” by Andrew K. Dennis. It’s an excellent read for the beginners to jump into the field of Home Automation. It deals with the necessary background details required to build a H.A system. It talks about Raspberry Pi, Arduino controller, database design and all sorts of things.

Another one good read is “Getting Started with Raspberry Pi” by Matt Richardson and Shawn Wallace. It covers a great deal of information about the core of our project that is Raspberry Pi. It deals with lots of things that can be done with a Raspberry Pi. It explains the procedure of building some simple yet innovative projects with lots of application packages that come with Raspberry Pi.

Last but not the least, the book “Designing the Internet of Things” by Adrian McEwen and co. gives a great deal of knowledge on the concept of Internet of Things which ranges from the day to day examples of IoT based projects, the information of taking you prototype to manufacturing. This book is really a good take on IT based entrepreneurship.

Other helpful resources are the online sources like official Raspberry Pi documentation and resource site [7] which has detailed information about how to get started with the Raspberry Pi, configuration details, forum discussions and whole lot of useful stuffs like setting up the apache server on pi. Also, it has information regarding setting up the Raspberry Pi camera module, taking pictures and video using the Python pi camera module, connecting a physical button with the GPIO pins and programming it to control the camera.

Likewise, some YouTube tutorial lessons really helped as well. A really good explanation for the YouTube live streaming from Raspberry Pi was due to blog of Max Ogden [8]. Similarly, from the site of tutorials-point [9], we learnt connecting the MySQL database from Python using MySQLdb library connector. The book on "Networking and Web application using Raspberry pi, Arduino and Teensy" by Yury Magda gives the knowledge on connecting raspberry pi with Arduino using serial

interface.

Our system has application layer prototype. There is no explicit use of socket programming to directly connect the android application with the raspberry pi but instead it is connected with a database which is connected to and hosted by Raspberry Pi. This further adds security to our system. The data are received only by the server at the specified port and data are further analysed. Our project is different in a sense it has its own software level application to control the home appliances. We are trying to incorporate both LAN and Internet approach to our solution of H.A. So that users at home can simply connect to their private Wi-Fi and control the H.A system even without Internet, and when user is away from home he/she can control the system through Internet. And, also our approach to the solution differs from all other previous projects in regards to live video streaming and also has lots of improvements in other areas as well.

## Chapter 3: Methodology

This section of the report explains about what are we going to do and how are we going to do it. We will be following incremental development model for the completion of this project which is discussed below briefly:

### Incremental development model

Incremental development is based on the idea of developing an initial implementation, exposing this to user comment and evolving through several versions until a complete system has been developed. It interleaves the activity of specification, development & validation. Developed as a series of version (increments) with each version adding functionalities to the previous one.

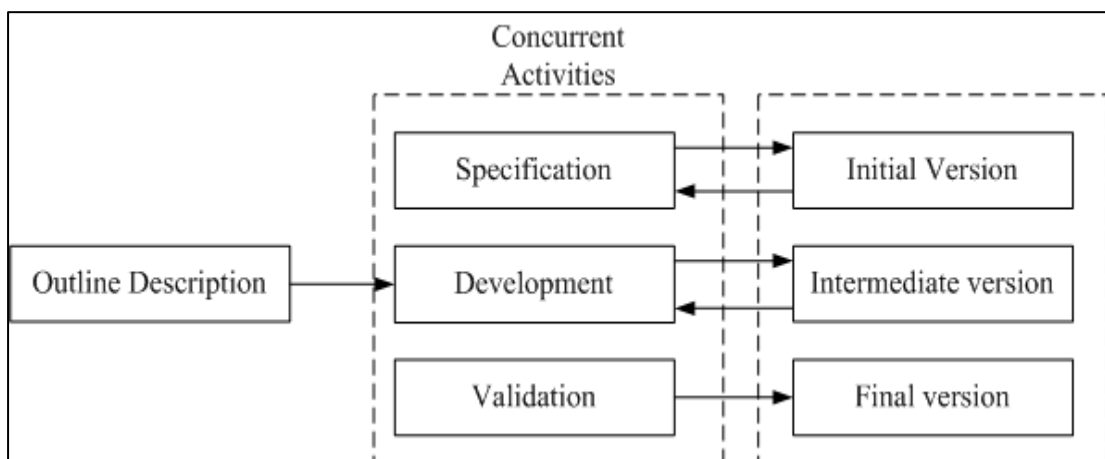


Figure 3.1: Incremental Development Model

We have closely followed this model of software development in our project. As the requirements change or new features are to be added to enhance the functionality as a whole, we integrate them as they come up. As for the hardware aspect of the project, there is limited flexibility in design and implementation. We cannot go on producing and then redesigning the end products upon changes or failures, so we model the complete design conceptually in diagrams plus in temporary, easy to integrate and disintegrate bread boards.



### **Version 1.0**

At first, we developed an app with basic facility of making Http requests to the local Apache server hosted on the PC. This version could make changes to the MySQL database on the server.

### **Version 1.1**

Next, we uploaded and hosted the MySQL database on the Apache server on the Raspberry Pi. And, both android app and Raspberry pi were connected over a LAN. Further, server script was coded on the Raspberry pi to react to the changes made on MySQL database.

### **Version 1.2**

After that, we integrated the live streaming part to the android app and also on the Raspberry pi to capture and stream live video to the YouTube server. Similarly, we designed and fabricated PCB to interface Raspberry pi with AC appliances.

### **Final Version**

After all these intermediate version, at last, the final version of system was developed. This version facilitated the database on the cloud and both android app and Raspberry pi could communicate with each other over the internet. Hence, android app facilitated remote controlling of appliances with live video streaming.

