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

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Approval Sheet

This Project Report entitled ***"Power Consumption Monitoring Using Home Automation"*** Submitted by ***"Bhavana Gupta"(15102047),"Siddhesh Dalvi"(15102070), "Anish Salgia"(16202005),"Daisy Maniar"(16202011)***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***.

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Date:

CERTIFICATE

This is to certify that the project entitled ***"Power Consumption Monitoring Using Home Automation"*** submitted by ***"Bhavana Gupta" (15102047),"Siddhesh Dalvi" (15102070),"Anish Salgia" (16202005),"Daisy Maniar" (16202011)*** 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.

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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.

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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.

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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 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 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

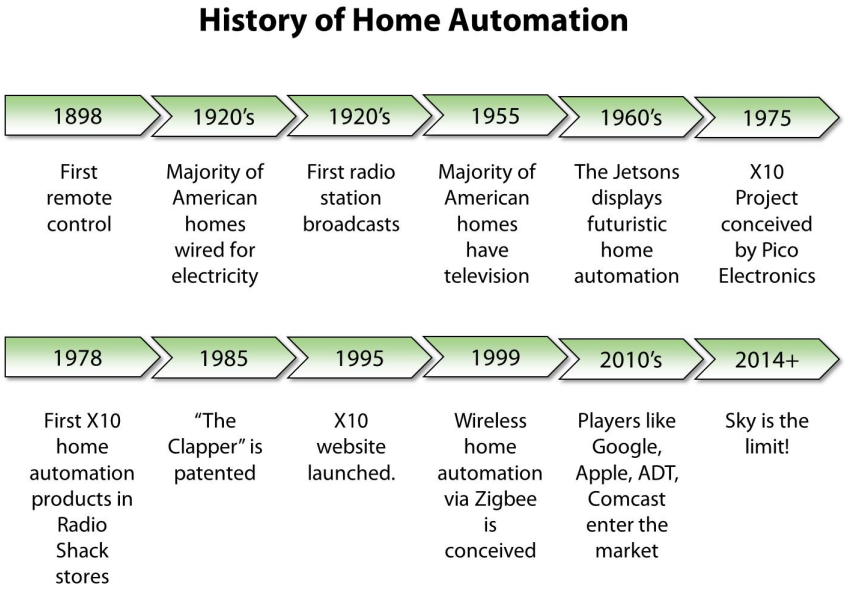

Figure 1.1: History of Automation

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.

1.2 Arduino UNO R3 Board

The Arduino UNO is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 Digital pins, 6 Analog pins, and programmable with the Arduino IDE (Integrated Development Environment) via a type B USB cable. It can be powered by a USB cable or by an external 9 volt battery, though it accepts voltages between 7 and 20 volts. It is also similar to the Arduino Nano and Leonardo. The hardware reference design is distributed under a Creative Commons Attribution Share-Alike 2.5 license and is available on the Arduino website. Layout and production files for some versions of the hardware are also available. "Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0.

The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases.The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform. The ATmega328 on the Arduino Uno comes preprogrammed with a bootloader that allows uploading new code to it without

the use of an external hardware programmer. It communicates using the original STK500 protocol. The Uno also differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it uses the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

General Pin functions :
LED: There is a built-in LED driven by digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.
VIN: The input voltage to the Arduino/Genuino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.
5V: This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 20V), the USB connector (5V), or the VIN pin of the board (7-20V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage the board.
3V3: A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.
GND: Ground pins.
IOREF: This pin on the Arduino/Genuino board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source or enable voltage translators on the outputs to work with the 5V or 3.3V.
Reset: Typically used to add a reset button to shields which block the one on the board.

