A Project Report on

Power Consumption Monitoring using Home Automation

Submitted in partial fulfillment of the requirements for the award
of the degree of
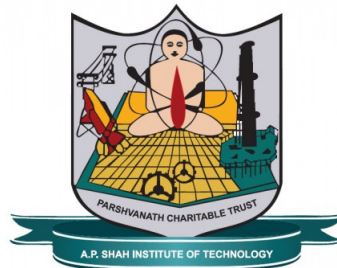
Bachelor of Engineering

in

Computer Engineering

by

Bhavana Gupta
(15102047)

Under the Guidance of

Prof.P.P.Adivarekar

Department of Computer Engineering
A.P. Shah Institute of Technology
G.B.Road,Kasarvadavli, Thane(W), Mumbai-400615
UNIVERSITY OF MUMBAI

Academic Year 2018-2019

Approval Sheet

This Project Report entitled **"Power Consumption Monitoring Using Home Automation"** Submitted by **"Bhavana Gupta"(15102047))** is approved for the partial fulfillment of the requirement for the award of the degree of **Bachelor of Engineering** in **Computer Engineering** from **University of Mumbai**.

(Prof.P.P.Adivarekar)   Prof. Sachin Malave
Guide :   Head Department of Computer Engineering

Place : A.P.Shah Institute of Technology , Thane
Date:

CERTIFICATE

This is to certify that the project entitled **"Power Consumption Monitoring Using Home Automation"** submitted by **"Bhavana Gupta" (15102047)** for the partial fulfillment of the requirement for award of a degree **Bachelor of Engineering** in **Computer Engineering.**,to the University of Mumbai,is a bonafide work carried out during academic year 2018-2019.

(Prof.P.P.Adivarekar)
Guide

Prof. Sachin Malave   Dr. Uttam D.Kolekar
Head Department of Computer Engineering   Principal

External Examiner(s)

1.

2.

Place:A.P.Shah Institute of Technology, Thane
Date:

Declaration

We declare that this written submission represents our ideas in our own words and where others' ideas or words have been included, We have adequately cited and referenced the original sources. We also declare that We have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

_____

(Signature)

_____

(Bhavana Gupta , 15102047)

Date:

Abstract

Controlling the appliances remotely even when the users are outside their properties,this system is all about a low cost,simple and small sized controller that helps the users do the controlling.The users of this system can control the appliances by using cell phone through global system for mobile communications(GSM)technology.For activities like controlling from remote locations cellular communications are best solutions.For controlling appliances from distance SMS(Short message service) technology can be used.Remotely the system allows the users to control and monitor the appliances by sending commands in the form of SMS message and also receive the status of the appliances.The Infrared(IR) is to control the sensored devices like T.V,Air Conditioner and other appliances from about 10 meters away.The smart remote can include all infrared remote controls in the room or office into users cell phone based on Android Platform.Through android application one can configure their remotes into smart remote application and then control the appliances through his/her smart phones and eliminate the controllers spread across the home or office.Though Application the users can also monitor and obtain a detailed report about the power consumed by each and every appliance controlled.

Contents

List of Figures

List of Tables

List of Abbreviations

SMS :   Short Message Service
GSM :   Global System for Mobile
LED :   Light Emitting Diodes
AT :   Attention Commands
SIM :   Subscriber Identity Module
IR :   Infrared

Chapter 1

Introduction

Nowadays, there is a growing demand of automation and intelligent systems so that it leaves us with less human intervention and smart decision making devices.The term Home Automation means to automate our homes or offices.As we all know ,the basic concept of Home Automation is to control all the appliances in a controlled environment.The controlled environment can be offices and residences.By this we can have access of the appliances with just a single click.With the growing demand, comes the growing competition which has forced the competitors to come out with more intelligent,efficient as well as user friendly models.Our topic deals with the same idea as base concept and also includes monitoring of power consumed by the appliances.It will regulate our lights, heaters, AC, and other home appliances and devices, turning them on and off. The system will not only do the tasks of switching the devices on or off but will also send status of the appliances back to the users.The status will be stored and a report of the same will be generated that can be accessed by the user at any point of time .

1.1 Origin

1.1.1 History of Automation

This project is based in automation technology and more specifically in home automation systems. Automation is the transfer of tasks normally performed by humans to a set of technological elements. An automated system consists of two parts:
Operation: Part formed by elements that act directly on the machine and make it perform desired operations. These elements are called actuators and some examples are engines, cylinders or photodiodes.
Control: Brain of system, normally constituted by a programmable automaton, able to communicate with all constituents of the operation part. The inclusion of control in the automation system, allows to decide on the development of a process, manipulating certain variables to get these or other variables to act in the desired way. Although it seems a recent technology and currently is in full development, automation dates back to ancient times.
   At this point, is called home automation to a system capable of automate a house or building including energy management, security, comfort and communication. It can be integrated through wired or wireless communication networks, although nowadays the predominant trend is wireless. It could be defined as the integration of technology into the

History of Home Automation

1898	1920's	1920's	1955	1960's	1975
First remote control	Majority of American homes wired for electricity	First radio station broadcasts	Majority of American homes have television	The Jetsons displays futuristic home automation	X10 Project conceived by Pico Electronics

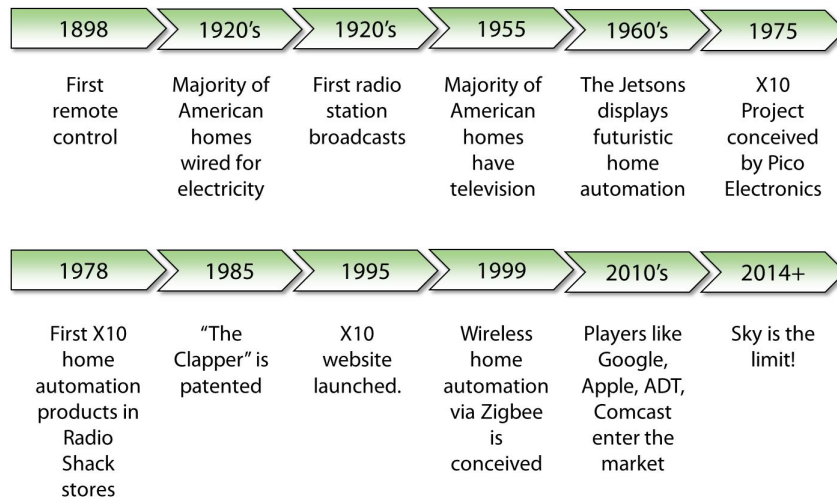| 1978	1985	1995	1999	2010's	2014+
First X10 home automation products in Radio Shack stores	"The Clapper" is patented	X10 website launched.	Wireless home automation via Zigbee is conceived	Players like Google, Apple, ADT, Comcast enter the market	Sky is the limit!

Figure 1.1: History of Automation

intelligent design of an enclosure. The main points of this technology are energy saving, comfort, security,communication and data accessibility. Over years the improvements were continuous, automation was gaining memory, ability to governcontrol loops, communications and programming languages became more powerful, obtaining faster processing speed, more complex control techniques Until nowadays, having the great number of existing automatons, increasingly powerful and useful in different fields, even disengaging from the industry to open new roads, such as home automation applications.

1.1.2 Arduino Boards

The core of this project will be an Arduino board .The new prototype board, the Arduino, created by Massimo Banzi and other founders, is a low cost microcontroller board that allows even a novice to do great things in electronics. An Arduino can be connected to all kind of lights, motors, sensors and other devices; easy-to-learn programming language can be used to program how the new creation behaves. Using the Arduino, you can build an interactive display or a mobile robot or anything that you can imagine.

1.1.3 Mobile Applications

The prototype on which this project is based can be controlled from a customized mobile application. A mobile application is a computer application designed to be executed on smartphones, tablets and other mobile devices which allows the user to perform specific tasks of any kind, like professional, educational or social. Apps are usually available through distribution platforms operated by companies that own mobile operating systems such as Android .Currently, due to the applications, all functions are centralized in a small mobile device: calls, mail, social network, alarm clock, bank account, photography, GPS and a multitude of other utilities. The trend is on the raise as more and more users want to carry their life in the pocket: information, communication and personal and professional resources, all accessible at any time.

1.2 Objective

Our project is aimed at developing a system based on sensors and GSM to capture many things.Our aim is to develop a system to provide people a convenient,comfortable and intelligent living environment.The main objective is to develop a system for fair dealing with better management.It will also be remotely accessed.This is the spirit and main driving force behind this proposed system. The steps that should be taken to achieve the expected result are the following:

1) Determine the scope of the application and delimit the points that each mode of operation must deal with.
2) Select the components and software.
3) Electronic design.
4) Program the board.
5) Program the mobile application.
6) Build the house model.
7) Place and weld the components in the model.
8) Test and debug the application.

3

Chapter 2

Literature Review

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 IEEE Transactions,2006

This paper presents the design and the implementation of an interactive home automation system with the GSM, the Internet accessibility and the speech features. As the mobility in the world increases, the need to control home from remote locations also increases. The GSM is an excellent choice for this due to its extensive coverage. Since SMS is a text based protocol, even the most basic GSM systems can have an access to the status of the devices or make changes on these states. The whole system is secured through a login password based authentication. The design is completely wireless and integrated with the software to form a low-cost, robust and easily operable system. RF communication makes the system easy to install.

Ch. Pandu Ranga Sai, V. Sameeka Datta, Mrs. Sudheera, Design of a Smart Remote , 2016 International Conference on Circuit, Power and Computing Technologies [ICCPCT] , 2016

This paper describes a design and implementation of a smart infrared (IR) remote control which can be used for various home appliances. The entire system is based on microcontroller that makes the control system smarter and easy to modify. It enables the user to operate a T.V, Air Conditioner and other Home appliances from about 10 meters away. This Smart remote control can incorporate all infrared remote controls in the room or office into ones smart phone based on Android Platform. By downloading the android app one can configure their remotes into the smart remote app and control them from his/her smart phone to eliminate the need to have half a dozen controllers spread out across their home or office.

Majd Ghareeb, Ahmad Farhat, Ali Oleik, Ali Bazzi, Zaher Merhi, Samih AbdulNabi ,Smart Electrical Appliances Controller using SMS,IEEE International Conference on Power, Control, Signals and Instrumentation Engineering (ICPCSI-2017)

This paper describes about a simple low cost, small sized controller that helps people controlling their home appliances remotely even if they are outside their properties. The system lets them turn on or off any device while being outside home by sending messages

using mobile phones. Moreover, a message could be sent to know more specific details like the temperature of the boiler, AC, etc. The main purpose of this system is to adapt with the private electricity subscription issue that almost all the Lebanese citizens are using to cope with the long electricity current cut off periods. However, the difference in payment rates between the normal current and that of the subscriber is always making a big concern over electricity consumption. Hence, the system will help users to minimize their payments for electricity usage by informing them if the current is on or off so they can control their appliances accordingly

Chapter 3

Problem Definition

The field of Automation has well advanced in Industries, as majority of automobile industry plants as well as bottling plants have Automated assembly lines. But automation has not yet penetrated in the homes especially in India. If automation was to be used in homes than everyday life would be get eased. Simple example of use of automation in home can be seen in the transfer of water from the under-ground water tank to the over-head water tank, by sensing the level of water in both the tanks. This process eases the every time effort the user has to put in for filling the tank and also helps in saving water. Also people are getting more acquainted daily with the use of Smartphone and tablets which are capable of doing much of PCs work handy. So we have decided to make a low cost Embedded System in which the smart phones can be used to help automate entire home. In this system the user will have remote access and control over all the subsystems present in the house.
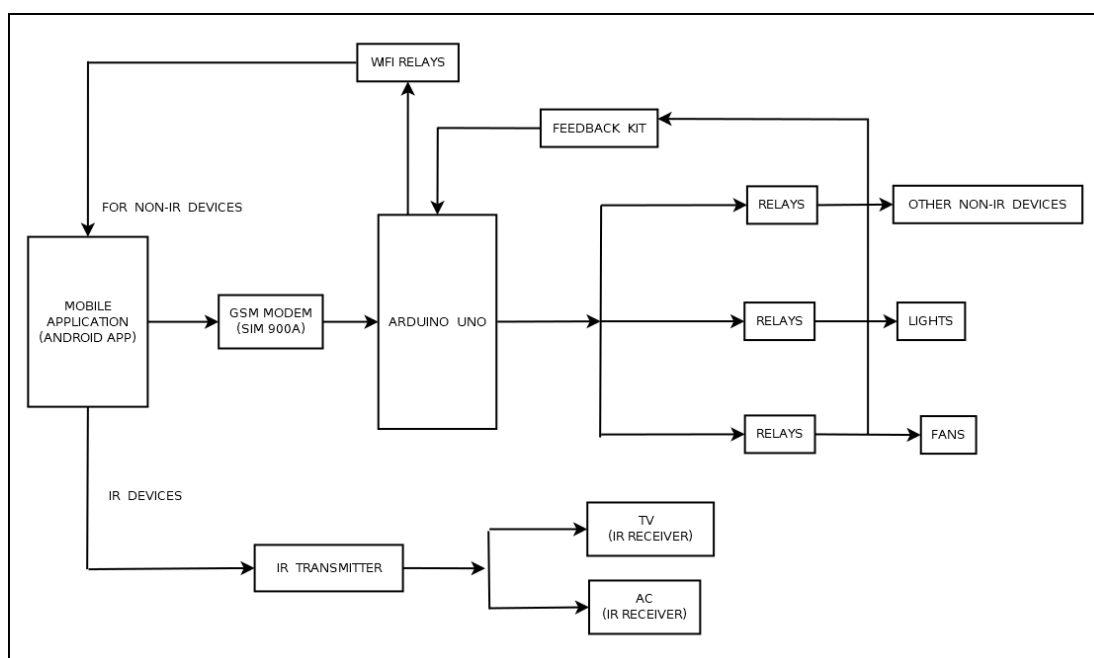
Figure 3.1: Block Diagram

Chapter 4

Proposed System Architecture

The proposed system will be able to control all the appliances in a controlled environment .Controlling the appliances(turning on and off respectively)can be done by the user itself. Firstly the mobile Application will send the commands instructed by the user to the Arduino Uno module. From there it will be forwarded to a set of relays and finally the relays will send the sensed signal to the respected appliance(Non IR). The relays will be connected to a feedback kit,which will revert the status of the relays to the Arduino. In addition to this, the system will also notify the user about the status of the appliances through notification. The data about the appliances(i.e time of switching on and off,power consumed by a particular appliance)will also get generated and the user can access this data at any point of time.
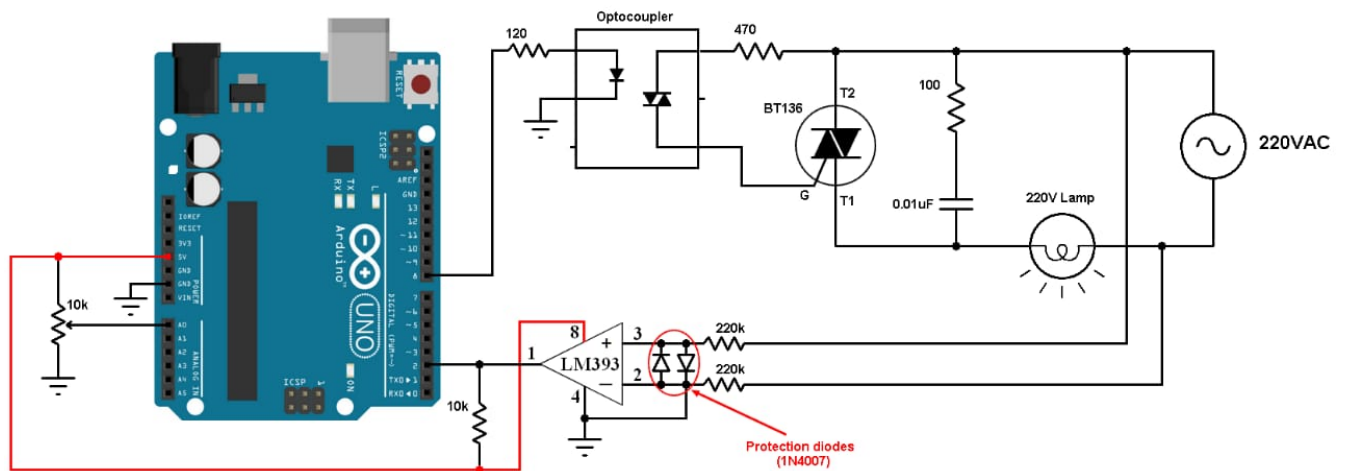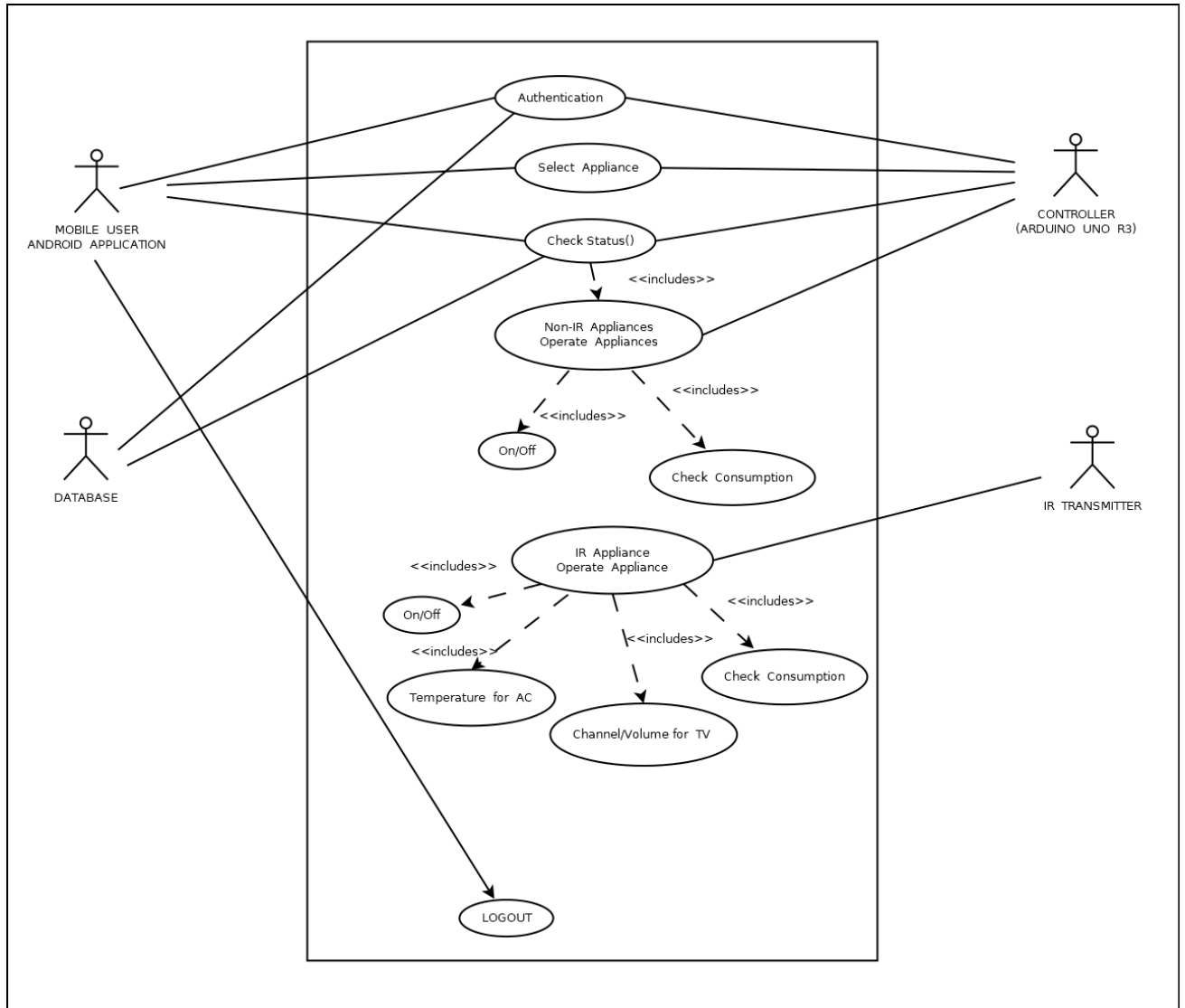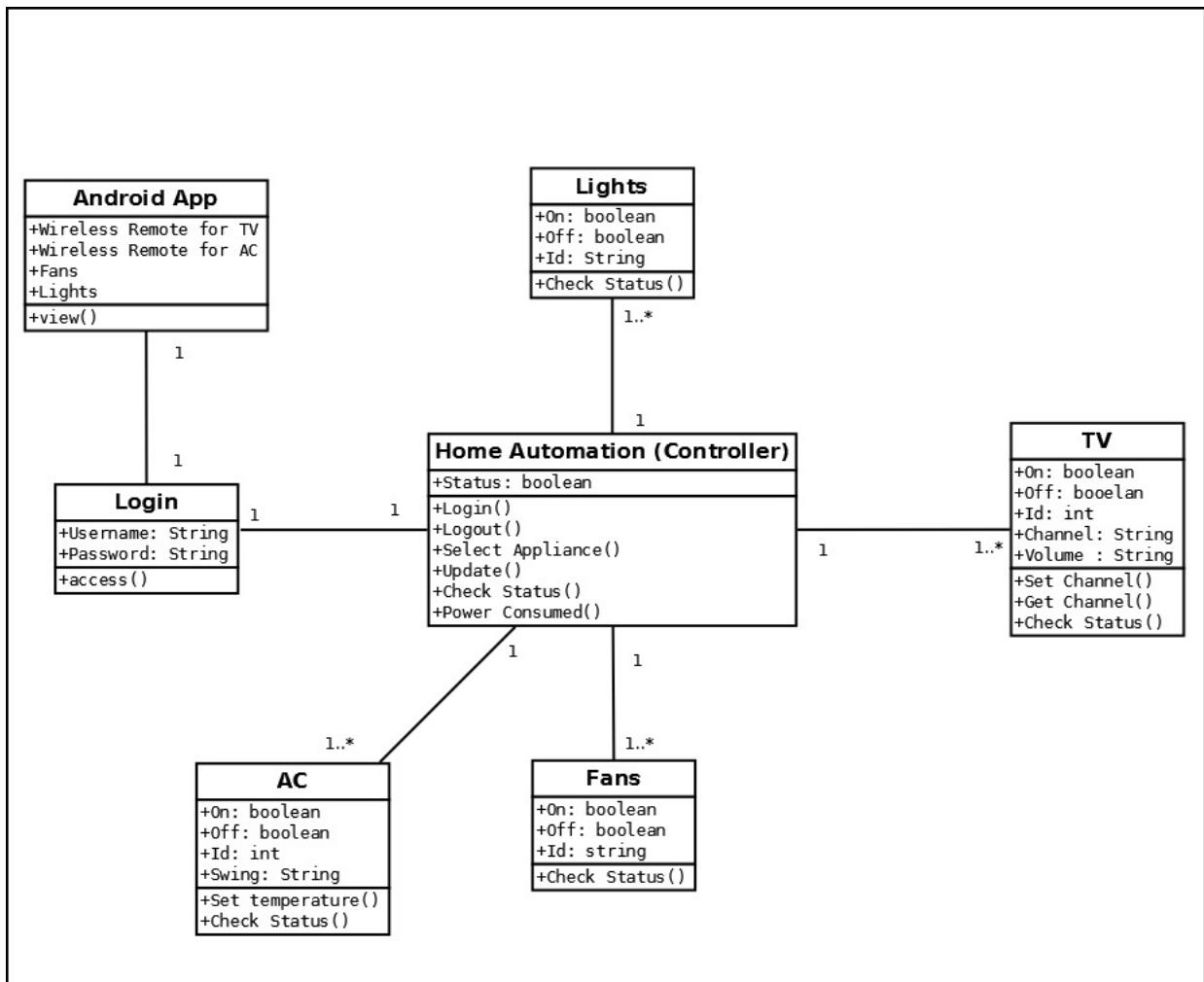

Figure 4.1: Pin Diagram

Figure 4.2: Use Case Diagram

Figure 4.3: Class Diagram

Chapter 5

Technology Stack and Dependencies

5.1 Technology Stack

5.1.1 Hardware Requirements

1) GSM SIM900A Module Our project will be connected to the smartphone using GSM technology.

2) Controller or the main processing circuit- In this project, Arduino Uno is the main controlling / processing unit.

3) LED The Light Emitting Diode is optional used to check the working of the project on a very basic stage.

4) Relays to control devices We have used 12volt Single push single throw relays.

5) Output devices For the demo purpose, we connected a DC devices to a relay (12 volt DC bulb). You can connect any AC/DC devices to the remaining 3 relays.

5.1.2 Software Requirements

1) A smartphone or an Android mobile which should have the android app installed in it.

2) Android App for controlling all devices.

5.2 Dependencies

1. A smartphone or an Android mobile which should have the android app installed in it for controlling devices.

2. Active SMS facility for sending messages to the GSM Module.

Chapter 6

Planning for Next Semester

In the next semester we are planning to implement IR based automation for all IR devices which can be controlled about from 10 meters away . The feedback of the devices and consumption part will be also done.This Smart remote control can incorporate all infrared remote controls in the room or office into ones smart phone based on Android Platform. By downloading the android app one can configure their remotes into the smart remote app and control them from his/her smart phone to eliminate the need to have half a dozen controllers spread out across their home or office.

6.1 IR Sensors

An infrared sensor is an electronic instrument that is used to sense certain characteristics of its surroundings. It does this by either emitting or detecting infrared radiation. Infrared sensors are also capable of measuring the heat being emitted by an object and detecting motion. Infrared waves are not visible to the human eye. In the electromagnetic spectrum,
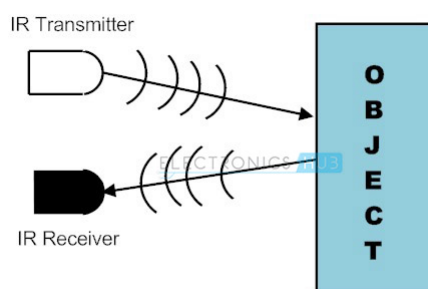

Figure 6.1: Working of IR Sensors

infrared radiation can be found between the visible and microwave regions. The infrared waves typically have wavelengths between 0.75 and 1000m .The infrared spectrum can be split into near IR, mid IR and far IR. The wavelength region from 0.75 to 3m is known as the near infrared region. The region between 3 and 6m is known as the mid-infrared region, and infrared radiation which has a wavelength greater higher than 6m is known as far infrared.

Chapter 7

Result

After the connections are made and checked properly the system is now ready for use. The system works by sending a predefined text string from a mobile phone which can be present in any part of the world. The string is then received by the Arduino which decodes it and checks if it matches with the already stored string in command. If it matches the Arduino further switches ON and OFF the electrical appliances. The sending and receiving of the strings from/ to the Arduino can be achieved by AT commands. These are following AT Commands used in the .

Serial.print("AT+CMGF=1")
This is the AT Command used to AT command to set SIM900A to SMS mode .

Sr.No	Message	Operation
1.	Redon	Red Led On
2.	Greenon	Green Led On
3.	Blueon	Blue Led On
4.	Allon	All Led On
5.	Redoff	Red Led Off
6.	Greenoff	Green Led Off
7.	Blueoff	Blue Led Off
8.	Alloff	All Led Off

Table 7.1: Commands / Messages used to control LEDS using Android App

Chapter 8

Conclusions and Future Scope

As the main objective of this project is to promote energy-conscious minds,the Smart Home System allows for users to keep track of energy usage at each outlet at any given time. This feature encourages the user to keep track of power consumption based on each device plugged into a power outlet, allowing one to determine whether a particular device is consuming too much power and should be replaced with a more efficient one, such as an energy star product. The feature of being able to remotely control power outlets and lights may also give the user an ultimate sense of convenience as well. In future the app needs to be developed on IOS platform too, as it should reach more people . App updates should be released so that it can more customizable The future scope of the project is that it can be used for industrial automation as well as for security purpose

Bibliography

[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 IEEE Transactions,2006

[2] Ch. Pandu Ranga Sai, V. Sameeka Datta, Mrs. Sudheera, Design of a Smart Remote , 2016 International Conference on Circuit, Power and Computing Technologies [ICCPCT] , 2016

[3] Majd Ghareeb, Ahmad Farhat, Ali Oleik, Ali Bazzi, Zaher Merhi, Samih AbdulNabi ,Smart Electrical Appliances Controller using SMS,IEEE International Conference on Power, Control, Signals and Instrumentation Engineering (ICPCSI-2017),2014.

Appendices

This part contains the components / programs required to implement the project . There are 2 main components required to run the android app and also the arduino code. Android Studio is required to build the android app and Arduino Ide is used to upload the code into Arduino

Appendix-A: Arduino IDE Download and Installation

1. Download arduino.exe from https://www.arduino.cc/en/Main/Software

2. Double Click the .exe to download the arduino ide application .

3. When the download finishes, proceed with the installation and please allow the driver installation process when you get a warning from the operating system.
==¿ **Choose the components to install**
==¿ **Choose the installation directory (we suggest to keep the default one) .**

4.When the Arduino Software (IDE) is properly installed you can go back to the Getting Started Home and choose your board from the list on the right of the page.

Appendix-B: Android Studio Download and Installation

1.Download Java Platform (JDK) and install it on your computer. Once completed, then proceed to the next step. Java is important for the functioning of Android Studio from https://www.oracle.com/technetwork/java/javase/downloads/index.html

2. Download Android Studio from the Android Developers website i.e https://developer.android.com/stu

3. Run the EXE setup file you just downloaded. You should be greeted with a similar setup wizard screen as shown below. Click Next to begin!

4. Keep the default components selected for installation. Click Next.

5. This is where you select the installation location for Android Studio and Android SDK. You may select another location / drive that has the required space available. Click Next to

continue.

6. Once the installation is completed, click Next.

7. You can start your application development by calling start a new android studio project. in a new installation frame should ask Application name, package information and location of the project.

8. The next level of installation should contain selecting the activity to mobile, it specifies the default layout for Applications.

9. The main activity code is a Java file MainActivity.java. This is the actual application file which ultimately gets converted to a Dalvik executable and runs your application.

Acknowledgement

We have great pleasure in presenting the report on **Power Consumption Monitoring using Home Automation.** We take this opportunity to express our sincere thanks towards our guide **Prof.P.P.Adivarekar** Department of Computer, APSIT thane for providing the technical guidelines and suggestions regarding line of work. We would like to express our gratitude towards his constant encouragement, support and guidance through the development of project.

We thank **Prof. Sachin Malave** Head of Department,Computer, APSIT for his encouragement during progress meeting and providing guidelines to write this report.

We thank **Prof. Amol Kalugade** BE project co-ordinator, Department of Computer, APSIT for being encouraging throughout the course and for guidance.

We also thank the entire staff of APSIT for their invaluable help rendered during the course of this work. We wish to express our deep gratitude towards all our colleagues of APSIT for their encouragement.

Student Name : Bhavana Gupta
Student ID : 15102047

Publication

Paper entitled **"Paper Title"** is presented at **"International Conference/Journal Name"** by **"Author Name"**.