## Use Case Diagram

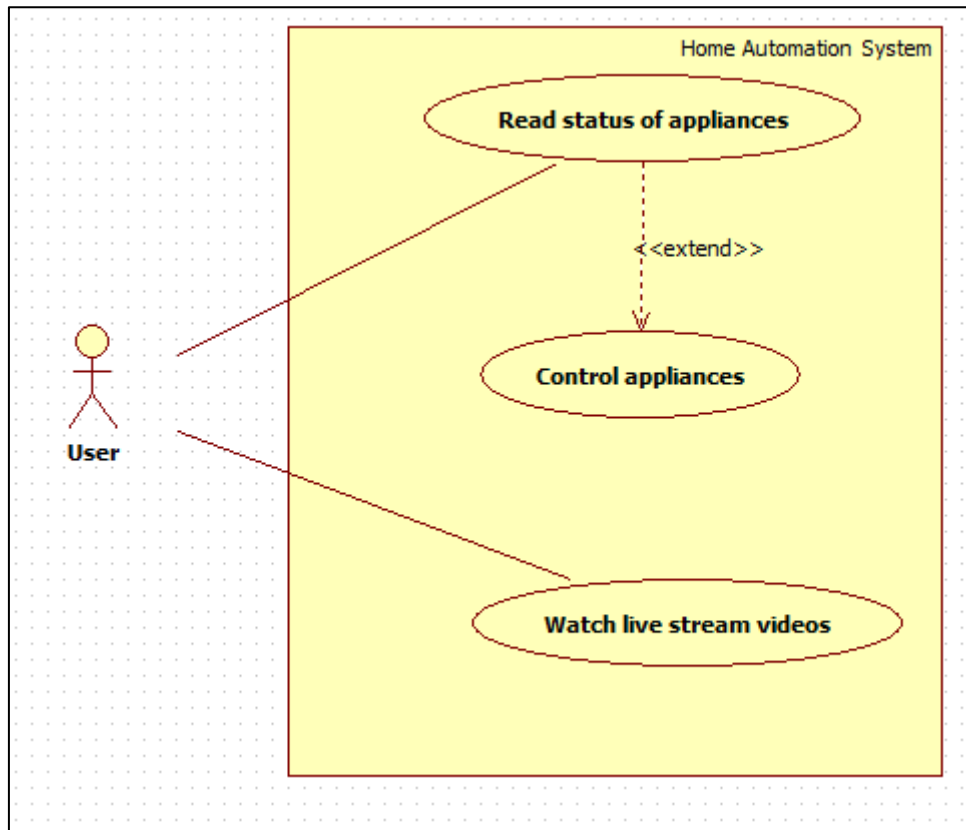


Fig 3.2: Use Case Diagram of Home Automation

In our system, user acts as a primary actor who can read status of appliances either in ‘‘ON’’ state or ‘‘OFF’’ state through the database. Further, the user may change the state of appliances and control them according to the need by sending the status signals to the database and raspberry pi gets access to the database and send control signals to the appliances. Also watching the live stream video can be done by the user through the YouTube stream server whenever required.

## Class Diagram

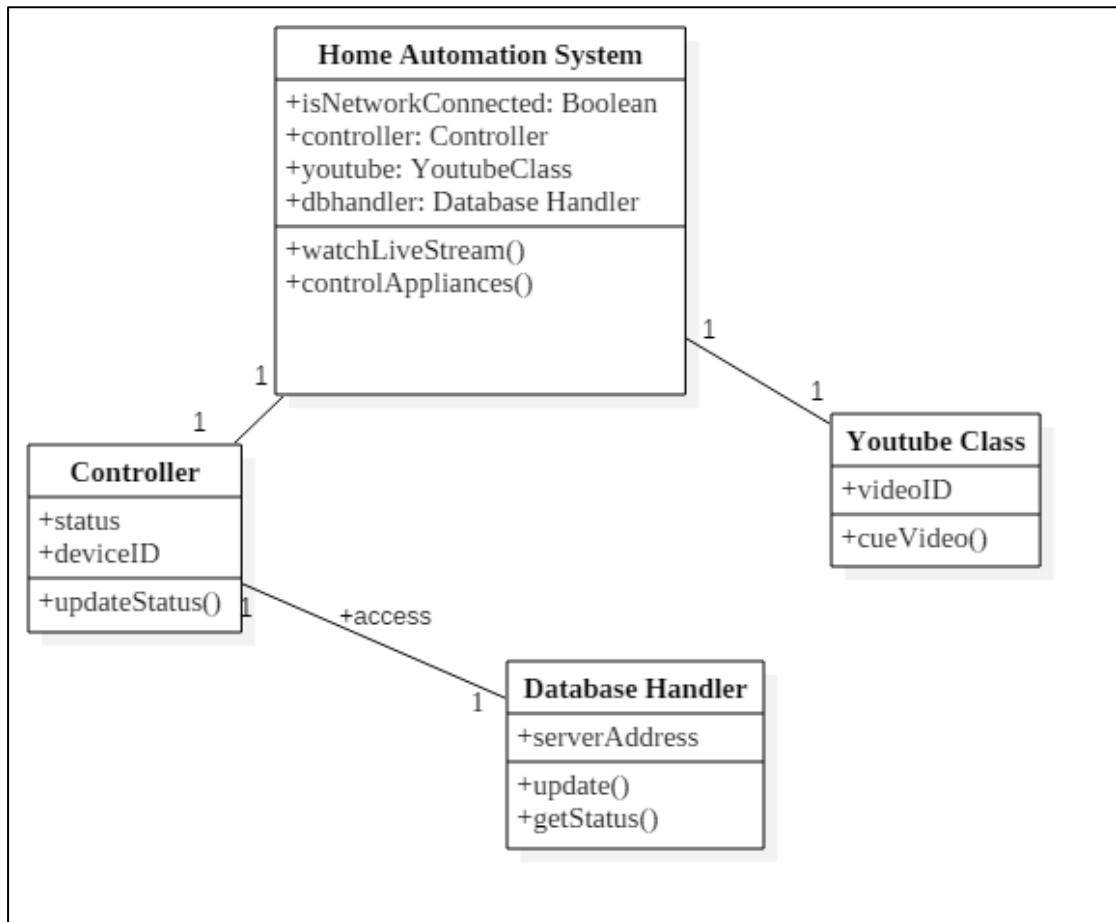


Fig 3.3: Class Diagram of Home Automation

## Activity Diagram

The Activity diagram below shows the flow of activities or actions that occur when user tries to interact with the system and tries to access the functionalities provided by the system.

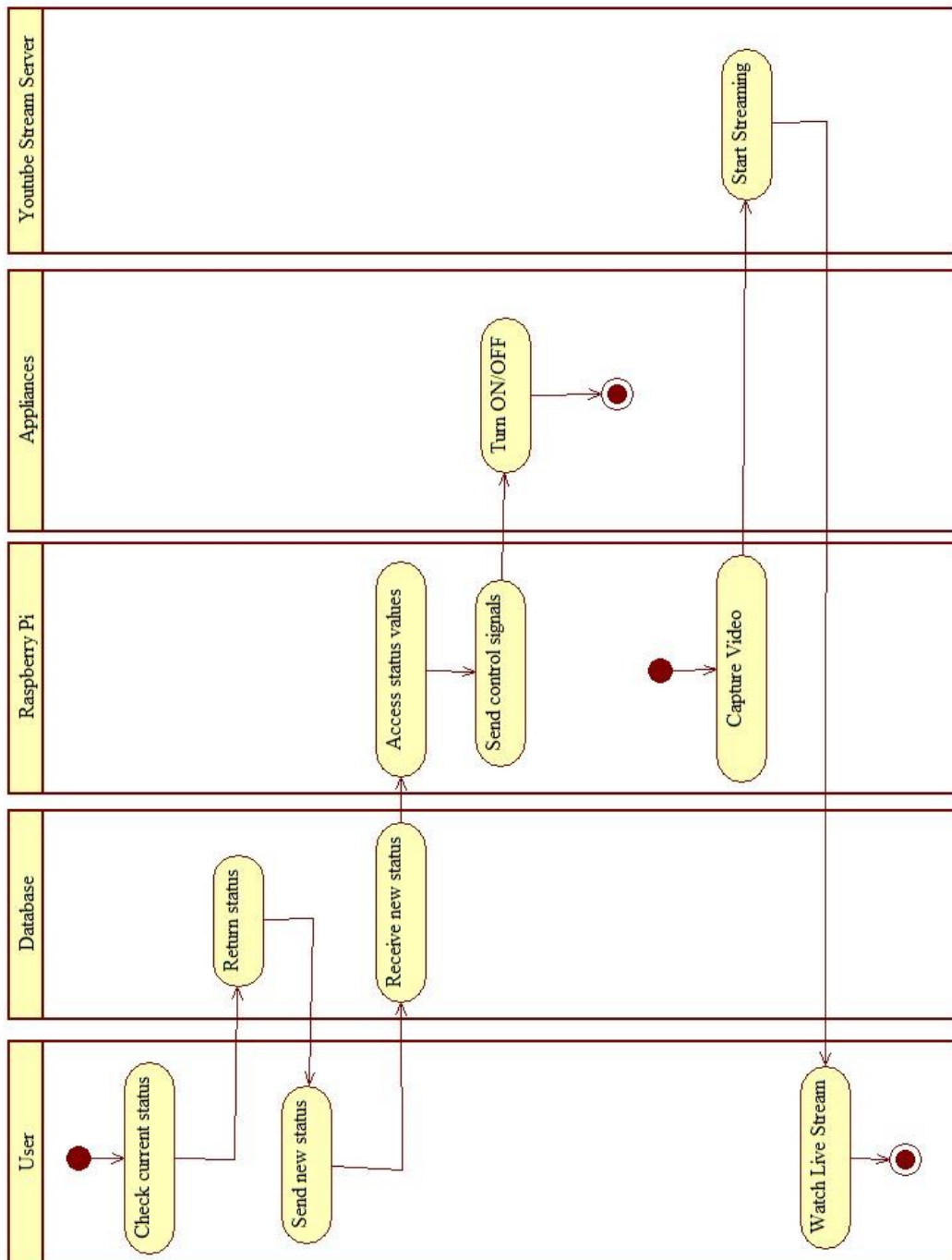


Fig 3.4: Activity Diagram of Home Automation System

## Sequence Diagram

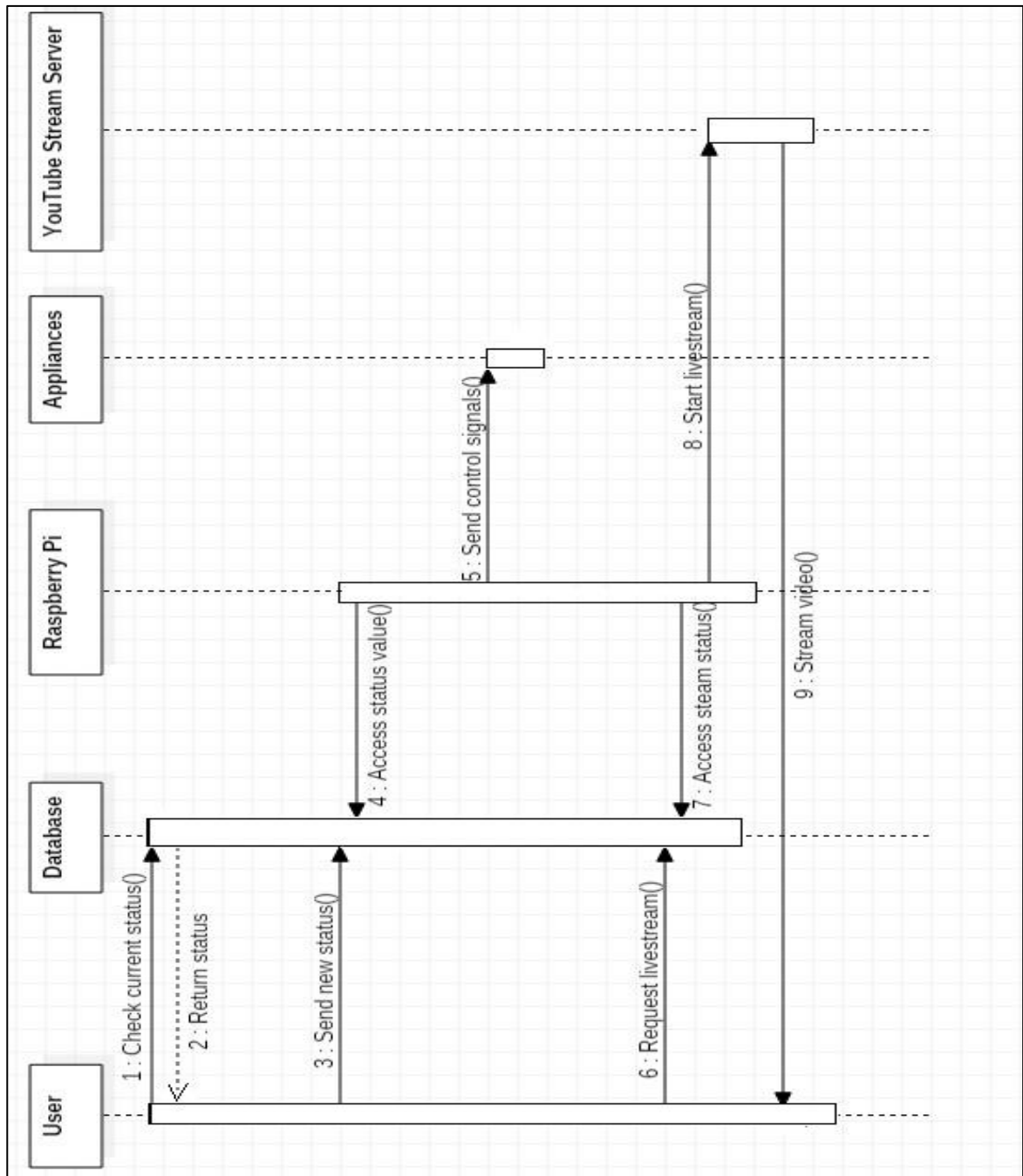


Fig 3.5: Sequence Diagram of Home Automation System

First of all, the user checks the current status of home appliances in the database and then the user can send new status for controlling appliances to the database. Raspberry pi continuously checks the status values in the database and as soon as new status gets stored in the database, the pi sends control signals to the concerned appliances. Further,

the user can watch live stream video through the YouTube stream server whenever required for monitoring purposes.

### Working

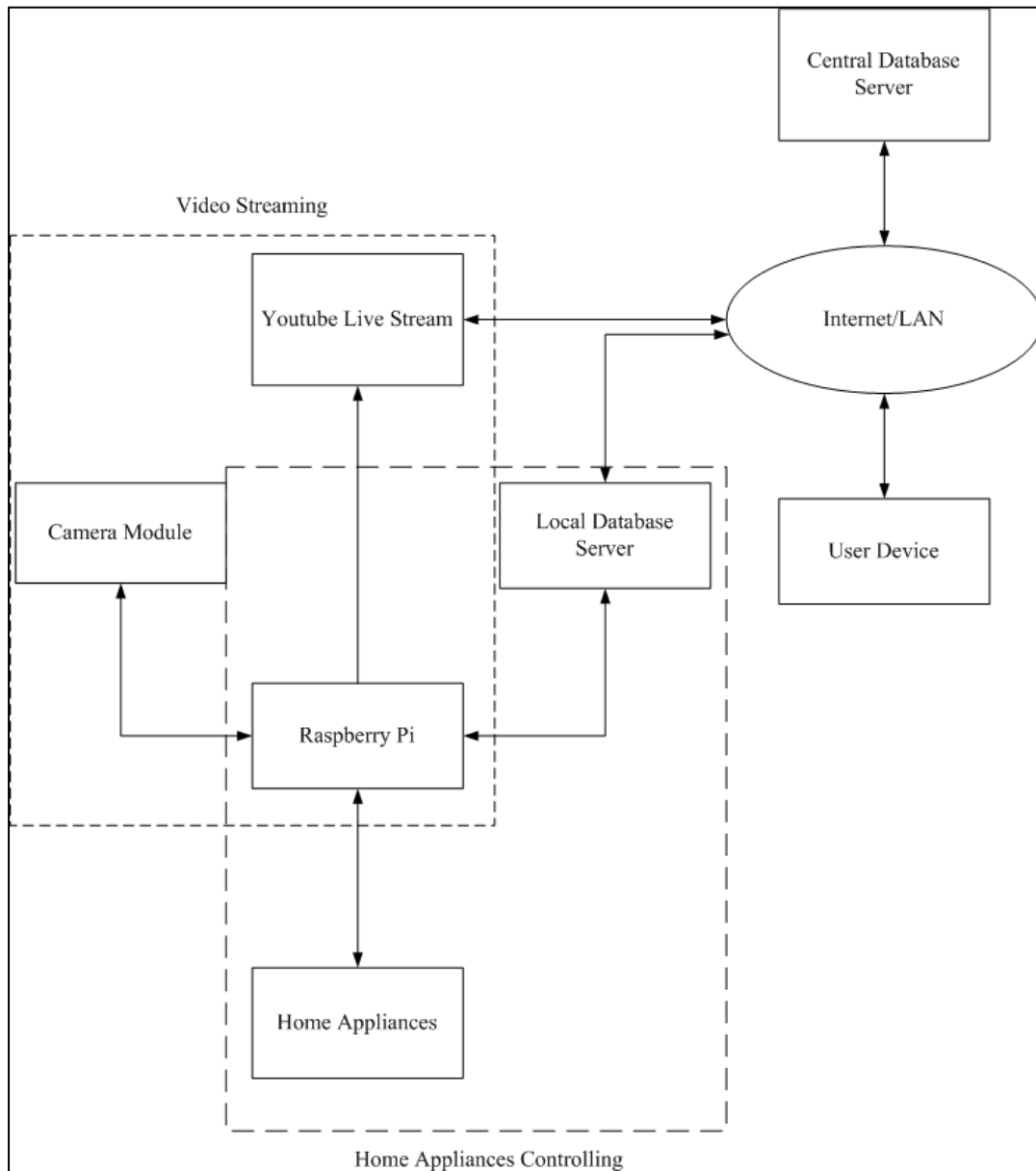


Figure 3.6: Block Diagram of Home Automation System

The android OS provides the flexibility of using the open source. The inbuilt sensors can be accessed easily. An application with the feature to control the home appliances and watch the live stream of the site for monitoring purposes is developed. Android Phone acts as a client and data are sent via sockets programming. The app has two basic modes: control mode and video streaming mode. Control mode uses the toggle buttons

that are used to control the home appliances. The toggle button sends the status of the switch. Video streaming mode shows the live stream of the room. The captured video is streamed on the android application.

All the devices are connected to a common network either through LAN or Internet. Smartphone, raspberry pi and camera are connected to the common network. Router is used to create a common network. Raspberry pi is used to maintain the web server. The pi collects the data, analyses it and further activates GPIO pins as necessary. The GPIO pins of raspberry pi are connected to the relay. Relay switch are used to connect the home appliances.

### 3.1 Hardware Description

The major hardware required for this project are Raspberry Pi, camera module, router, android phone and the power strip circuit. Raspberry pi is the central part of the whole system and pretty much acts at the core processing and control system. The camera module is used to capture video and stream it online. Likewise, router is used to create a LAN, which connects pi and the android phone to a common network. Similarly, android phone is necessary to run the android app and finally power strip connects the electrical appliances to the electronic control logic of the system.

The power strip is designed on a PCB and it contains various electronic elements like capacitors, resistors, LEDs and relays. One end of the power strip is connected to the electronic logic part of the raspberry pi while next end to the electrical home appliances. So, basically it controls the home appliances based on the logic of GPIO pins of pi.

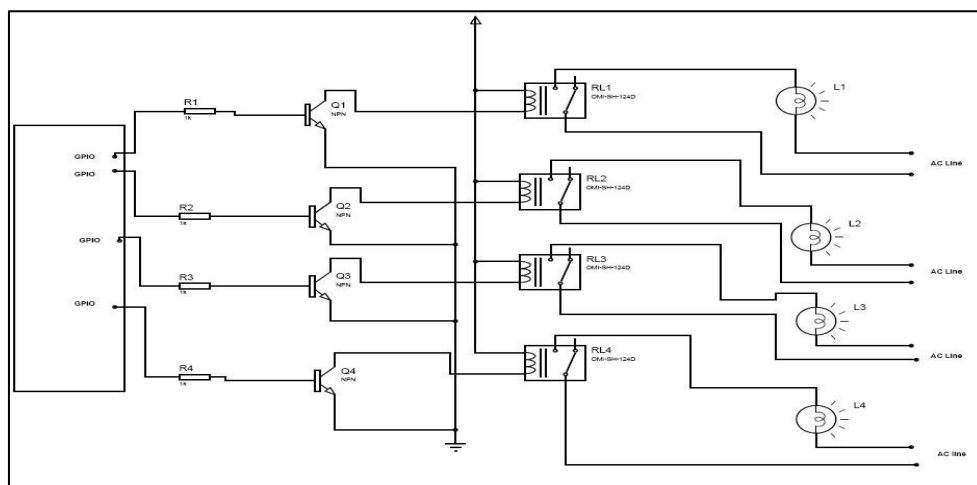


Figure 3.7: Block Diagram of the power strip

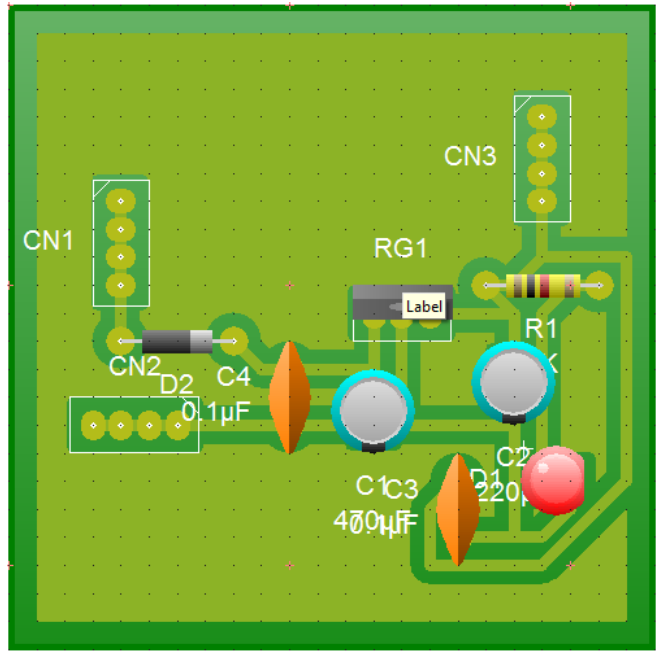


Figure 3.8: Real world model of 5V regulator on PCB

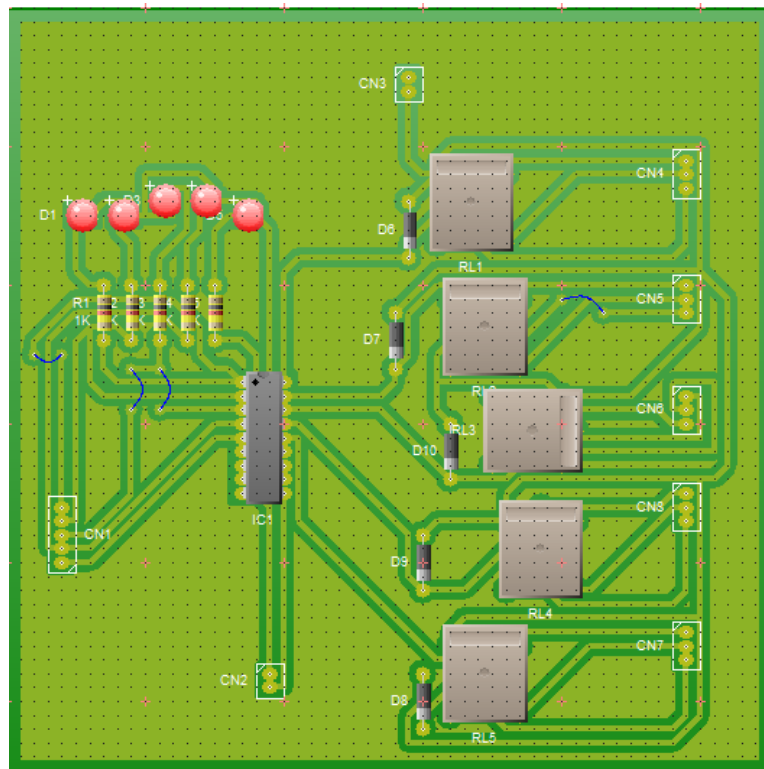


Figure 3.9: Real world model of relay board on PCB

### 3.2 Software Description

There are two major pieces of software in this project. First one is the android application, which is front end and next is the server side software running on the



raspberry pi at the backend.

Android app is capable of nicely presenting the current status of the home appliances and also control them by simply pushing certain buttons. Also, app streams the live video from the site of pi. Android app sends the data about status of appliances to the MySQL database in the form of JSON and receives in the same way with the help of web services developed with PHP.

Raspberrry pi hosts the MySQL database on the apache server and a Python script which control the GPIO pins of the pi based on the data send over by the android app. Similarly, live streaming is done with the help of the video encoder named Ffmpeg which streams the video captured using inbuilt python camera library to YouTube.

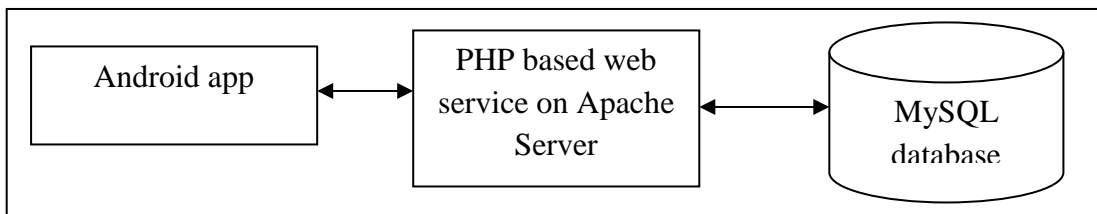


Figure 3.10: Exchange of data between android app and MySQL database

The software and other utility tools required/used for the development of software aspect of this project is discussed in the further part of this section.

### **Android Studio**

Android Studio is the comprehensive IDE for the android application development by Google. We developed our android app entirely in android studio.

### **Python IDLE**

IDLE is the IDE for the python language. We coded the server side script which runs on the pi using python. This script is responsible for controlling the status of the home appliances.

### **MySQL and Apache**

Apache server was setup on the pi to host the MySQL database and PHP web services which make the communication between the android app and database possible. MySQL hosts a database which has table that stores the status of the devices connected to the pi. These status are updated based on the data obtained from the android app to

reflect the status of the home appliances.

### **Ffmpeg encoder**

It is a video encoder which encodes the video captured by the raspberry pi camera to convert it into a suitable format, for instance, flv, which is an acceptable video format to be streamed by the YouTube server. We can specify a lot of parameters of the video that we are trying to stream with this encoder for example the frame rate, video width, height i.e. resolution and so on .

### **PCB Wizard**

PCB Wizard is a powerful package for designing single-sided and double-sided printed circuit boards (PCBs). It provides a comprehensive range of tools covering all the traditional steps in PCB production, including schematic drawing, schematic capture, component placement, automatic routing, Bill of Materials reporting and file generation for manufacturing.

### **MobaXterm**

It is an enhanced terminal for Windows with an X11 server, a tabbed SSH client and several other network tools for remote computing (VNC, RDP, telnet, rlogin). MobaXterm brings all the essential UNIX commands to Windows desktop, in a single portable exe file which works out of the box. This software is useful for easy uploading and downloading of files to and from raspberry pi using another machine on the network (for instance, laptop running windows).

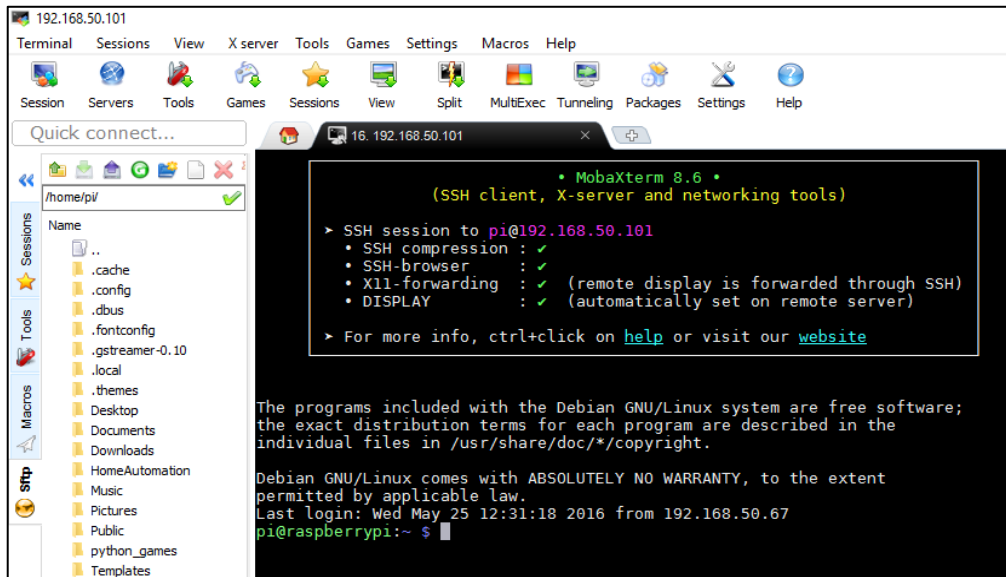


Figure 3.11: Established session of pi with Linux terminal in MobaXterm

### 3.3 Procedures

In this section of the report, we discuss how we achieved the aforementioned targets.

#### For setting up webserver on Raspberry Pi

We first installed the Raspbian OS on the raspberry pi and performed update and upgrade to get the latest version of the OS. Then, we configured the Wi-Fi connection on the pi. Then finally we installed apache server and MySQL server on the pi and created a database and then a table to store the status of the devices.

#### For developing Server side program

We used python language to write the server side script. This script connects to the database set up on the above step and reads the status of the devices. And based on those data, it either turns on or off the devices.

#### For setting up YouTube live stream

We created a YouTube account and using live streaming option got a private key and the server address to which the video is to be streamed. This combination is later supplied to the Ffmpeg encoder to start the streaming.

### **For the designing of android application**

We used the Android Studio IDE for the design and development of android application which is used to communicate with the Raspberry Pi and control the home appliances. Further, it streams the live video feed from the raspberry pi camera using YouTube API. This process involves the layout design of the app to give the look and feel of the android app and the coding part that does the actual task behind the scene in the background.

### **For the live streaming of video**

We wrote a script in Linux bash shell to live stream the video captured by the camera module to the live events URL of YouTube account configured for the live streaming using the Ffmpeg encoder. When the YouTube server gets the source for the live streaming, it streams the live video. The android app then embeds the YouTube video with the help of YouTube API and we get the live streaming of the site where camera is installed on the android app.



Figure 3.12: Raspberry Pi camera module connected to CSI port

### For the design and fabrication of hardware part (PCB)

We used PCB Wizard software for the design of PCB boards for 5V DC regulator and Relay board. This software tool allows drag and drop feature to place the electronic components on the PCB to obtain the various styled optimized design of PCB. Then, we extract the schematic diagram for our purpose. After that, we printed it out on a paper and got it imprinted onto the copper plated PCB with the help of hot iron. We then, washed the board with Ferric Chloride ( $\text{FeCl}_3$ ) solution to get rid of extra copper. This was followed by drilling to place the components onto the PCB and finally soldering them and laminate the surface with paint to prevent rust.

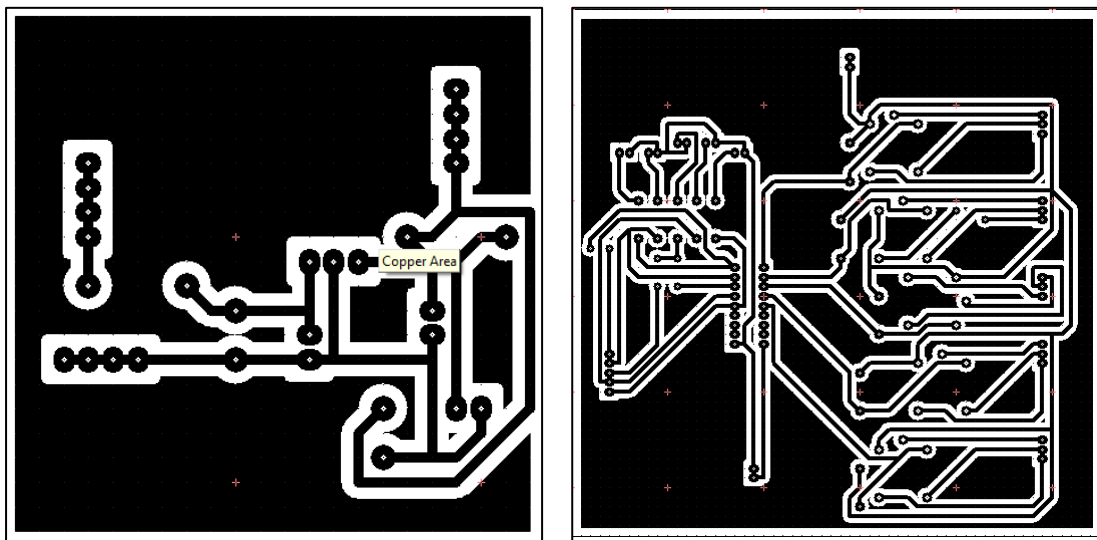


Figure 3.13: Schematic diagram of PCB design of 5V regulator (left) and relay board

## Chapter 4: Results and Conclusion

### 4.1 Result and Discussion

The final outcome of this project is a prototype for a simple home automation system which can control home AC appliances with a touch of a finger and is equally capable of monitoring with live stream video feed of the site. On the front end, there is an android app to control the home appliances and PCB board to which a number of home appliances are connected. Then on the backend, there is raspberry which has been programmed to control the status of GPIO pins and thereby controlling the appliances, and also capture video using camera module and stream it live to YouTube server.

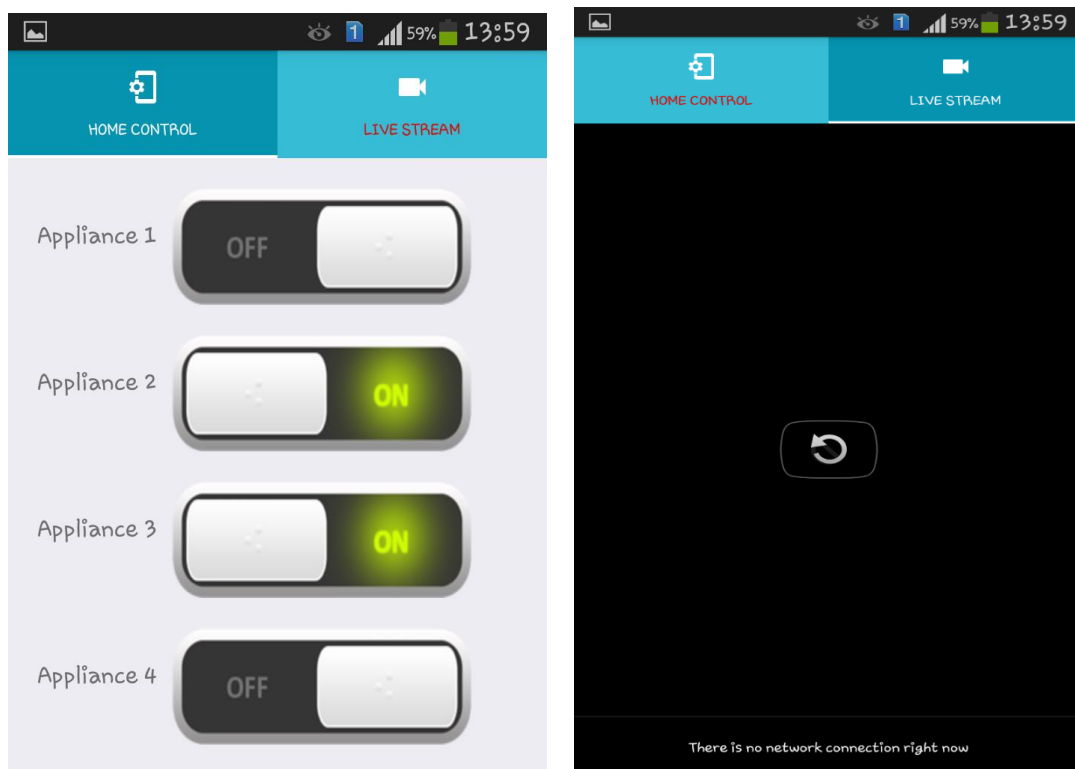


Figure 4.1: Android app interfaces for control (left) and live stream

The results of this project have been up to the mark as expected when the project began initially. The user can remotely control the appliances and also watch the live stream on the same mobile app. Hence, the target we set were successfully reached on time effectively.

## 4.2 Problems Faced

This project, by no means, completed without any problems and difficulties along the way. Following are the problems faced during the course of completion of this project.

- We had lots of difficulties getting a fully working Raspberry Pi and thus it took a lot of our time configuring it to a fully working state.
- Due to diverse nature of this project, the hardware components along the same line, it was a difficult task to research on it and get devices that perfectly matched our requirements on time. Moreover, some materials had to be bought on authors' part.
- As it was our first take on the hardware design, for instance, the fabrication of PCB with varieties of electronic components, we faced a lot of complexities and the overall process was a challenging one.
- On the software part, android app development and server side scripting were fairly easy. Nonetheless, they produced some critical scenarios where it took some handsome amount of effort.

## 4.3 Limitations and Future Enhancements

This project is our take on trying to create a prototype of a fully working Home Automation System. Although every effort has been made to make it a complete and very much closer to an ideal solution product that we wanted to achieve, there always remain areas where further improvements are possible.

### **Limitations:**

Since our project is just a prototype resembling a real world home automation system, our project has following limitations:

- No sensors for the real time data logging and automatic control of appliances.
- Since, we utilized the free live streaming feature of YouTube, 24/7 streaming is not possible.
- Delay of around 10 sec in the live stream from the camera module to YouTube server when it is viewed in the app.
- Only limited number of appliances can be connected and thus controlled using this system.

## **Future enhancement**

By interfacing various sorts of sensors, we can program the automatic controlling of the appliances. As for example, using temperature sensors to log the current temperature of a room, we can control the automatic turning ON/OFF of the heater or fan. Likewise, for the continuous streaming of video, we can set up our own video server. This is surely to cost a lot. We could also interface Arduino to raspberry pi so that we can increase the number of appliances that can be controlled remotely.

## **4.4 Budget Analysis**

The following section consists of the budget analysis of the project, that is, the total budget for the development of the project and the operational and maintenance cost that follows after the implementation of the project.

### **4.4.1 Development cost**

The development cost can be categorized into software and hardware development cost.

#### **Software design and development cost:**

Development cost = Rs.100 per hour

Working hours = 5 hrs per day

Total working days = 60 days (2 months)

Total working hours = 120 \*5 = 300 hrs

Total cost = Rs.100\*300 = Rs.30,000

#### **List of equipment with cost:**

The cost of equipment used in this project can be summarized in the following table.



<b>Name</b>	<b>Quantity</b>	<b>Price (Rs.)</b>
Raspberry Pi 2 Model B 1 GB RAM	1	7000
Raspberry Pi Camera module	1	5000
MicroSD card 8GB	1	400
Router	1	2000
Wi-Fi 802.11n dongle	1	450
Relays(5V)	5	50 per piece
Jumper Wires	1 pkt.	20
Resistors	1 pkt.	30
Capacitors	1pkt.	30
PCB	1 piece	300
Grand total		Rs.15,480

Table: Equipment list with their respective cost

The cost for design and fabrication of PCBs = Rs. 500

Total project development cost = Rs. (30000+15480+500) = Rs.45, 980

#### 4.4.2 Operation and Maintenance cost:

Overall electricity cost = Rs. 100 per month (for raspberry pi and router only)

Internet Service Provider cost = Rs. 1500 per month (broadband internet)

Hardware and Software maintenance cost = Rs. 2500 per month (if needed be)

**Total operational cost:** Rs. (100+1500+2500) = Rs. 4,100 per month

#### 4.5 Work Schedule

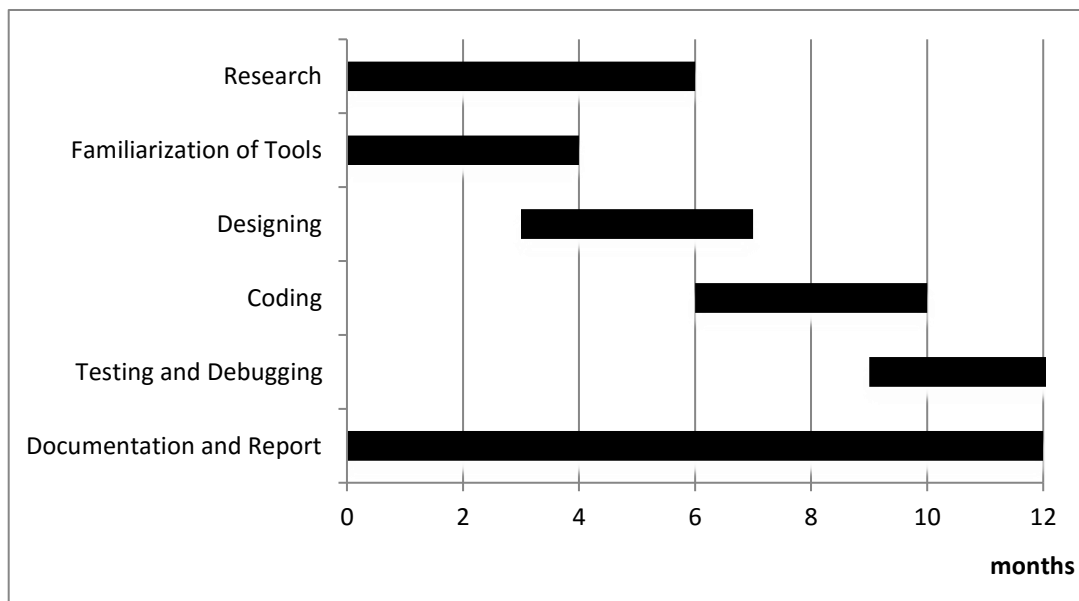


Fig 4.2: Gantt chart of work schedule

The estimated time period of this project was 12 months. The work was divided into several phases as shown in Gantt chart. We were continuously involved in the proper documentation and report preparation throughout the whole project period. Firstly, we did research and got familiarized with the tools which we used during later phases. Then the design and planning of software and hardware part followed. After that we started coding for an android app and side by side fabrication of relay board and related hardware was done on the PCB. Testing and debugging was performed along the way. Hence, we completed the project in time as expected.

#### 4.6 Conclusion

Hence, the idea to create a fully working home automation system with facility to control and monitor appliances has been finally realized. The output of this project is

an array of home appliances that are controlled over the internet with the help of a mobile app and the facility to stream the video live, as well. This project is a successful outcome of continuous and tireless effort from all the project members, supervisors, college faculty, colleagues and other helping hands.

This project has been a really great experience and opportunity to learn and to experiment. Moreover, the authors got the chance to closely experiment and learn about what goes into designing and developing home automation systems. We are very much delighted that we explored this topic as our major project title and in a way, created a version of home automation system of our own, and to be closely related with the technology that is of a great interest of study and research today and is sure to revolutionize the way of living of people in the days to come.

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# **APPENDIX**

## **QUICK START GUIDE – For Raspberry Pi**

(Source: <https://www.raspberrypi.org/help/quick-start-guide/>)

### **WHAT YOU WILL NEED**

#### **REQUIRED**

- SD Card

We recommend an 8GB class 4 SD card – ideally preinstalled with NOOBS.

- Display and connectivity cables

Any HDMI/DVI monitor or TV should work as a display for the Pi . For best results, use one with HDMI input, but other connections are available for older devices. Use a standard Ethernet cable for internet access.

- Keyboard and mouse

Any standard USB keyboard and mouse will work with your Raspberry Pi.

- Power supply

Use a 5V micro USB power supply to power your Raspberry Pi. Be careful that whatever power supply you use outputs at least 5V; insufficient power will cause your Pi to behave in strange ways.

#### **NOT ESSENTIAL BUT HELPFUL TO HAVE**

- Internet connection

To update or download software, we recommend that you connect your Raspberry Pi to the internet either via an Ethernet cable or a Wi-Fi adapter.

- Headphones

Headphones or earphones with a 3.5mm jack will work with your Raspberry Pi.

## **PLUGGING IN YOUR RASPBERRY PI**

Before you plug anything into your Raspberry Pi, make sure that you have all the equipment listed above to hand. Then follow these instructions:

- Begin by slotting your SD card into the SD card slot on the Raspberry Pi, which will only fit one way.
- Next, plug in your USB keyboard and Mouse into the USB slots on the Raspberry Pi.
- Make sure that your monitor or TV is turned on, and that you have selected the right input (e.g. HDMI 1, DVI, etc.)
- Then connect your HDMI cable from your Raspberry Pi to your monitor or TV.
- If you intend to connect your Raspberry Pi to the internet, plug in an Ethernet cable into the Ethernet port next to the USB ports, otherwise skip this step.
- When you are happy that you have plugged in all the cables and SD card required, finally plug in the micro usb power supply. This action will turn on and boot your Raspberry Pi.
- If this is the first time your Raspberry Pi and NOOBS SD card have been used, then you will have to select an operating system and configure it.

## **LOGGING INTO YOUR RASPBERRY PI**

Once your Raspberry Pi has completed the boot process, a login prompt will appear. The default login for Raspbian is username pi with the password raspberry. Note you will not see any writing appear when you type the password. This is a security feature in Linux.

After you have successfully logged in, you will see the command line prompt `pi@raspberrypi~$`

To load the graphical user interface, type `startx` and press Enter on your keyboard.

## General purpose input-output (GPIO) connector

(Source: [https://en.wikipedia.org/wiki/Raspberry\\_Pi](https://en.wikipedia.org/wiki/Raspberry_Pi))

RPi A+, B+, 2B and Zero GPIO J8 40-pin pinout. Models A and B have only the first 26 pins.

GPIO#	2nd func.	Pin#	Pin#	2nd func.	GPIO#
	+3.3 V	1	2	+5 V	
2	SDA1 (I2C)	3	4	+5 V	
3	SCL1 (I2C)	5	6	GND	
4	GCLK	7	8	TXD0 (UART)	14
	GND	9	10	RXD0 (UART)	15
17	GEN0	11	12	GEN1	18
27	GEN2	13	14	GND	
22	GEN3	15	16	GEN4	23
	+3.3 V	17	18	GEN5	24
10	MOSI (SPI)	19	20	GND	
9	MISO (SPI)	21	22	GEN6	25
11	SCLK (SPI)	23	24	CE0_N (SPI)	8
	GND	25	26	CE1_N (SPI)	7
(Models A and B stop here)					
EEPROM	ID_SD	27	28	ID_SC	EEPROM



5	N/A	29	30	GND	
6	N/A	31	32		12
13	N/A	33	34	GND	
19	N/A	35	36	N/A	16
26	N/A	37	38	Digital IN	20
	GND	39	40	Digital OUT	21

Model B rev. 2 also has a pad (called P5 on the board and P6 on the schematics) of 8 pins offering access to an additional 4 GPIO connections.

Function	2nd func.	Pin#	Pin#	2nd func.	Function
N/A	+5 V	1	2	+3.3 V	N/A
GPIO28	GPIO_GEN7	3	4	GPIO_GEN8	GPIO29
GPIO30	GPIO_GEN9	5	6	GPIO_GEN10	GPIO31
N/A	GND	7	8	GND	N/A

Models A and B provide GPIO access to the ACT status LED using GPIO 16. Models A+ and B+ provide GPIO access to the ACT status LED using GPIO 47, and the power status LED using GPIO 35.