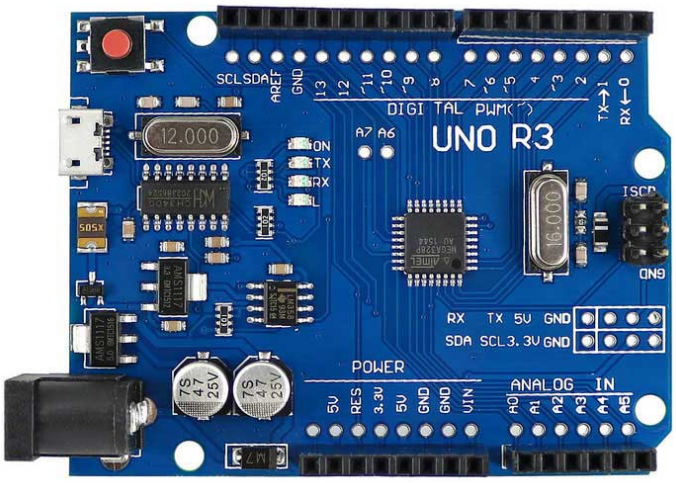

Figure 1.2: ARDUINO UNO R3 BOARD

1.3 GSM Module SIM900A

GSM is a mobile communication modem; it is stands for global system for mobile communication (GSM). The idea of GSM was developed at Bell Laboratories in 1970. It is widely used mobile communication system in the world. GSM is an open and digital cellular technology used for transmitting mobile voice and data services operates at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands.

GSM system was developed as a digital system using time division multiple access (TDMA) technique for communication purpose. A GSM digitizes and reduces the data, then sends it down through a channel with two different streams of client data, each in its own particular time slot. The digital system has an ability to carry 64 kbps to 120 Mbps of data rates. A GSM modem is a device which can be either a mobile phone or a modem device which can be used to make a computer or any other processor communicate over a network. A GSM modem requires a SIM card to be operated and operates over a network range subscribed by the network operator. It can be connected to a computer through serial, USB or Bluetooth connection

GSM SIM900A is an ultra compact and reliable wireless module. The SIM900A is a complete Dual-band GSM/GPRS solution in a SMT module which can be embedded in the customer applications allowing you to benefit from small dimensions and cost-effective solutions.Featuring an industry-standard interface, the SIM900A delivers GSM/GPRS 900/1800MHz performance for voice, SMS, Data, and Fax in a small form factor and with low power consumption. With a tiny configuration of 24mm x 24mm x 3 mm, SIM900A can fit almost all the space requirements in your applications, especially for slim and compact demand of design. SIM900A Modem can work with any GSM network operator SIM card just like a

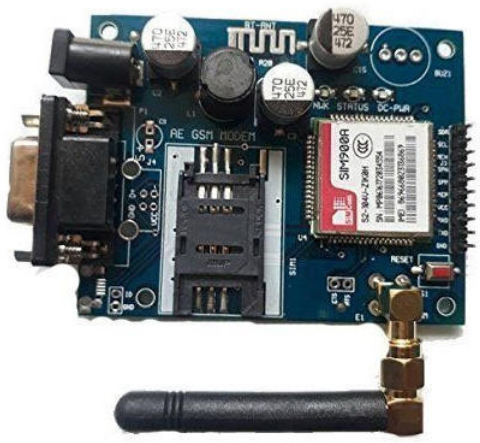

Figure 1.3: GSM SIM900A Module

mobile phone with its own unique phone number.SIM900A GSM/GPRS modem is plug and play modem with RS232 serial communication supported. Hence Advantage of using this modem will be that its RS232 port can be used to communicate and develop embedded

applications. Applications like SMS Control, data transfer, remote control and logging can be developed. SIM900 modem supports features like voice call, SMS, Data/Fax, GPRS etc.

1.4 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.

1.5 IR Receiver Diode - TSOP38238

The TSOP382 is a miniaturized receiver for infrared remote control systems. A PIN diode and a preamplifier are assembled on a lead frame while the epoxy package acts as an IR filter. The demodulated output signal can be directly decoded by a microprocessor. The TSOP382 is compatible with all common IR remote control data formats. Tsop is an IR receiver which will help you to interface your TV remote with arduino.

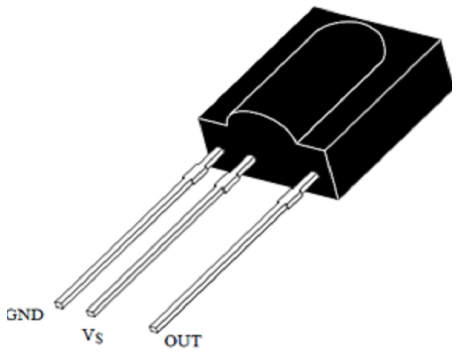

Figure 1.4: IR Receiver

The TSOP outputs a constant HIGH signal when idle and as it receives data, it tends to invert the data. i.e when an IR LED is transmitting data onto the TSOP, every time the IR led goes high, the TSOP will go LOW and vice versa. Remote control signals are often bytes of data that is encoded and transmitted by pulsing(switching ON and OFF the IR LED at a specific frequency) Most TV remote controls work at 32-40 Khz frequency and

most receivers can receive this range. The SIRC protocol uses a pulse width encoding of the bits. The pulse representing a logical "1" is a 1.2ms long burst of the 40kHz carrier, while the burst width for a logical "0" is 0.6ms long. All bursts are separated by a 0.6ms long space interval.

1.6 Relays

Relay is an electromagnetic device which is used to isolate two circuits electrically and connect them magnetically. They are very useful devices and allow one circuit to switch another one while they are completely separate. They are often used to interface an electronic circuit (working at a low voltage) to an electrical circuit which works at very high voltage. For example, a relay can make a 5V DC battery circuit to switch a 230V AC mains circuit. Thus a small sensor circuit can drive, say, a fan or an electric bulb. A relay switch can be divided into two parts: input and output. The input section has a coil which generates magnetic field when a small voltage from an electronic circuit is applied to it. This voltage is called the operating voltage. Commonly used relays are available in different configuration of operating voltages like 6V, 9V, 12V, 24V etc. The output section consists of contactors which con-

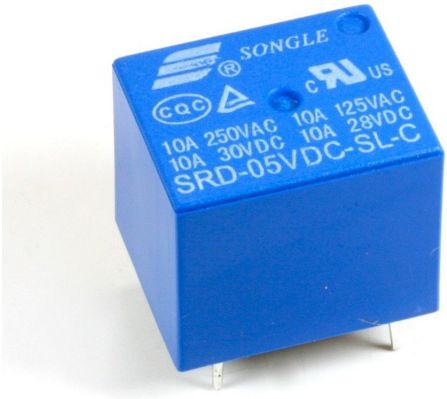

Figure 1.5: 5V Relay

nect or disconnect mechanically. In a basic relay there are three contactors: normally open (NO), normally closed (NC) and common (COM). At no input state, the COM is connected to NC. When the operating voltage is applied the relay coil gets energized and the COM changes contact to NO. Different relay configurations are available like SPST, SPDT, DPDT etc, which have different number of changeover contacts. By using proper combination of contactors, the electrical circuit can be switched on and off.

Features of 5-Pin 5V Relay :

- Trigger Voltage (Voltage across coil) : 5V DC
- Trigger Current (Nominal current) : 70mA
- Maximum AC load current: 10A @ 250/125V AC
- Maximum DC load current: 10A @ 30/28V DC
- Compact 5-pin configuration with plastic moulding
- Operating time: 10msec Release time: 5msec
- Maximum switching: 300 operating/minute (mechanically)

Applications of Relay :

- Commonly used in switching circuits.
- For Home Automation projects to switch AC loads
- To Control (On/Off) Heavy loads at a pre-determined time/condition
- Used in safety circuits to disconnect the load from supply in event of failure
- Used in Automobiles electronics for controlling indicators glass motors etc.

1.7 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.

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

In this paper they stated that the Home Automation today needs to make use of the latest technological components available. So based on this,they presented the design and implementation of a home automation system where communication technologies GSM (Global System for Mobile Communication), Internet, and speech recognition have been used.All these techniques are successfully merged in a single wireless home automation system. This system offers a complete, low cost, powerful and user friendly way of realtime monitoring and remote controlof a house. As the integrated circuits and microprocessors become more and more accessible and the Internet communication is a fact of today with the improved availability of cellular networks, these advancements naturally should find use in modern home automation systems.

The system provide the consumers increased security and safety, economic benefits and convenience by giving them control over all the appliances in the house. Designing a home automation system for monitoring and controlling various devices in remote locations can be done through a variety of communication options such as wireless LAN technologies, dial-up modems, private radio networks, satellite communication, Internet, cellular network and so on. Several studies on home automation have been done using different types of control methods. They refered some examples of a M2M (Machine-to-Machine) system using GSM (Global System for Mobile Communication) cellular communication network for remote controlling. They also proposed some Speech controlled automation systems. They studied some examples of the Internet based automation. However, they were not too feasible to be implemented as a low cost solution. They also studied a recently introduced a low cost Java-Based Home Automation System, without highlighting the low level details of the type of peripherals that can be attached. In a paper refered while researching they also refered a similar system also based on the Internet with hardware implementations is proposed. It was also a low-cost solution and had a scalable structure which allowed new appliances to be added with no major changes to its core. The weakness of the above system was their lack of alternative control mechanisms. Through this paper,the researchers proposed three remote controlling methods which are via: GSM Network, Internet, Speech. The first two of these methods were designed for the users who would like to remotely access the devices in the house whereas the third one was designed for the users while they are inside the house. 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. Thus, their main objective for using GSM network for the communication between the home and the user was its wide spread coverage which made the whole system online for almost all the time. Another advantage of using the GSM network according to them in home automation was its high security infrastructure which provided maximum reliability so that the information sent or received couldnt be monitored by an eavesdropper. Although using GSM network had all the mentioned important advantages over other communication methods, it would be a tedious, time and money consuming task for the user to use his mobile phone each time he/she needs to communicate with the system when the user is already at home. So the researchers suggested and implemented another method which used the voice of the user for controlling the system. In their model, the user could interact with the system by giving commands with his/her voice. This method greatly simplified the interaction with the appliances when the user is at home. The communication between the home appliances is carried out by the RF communication protocol. Unlike a system using wired communication methods such X10, an RF system has the advantage of installation and maintenance. Moreover, it has a lower cost when compared to other wireless communication methods such as using Bluetooth. The entire research was briefed into four sections ,the first section stated the above mentioned details.The second section showed a brief overview of the automation system while in the section followed by the second showed the operation of the whole system is discussed in detail. The last section was the conclusion. The overview of the system proposed is that the communication between the user and the system was established by the three methods; via a mobile phone, the Internet or speech. User commands were transferred to the home automation server (which is done by a PC) via one of these three alternatives. In the home automation server the incoming commands were processed, then digitized and sent to the relevant unit to be processed. In each unit there were separate low-cost microcontrollers to receive the commands from the transceiver and apply these to the appliances they are attached to. These devices also had the capability of sending their status back to the transceiver node which was connected to the home automation server thus they can be monitored in real- time. After receiving the feedbacks from the appliance nodes,the home automation server interpretted them and can perform the necessary tasks .

GSM

The GSM is an excellent choice in establishing a communication from remote locations where Internet may not be available. The communication between the user and the home was established by the SMS (Short Message Service) protocol. A GSM modem was connected to the home automation server. The communication between the home automation server and the GSM modem is carried out by the AT (Attention) commands. Sending and receiving SMS messages are all performed in the PDU (Protocol Description Unit) mode since the text mode may not be available on all GSM modules. For the mobile part, an interactive software had been developed in J2ME platform. The software developed could be used in any mobile phone that supports Java. By using this software, the user c interact with the house simply by choosing the right commands from the menus. They demonstrated the same by using a door-locking system example . The details of the Lock the Door command is as follows: 1. An SMS message was created which had a content of Lock the Door command in an encrypted way. 2. This message was sent to the GSM modem which is connected to the server. 3. The main control program running on the server decrypts, reads and interprets the message content. 4. An appropriate command was sent to the door lock system via the

transceiver node and the door was locked. 5. A feedback SMS message (e.g. The Main Door is Locked at 04.07.2006 at 11:58.) was sent back to the user. The same mechanism was also used to inform the user about a status change in any device.

INTERNET

In order to achieve interaction with the home automation network from the outside, the other option used was the Internet. To accomplish this, a web server was built to take requests from remote clients. The clients could send requests to the home appliances. The home appliances can send their statuses to be displayed for the remote client through the server. A web page was constructed as an interactive interface where commands could be submitted by the client to change and also monitor the status of the devices.

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 was based on microcontroller that made the control system smarter and easy to modify. It also enabled the user to operate a T.V, Air Conditioner and other Home appliances from about 10 meters away. The Smart remote control could 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.

As the technology is developing and continuously improving peoples living standard, people are in pursuit of automated, intelligent and convenient home control systems. They considered a living room where anyone can have around 3 home appliances (TV, AC, Audio player) which imply bulk of different remotes in convenient to carry, high cost, and more usage of batteries. Therefore, according to them it is a good choice to design a smart remote. With the popularity of smart phones, particularly, the phone based on Android system is rapidly developing. The remote control based on Android phone will become a mainstream way. After logging into the GUI, users can easily control the TV, AC and Audio player, which brings great convenience to people and improves the quality of life. According to them the motivation behind the proposed system was that the users can manipulate appliances anytime letting our houses become more and more automated and intelligent.The home appliances have the different remotes for different appliances which is restricted to a single device. So therefore according to them its a good choice to design a smart remote which brings the all the remotes in a single smart remote. The proposed system was composed of android mobile terminal, Bluetooth network, Transceiver module fixed on Ardiuno Uno microcontroller. And the architecture of the system is shown below. at any moment; the GUI in phone allows the user to manually control any of appliances in the room. First of all, the action listener should be set for each button which will be clicked to send message command via the Bluetooth network. After reading and parsing the commands, Micro controller controls the wireless module to send the address and data codes to achieve remote control of appliances ultimately.

The terminal based on android phone was designed, which contained GUI design, user management and message command sending event. After entering the lighting control in-

terface, users send predefined commands just by touching the appropriate button or the button icon. The android app contained tiny db which is a database for storing the received hexadecimal values. They used an HC-05 Bluetooth module which allowed the serial data transfer between microcontroller and smart phone. The microcontroller needs 5v power supply to work .The TSOP1738 is an IR receiver that decoded signals from the original remote of appliances (TV, A C, etc). The IR transmitter led worked and successfully transmited pulse width modulated signals. The ardiuno uno which is an AT mega 328p microcontroller and it is a very powerful and easy to program. The hardware construction of main control board. Fig 2.2 demonstrates the hardware block diagram in the main control board. Ardiuno uno Microcontroller, AT Mega328p was chosen due to its capability to perform the both serial and USB features to establish the Bluetooth and USB connection to the GUIs. For the sensor, TSOP1738 Sensor Module was chosen because it is low cost. For the Bluetooth module, low cost HC-05 Bluetooth module was chosen to establish the Bluetooth connection between main control board and the GUIs. The electrical current was directly connected to the main control board whereby it separates the regulator and relay circuit. In the following block diagram the red line indicates the 5v supply; orange is the ground .The Bluetooth, IR receiver both takes the 5v supply. . Pin number 3 is the pulse width modulated pin and it is connected to IR led Anode pin. Pin 8 is a digital pin which receives the IR signals from the remotes and decodes them. The pins 10,11 were assigned as RX, TX pins for serial communication.

As the technology is rapidly increasing and the smart phones are the best example for it .Now considering the operating system that runs on them are majorly the android and the IOS, as compared to both Android has a very big market all over the world. They designed the app targeting lollipop 5.0 version mainly, but hopefully it also supported version Ice Cream Sandwich (4.0), Jelly Bean (4.1) and Kit Kat (4.4). Android applications are written in the Java language. Thanks to the MIT APP INVENTOR (beta 2), this website maked android development easy. They developed the application on this website with all proper permissions. The app inventor also provided a wonderful opportunity to turn our smart phone into emulator screen and can monitor the end result of the work.

Android devices used the .apk file to install the application. Android's application framework allows for the creation of extremely feature rich and novel applications by using a set of reusable components. The amalgamation of the Android development environment with the Bluetooth wireless technology is known by Androids support for the Bluetooth network stack, which permitted a device to wirelessly exchange data with another Bluetooth device (Smartphone Bluetooth with Bluetooth Module). The application framework enabled access to the Bluetooth functionality using the Android Bluetooth APIs. These APIs allow wireless applications to connect to other Bluetooth devices for point-to-point and multipoint wireless features. Using the Bluetooth APIs, an Android application can carry out the following functions By designing the smart remote the usage of alkaline batteries was reduced. The configuring of remote button values into the application database and transmission of Infrared signals with good signal strength are the two major tasks for the smart remote. The GUI was made easy to understandable by any age group of people and it works good and responsive. For the demo purpose an Phillips TV and a O General AC were operated using smart remote

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 article is 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 was 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 .

Technology is a model of progression, principles and patterns that people develop and work on over years. More importantly, the proposed model was spread around the people from different nations by exchanging the ideas. Also, technology could be improved and upgraded when its shared between different people and used at homes. One important part of any technology process is to make people comfortable and enhance their home devices flexibility. This is usually done by providing more methods and applying more technological systems at their homes. The new domain of research and engineering is called Home Automation which means the use of developed technologies to control basic home functions and features automatically and remotely. Although this domain is well developed in different world sides to serve people to the maximum, some countries like Lebanon, still need some important automation functionalities that serve the special requirements of the citizens.Home automation and control systems offer great benefits of convenience, cost and time savings. Depending on your budget and the needs of your home, an integrated wholehouse automation system or a series of standalone systems may be the right choice. Regardless of which approach you choose, it is likely you will see immediate returns both economically and in terms of increased free time. The most common method used in Lebanon for controlling home appliances was the standard switch control that was applied manually. They illustrated the disadvantages of such systems in terms of cost and lack of benefits. Besides, they discussed the disadvantages of systems such as home automation via wi-fi, Internet or Bluetooth and highly sophisticated systems in other countries systems.

Till the time of proposing this system, in Lebanon most of the houses didnt had a home automation system that was controlled from a distance via a remote control like mobiles and computers. Every home was equipped with the simplest method for controlling home appliances like the manual home appliances control which lacks mobility. These kind of system are applied in countries with low technological progress. Different communication means have been widely used in order to apply home automation concept. Bluetooth and Wifi communication are from the most well known technologies for such an objective. For these two modes of communication, coverage area will always raise as a challenging issue. Bluetooth communications are usually meant to be used for indoor control, which means if you are out of home, your system will not be functioning or beneficial. Besides, the access range of Bluetooth does not exceed the 100 meters in the best case, not forgetting its affection by barriers such as walls or doors. Wifi came as a solution, but the range of it

is still to limit it for indoor applications. Usage of the internet has been increasing a lot in the last few years and it became a need in every house and place. Hence, a good solution for outdoor home automation applications could be to use Internet or 3G communication networks.However, the problem here is the low speed and the unreliable connection in some countries such as Lebanon which makes it hard to apply on such a system that is mainly based on the internet. Due to this, this kind of system is not preferable. Instead simpler systems that are not based on the internet are more beneficial.

> Smart electricity appliances controller system was designed to cover the below requirements:Specify a phone number to receive the instructions message and dedicate the system to the entered number. The ability to receive informing message about the electricitys and machines state. