# SOFTWARE CONTROLLED APPLIANCES FOR ENERGY CONSERVATION AND DIFFERENTLY ABLED

**AN INTERNAL FUNDED PROJECT REPORT**

***Submitted By***


**SATISH P 312212104095**

**NAVEEN H. 312212104068**

**VIDHYALAKSHIMI S. 312212104117**

**NAREN T KESH 312212104067**


**ACADEMIC YEAR 2015-16**


**COMPUTER SCIENCE AND ENGINEERING**

**SSN COLLEGE OF ENGINEERING**

**KALAVAKKAM 603110**


**October 2015**

# SSN COLLEGE OF ENGINEERING : CHENNAI 603110

## BONAFIDE CERTIFICATE

Certified that this project report titled **"SOFTWARE CONTROLLED APPLIANCES FOR ENERGY CONSERVATION AND DIFFERENTLY ABLED"** is the *bonafide* work of "**Satish. P (312212104095)**, **Naveen. H (312212104068)**, **Vidhyalakshimi S. (312212104117)** and **Naren. T. Kesh (312212104067)**", who carried out the project work under my supervision as an internal funded project in department of CSE.

Place:
Date:

**Ms. Angel Deborah. S**
**Supervisor**
Associate Professor,
Department of CSE,
SSN College of Engineering,
Kalavakkam - 603 110

# ACKNOWLEDGEMENTS

We thank GOD, the almighty for giving us strength and knowledge to do this project.

We would like to thank our guide **MS. ANGEL DEBORAH S**, Associate Professor, Department of Computer Science and Engineering, for her valuable advice and suggestions as well as her continued guidance, patience and support that helped us to shape and refine our work.

Our sincere thanks to **Dr. CHITRA BABU**, Professor and Head of the Department of Computer Science and Engineering, for her words of advice and encouragement.

We express our deep respect to the founder **Dr. SHIV NADAR**, Chairman, SSN Institutions. We also express our gratitude to our **Dr. S. SALIVAHANAN**, Principal, for all the help he has rendered during this course of study.

We would like to extend our sincere thanks to all the teaching and non-teaching staffs of our department who have contributed directly and indirectly during the course of the project work. Finally, we would like to thank our parents and friends for their patience, cooperation and support.

**Satish P.** **Naveen H.** **Vidhyalakshimi S.** **Naren T Kesh.**

# ABSTRACT

With the increase in consumption of energy and population, there is a grave need to conserve energy in every way possible. The major reason for this is the inaccessibility to the appliances at all times. This concept of software controlled appliances provides the precise measure to avoid the wastage of electrical energy due to this reason. Any appliance located anywhere in the planet and within the controller's scope can be accessed using the internet and toggled between on/off states using Raspberry Pi controller in that location anytime. The Elderly and differently-abled people can access and control any appliance without any difficulty of having to get to the switch board to operate it, using this system. An android application, is used to instruct the Raspberry pi wirelessly . The Raspberry pi is the main control centre in a particular home and is connected to each of the switch boards in every room of the house. This system interfaces with existing wiring system rather than needing to replace the whole appliance system along with the wiring.

# TABLE OF CONTENTS

# LIST OF TABLES

# LIST OF FIGURES

-

# LIST OF ABBREVIATIONS

| | |
|---|---|
| **DEMUX** | Demultiplexer |
| **GSM** | Global System for Mobile Communication |
| **GPIO** | General Purpose Input Output |
| **JSON** | Javascript Object Notation |
| **J2ME** | Java 2 Mobile Edition |
| **LED** | Light Emitting Diode |
| **MUX** | Multiplexer |
| **M2M** | Machine to Machine |

0.5

CHAPTER 1

# Introduction

Electronic and Electrical environment with respect our context is any environment which consists of appliances such as fans, television sets, air conditioners, motors, heater, lighting systems, etc. A remotely accessible environment is an environment in which each appliance can be remotely accessed and controlled using software as an interface, which includes an android application and a web application. Such remotely accessible systems are already available in the market, but one of the greatest drawbacks of those systems is that it pertains to its own types of appliance that is, those appliances are tied to a specific remote control and those systems require proximity to the devices for access. To overcome these drawbacks we have tried to implement this system using a Raspberry Pi board which is always internet enabled. Hence it can be accessed and controlled from anywhere in the world by using a centralized server to which our smart phones or web applications connect, to control all appliances within its scope. One of the main aims of this system is to establish a platform for controlling any type of devices, based on the existing electrical wiring. The remote controls are independent of the devices and this system provides an interface to the already existing environment . The control is done through the electrical supply to the device, without relying on the appliance specific features.

CHAPTER 2

# Literature Survey

## 2.1 GSM based Home Automation System

The system proposed in [1] provides 3 means to control the home: the GSM network, the Internet and through speech. The real time monitoring has been an important feature that can be used in the home automation systems. As a change in the status of the devices occurs, the user can be informed in real time. The user commands are transferred to a server which is usually done by a PC. The server processes the user commands and sends them to the relevant units. This can help control the appliances. GSM is used as a communication medium to help establish connection in places where there may not be proper internet connectivity. The server uses AT commands to communicate with the GSM modem. The mobile interface is developed using J2ME. The server has 4 engines running the web server, database, main control program and speech recognition program. The system can be controlled using SMS. It can send confirmation messages. Speech processing is done with a dynamic time wrapping algorithm. The voice activation has been tested and found to be too impractical. As a more stable alternative, the voice input can be activated through a wireless unit the user carries along in the house. Each application node has four parts the transmitter, receiver, I/O device and a microcontroller. The main control program in the server takes status information from the devices transceiver in real time.

The system [2] is described as an M2M system. It uses GSM for communication. GSM offers options for M2M which include Dual Tone Multi Frequency (DTMF), SMS and General Packet Radio Service (GPRS). This system chooses to use the SMS along with AT (attention) commands. It has a PC as a centre of commands. A GSM dial-up and communication system is embedded in the PC. Visual C++ is used for implementation. The PC decodes the received messages via SMS and performs the commands required. It is a system that can be programmed for the required application as per requirements. The system also has the ability to control mechanical appliances, through sensors that convert electrical to mechanical signals. However, this system is not designed to provide feedback to the user. The system is PC centric and requires the PC to be on all the time. It cannot be used as a real time control system.

## 2.2 Bluetooth Based Home Automation

The system makes use of a cell phone and Bluetooth technology [3]. Bluetooth technology is secured and low cost. It makes use of an Arduino Bluetooth board. An interactive python program is used in the cell phone to provide the user interface. The I/O ports of the Bluetooth board and relays are used for interfacing with the devices which are to be controlled. The Bluetooth is password protected to ensure that the system is secure and not misused by any intruders. The Bluetooth has a range of 10 to 100 meters, 2.4 GHz bandwidth and 3Mbps speed. The python app on the phone is portable. It is also a fast and cost effective system. . Real time access cannot be achieved. Anywhere access to the devices cannot be achieved. Access is limited to within the Bluetooth range.

## 2.3 Phone Based Home Automation

Some systems [4] are described as an enabling system that can be used to provide a common framework for home Automation. It provides a system for a smart home that includes facilities such as a system controller, house-wide wiring and a common interface. This will enable using the existing system for home automation. A hardware based remote controller for power point control has been described [5]. The function of this remote controller is to control the power supplied to devices at a remote location. The system uses the telephone line for transmitting the commands. The controller is a logic system built entirely of hardware. It eliminates the cost incurred with microcontrollers.

## 2.4 ZigBee Based Home Automation

The ZigBee wireless communication technology can be applied [6] for home automation. The system uses PIC microcontroller and voice recognition for this purpose. The voice commands are taken from a mike. They are compared with a voice store and processed. The PIC microcontroller then transmits the commands through ZigBee to the receiver. The receiver unit has another PIC microcontroller that can process the command. It uses relays to control the respective appliances. This system has the drawback that ZigBee is a low range communication medium. So remote access is hindered from faraway locations. Also, the voice recognition module could become unwieldy. This system has the added feature of integrating a smoke detector to the system. When smoke is sensed, it sends a message to the users built-in mobile number.

## 2.5 Wireless Control Systems

Systems using wireless communication can be made [7] by linking up stand alone appliances that are present at home or in office and integrating to form a cooperating network. A combination of various technologies like Wi-Fi and Bluetooth are used to integrate the system.The universal Plug and play capability is used to provide a transparent network of devices to the user. The system makes use of the Open Service Gateway Interface (OSGi). The appliances are connected via different networking technologies. The user application layer makes use of web browsers, pocket PC application and a central console. Speech based commands can also be used for controlling the appliances. The universal plug and play system uses many standard protocols for interoperability. The main advantage of the system is its interoperability. Another advantage is the dynamic discovery of the service. It also has the ability for sharing of service.

CHAPTER 3

# System Functions

The implemented system has the following features:

- Control of appliances using the Raspberry Pi
- Mechanical control of the appliances using physical switches simultaneously
- An android application as the interface to the system allowing toggling of the devices
- A database that will store the current ON/OFF status of the device

CHAPTER 4

# Components Used

1. Raspberry Pi B+ model - A Raspberry pi model designed especially for flexibility and for learners. Has a powerful processor and comes with a Raspbian distribution. Can be easily programmed in a number of languages.

2. 8 Relay board module - It contains 8 relays together with the input and power supply pins in a convenient form for connecting to the devices

3. Multiplexer - Demultiplexer IC 74HC4052 - It can be used as both a MUX and DEMUX. Helps interface many inputs to a single output line and vice versa

4. D flip flop IC 7474 - has two flip flops on a single chip with different inputs and outputs. Performs functions of a D flip flop. It is positive edge triggered.

CHAPTER 5

# Working

The main modules of the home automation system are :

**Raspberry Pi :** This is the command centre at home. The control of devices is done through it. There is a python control program in the Pi that is running all the time. The Pi itself acts as a web server using a module called CherryPy. This allows it to respond to calls from the mobile app.

**Control circuitry :** The control circuitry is the part that is actually connected to the devices. It consists of a number of relays, multiplexers and D flip flops.

**Android application :** This is the remote access medium for the user. The app communicates with the Pi and causes the toggling of devices to take place.

**Web server :** The web server stores the status of the devices and the details of the number of devices for each room.

## 5.1 Raspberry Pi

The Raspberry Pi has a control program running. It acts as a web server and receives the requests from the android app. The Pi has GPIO pins that are used to send inputs to the control circuit. It uses a software called CherryPy which provides a python web server. The server we made listens for requests. These requests give details of the state change that needs to be made. When processing

this, the required changes are made by the Pi. When a particular device has to be toggled, the Pi sets the corresponding pins to either high or low as per requirements. It also makes the call to the server to update its database when the device state is modified.

## 5.2 Control Circuitry

The control circuitry is the interface between the Raspberry Pi and the electrical appliances. It consists of multiplexers, D flip flops and relays. The overall organization of the control circuit is as shown in 5.1 .Their functions are as follows :

- A DEMUX (demultiplexer) is used to select the various devices in a room. The selection lines are used to denote the devices number on that room. This helps eliminate the need for different lines for different devices in the rooms.
- Another DEMUX is used for selecting the room. Its output activates the enable input of the multiplexer assigned to that particular room. The inputs to all the room multiplexers are from common GPIO pins of the Raspberry Pi.
- The output lines of the DEMUX are connected to a D flip flop input. The D flip flop is a basic memory element. It reads its input only on a positive edge of a clock and maintains that constant output until changed. This used to store the input to be given to the relay which determines the position of the relay.

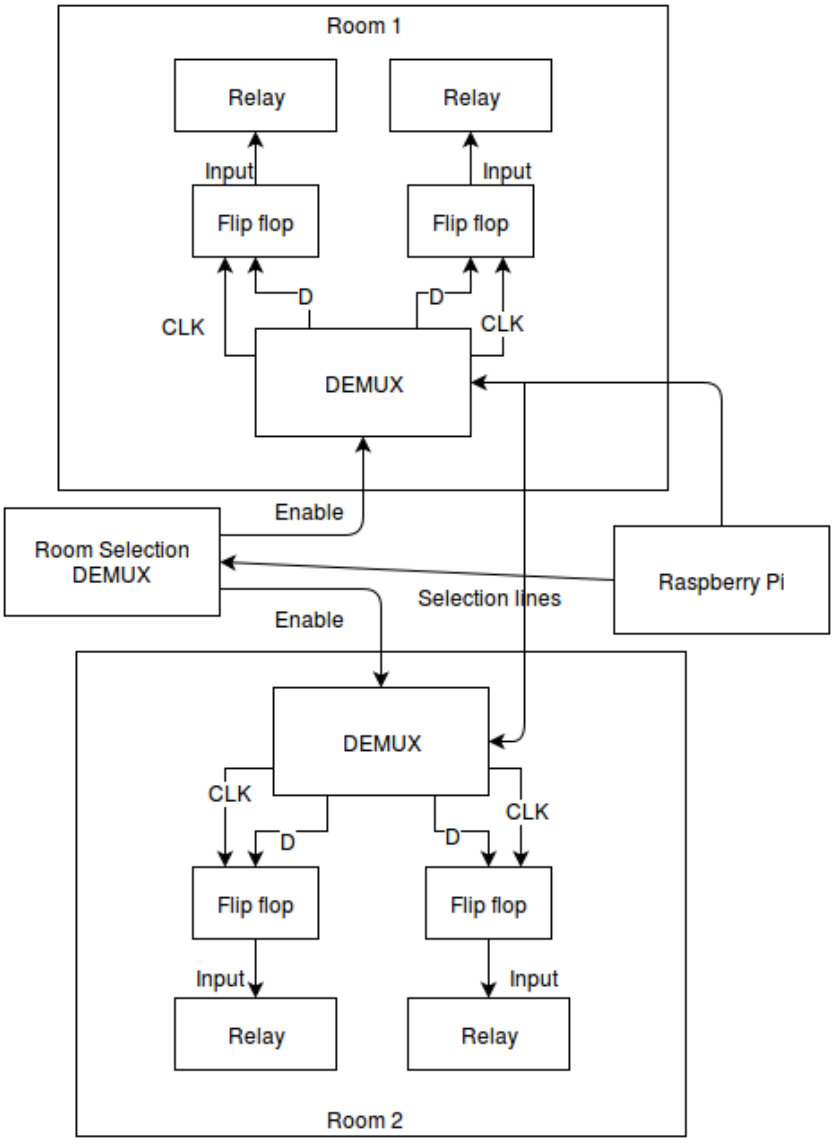


FIGURE 5.1: Control circuitry block diagram

- The relay is used to control the device. It is organized so that the manual switches in place can be used along with the automation system, just like a 2 way switch operates. This is achieved using the organization of the relay and switch as shown in 5.2. This enables the automation of the system without too much rewiring involved and still offer control to the users at home.

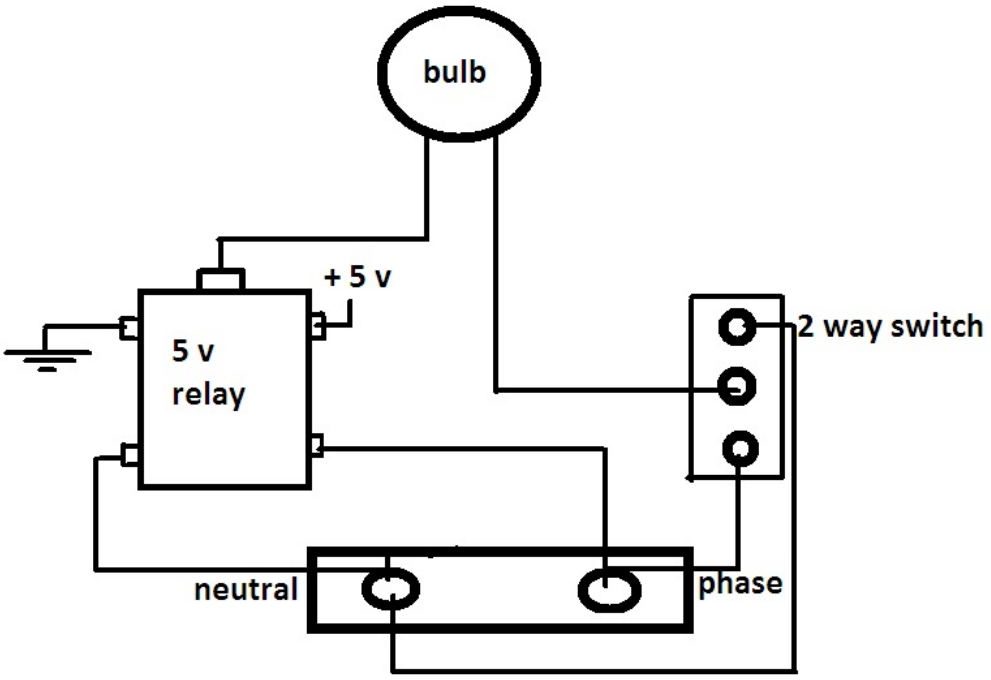


FIGURE 5.2: Two way switch with relay

## 5.3 Android App

The android application provides a simple user interface for users to make use of the home automation system as shown in 5.3. The app is organized to allow the users to select the rooms first and then view details of the devices there. The app takes data from the Pi server and displays the toggle switches for the users rooms and devices. On toggling, it sends a request to the server giving the room and device number.The app can also refresh its data by sending a request to the server and processing the JSON response sent by the server. This can be done as and when the user wishes. The buttons on the user screen will change based on the current device status.

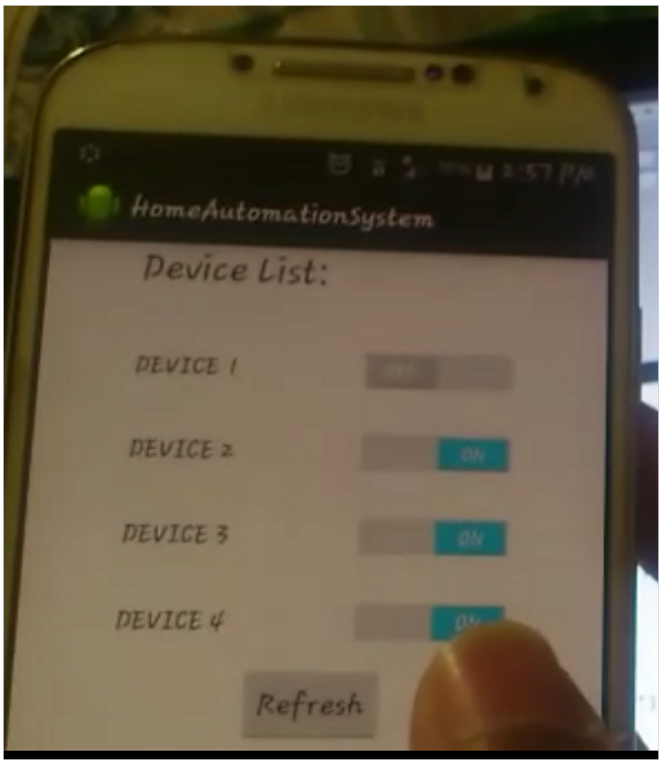


FIGURE 5.3: Android app home screen

## 5.4 Web Server

A PHP web server is used to store and update the user data. The database contains user details. It has the details of the rooms of each user and the devices within each room as seen in 5.4. The server exposes an API that is used by the clients to update as well as get the current state. It serves as the connection between the android app and the raspberry pi controller at home. Data is exchanged in JSON format by the server. When the server receives a request from the app, it sends a request to the CherryPy server of the appropriate Raspberry Pi. This gives the details of the operation requested by the user. It also simultaneously updates the database entries.

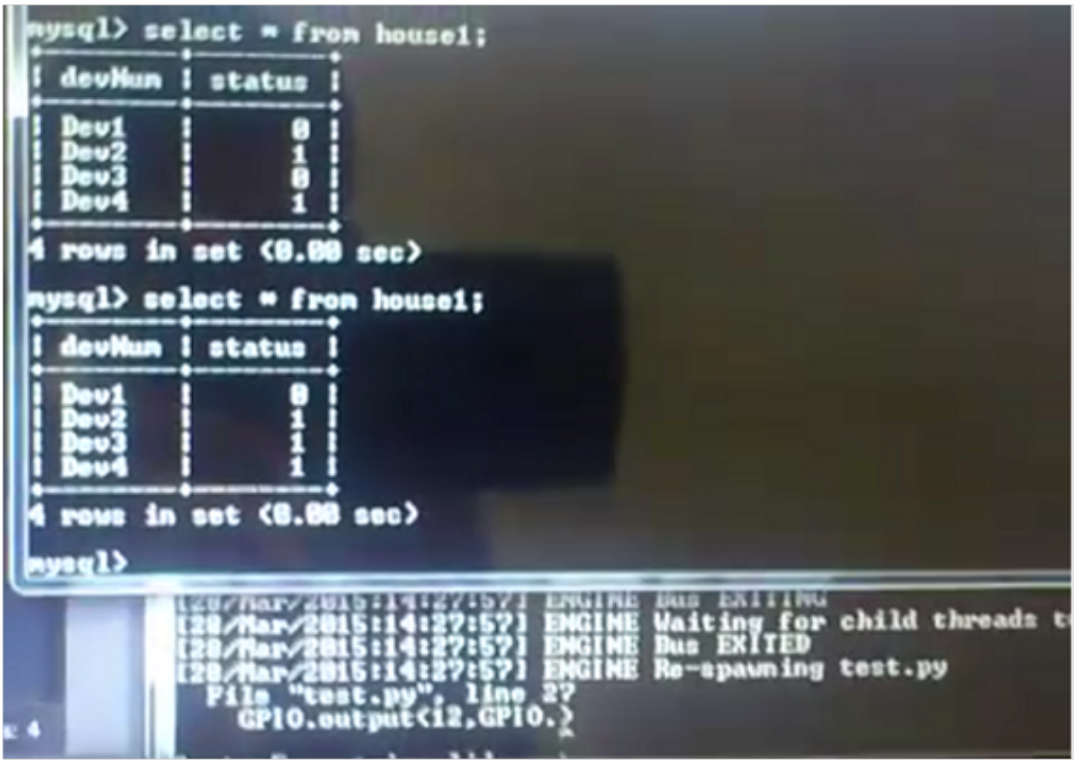


FIGURE 5.4: Server database

## 5.5 Final Working of System

The control circuitry is set up with devices. We made use of LEDs with a small power supply from an adapter. The connections are made with the devices and the switches as in 5.1 . The raspberry pi is booted and the server is started. The web server is always kept online. The user details are entered in the database. The details of the number of rooms is entered along with the number of devices in each room. The user installs the android application on their smartphone. Now the setup is ready. It looks as shown in 5.6 and 5.5 The user can connect to the internet and get the current states of the devices at home on the app. By using the toggle controls, the user can switch the states of the required devices. The app will communicate with the server. This will cause a change in the device. If the

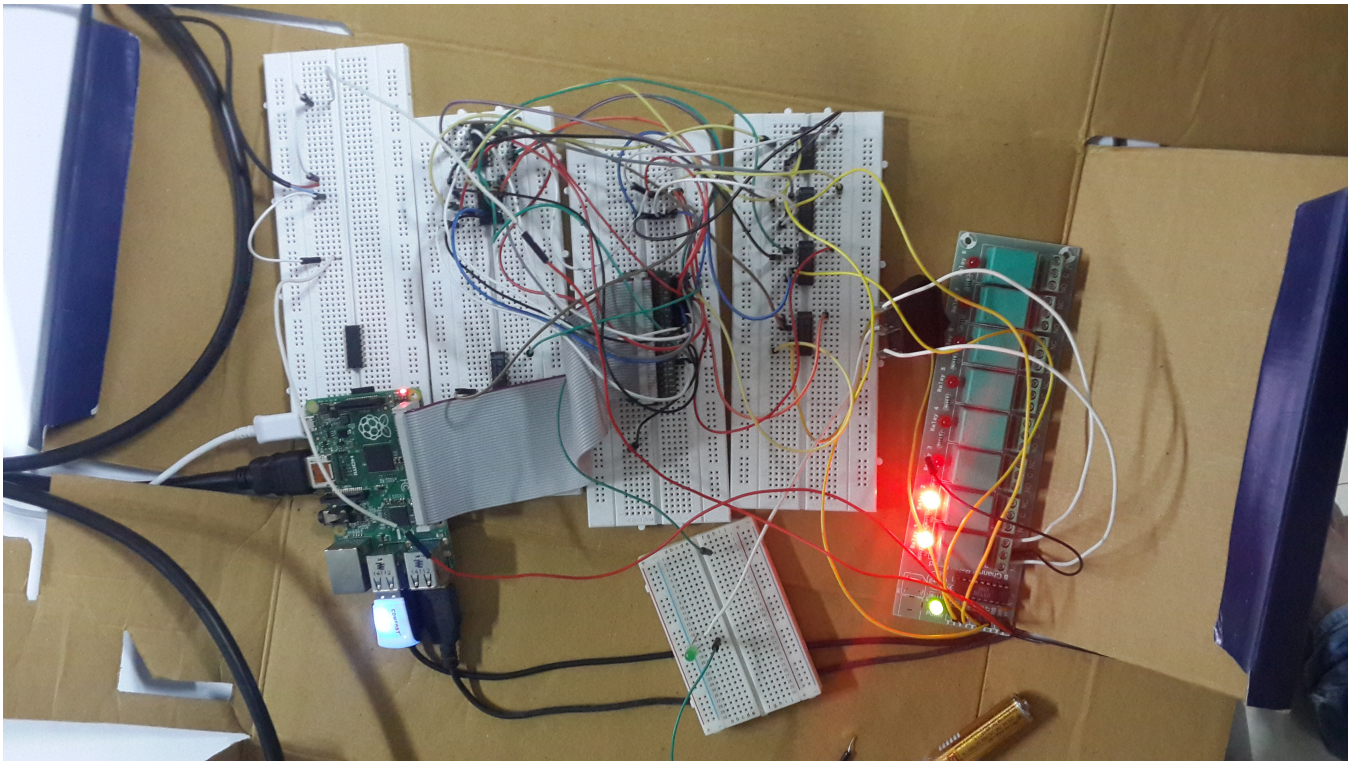

FIGURE 5.5: Overall connections of the System

user uses the manual switch also, the device state can be changed. Thus users will be able to access the devices from anywhere in the world, when connected to the internet.

## 5.6 Reverse Mapping

This is the process of mapping the current ON/OFF state of a device to the pins of the Pi. The aim of this is to be able to check whether a device is ON/OFF so that any changes made manually in the switch can be updated in the database. The database and hence the app would have a consistent view of the current state of all devices at home. This feature has been conceptualised by making use of a D flip flop connected directly to the device. The input to the flip flop will be from the

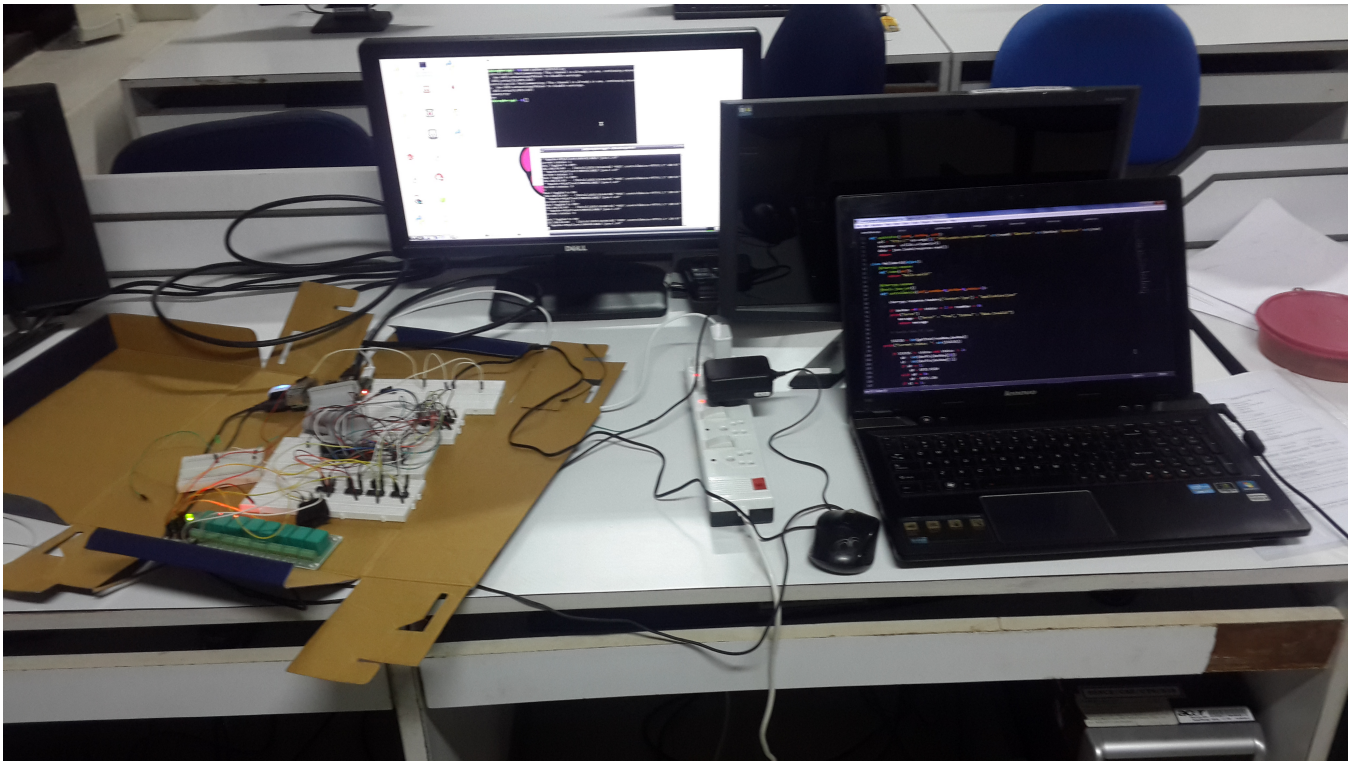

FIGURE 5.6: Complete Setup of the System

direct power line of the device. The outputs from all the flip flops are connected via a multiplexer to select the different devices. These are polled by the Raspberry Pi at regular intervals. If any state change is detected, then the server will be notified to update the database. The reverse mapping can be easily extended to any number of rooms and devices by adding many more multiplexers in different layers. This feature has not been implemented in the system, due to greater power requirements of the flip flops. The addition of this feature will cause changes in the control circuitry. The modified control circuit will be as in 5.7.

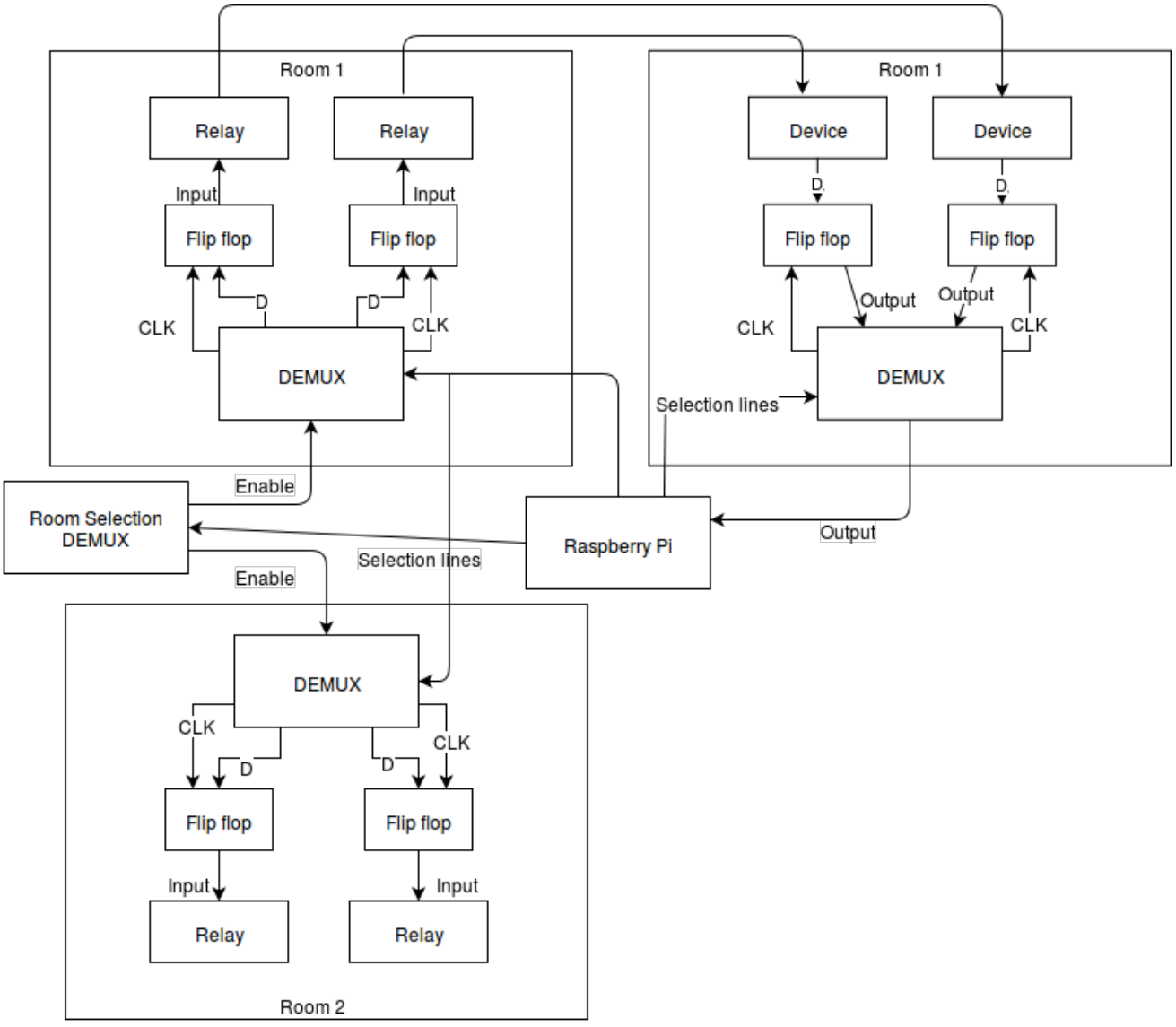


FIGURE 5.7: Control circuitry block diagram with reverse mapping

CHAPTER 6

# Conclusion and Future Work

In this report, we have presented the design and implementation of a home automation system that allows users to remotely access and control the power supply to the various devices at their home. The system using a Raspberry Pi as the control system has been implemented. The detailed working has been presented.

The feature of detecting and updating the database on manual operation has not been implemented, although a conceptual design is available. This can be taken up in future. The possibility of greater scalability of the system has to be explored. Possible application in offices and industries can be looked into. Another possible extension is the integration of various sensors such as light sensors and motion sensors with the system.

CHAPTER 7

# Account Statement

Amount Received from College : Rs.25000

| S.No. | Description | Quantity | Unit price | Amount |
|---|---|---|---|---|
| 1 | Raspberry Pi B+ kit | 1 | 5495 | 5495 |
| 2 | GSM Shield | 1 | 8780 | 8780 |
| 3 | Internal GSM antenna | 1 | 420 | 420 |
| 4 | Shipping Charges | | | 571 |
| 5 | Sim card | 1 | 160 | 160 |
| 6 | 3G Net pack | 1 month | 197 | 197 |
| 7 | Relay board | 2 | 418 | 836 |
| 8 | Bread board | 4 | 90 | 360 |
| 9 | Electrical items | | | 2064 |
| 10 | Miscellaneous | | | 284 |
| | Total amount Spent | | | 19167 |

TABLE 7.1: Account Settlement

# REFERENCES


1. Baris Yuksekkaya, A. Alper Kayalar, M. Bilgehan Tosun, M. Kaan Ozcan, and Ali Ziya Alkar 'A GSM, Internet and Speech Controlled Wireless Interactive Home Automation System', 2006, IEEE Transactions on Consumer Electronics, Vol. 52(3) , pp. 837 - 843.

2. A. Alheraish, 'Design and Implementation of Home Automation System', 2004, IEEE Transactions on Consumer Electronics ,Vol. 50(4) , pp. 1087-1092.

3. R.Piyare,M.Tazil, ' Bluetooth Based Home Automation System Using Cell Phone', 2011 ,IEEE 15th International Symposium on Consumer Electronics, Singapore, pp. 192 - 195.

4. H. Brooke Stauffer 'Smart Enabling System for Home automation', 1991, IEEE Transactions on Consumer Electronics, Vol. 37(2) , pp. 29-35.

5. Eddie M C Wong, 'A Phone Based Remote Controller for Home and Office Automation', 1994, IEEE Transactions on Consumer Electronics, Vol. 40(1), pp. 28-34.

6. V.Sathya Narayanan, S.Gayathri, 'Design of Wireless Home Automation and security system using PIC Microcontroller', 2013, International Journal of Computer Applications in Engineering Sciences, Vol. 3 ( Special Issue) , pp. 135- 140.

7. Baris Yuksekkaya, A. Alper Kayalar, M. Bilgehan Tosun, M. Kaan Ozcan and Ali Ziya Alkar, 'A GSM, Internet and Speech Controlled Wireless Interactive Home Automation System', 2006, IEEE Transactions on Consumer Electronics, Vol. 52(3), pp. 837-843.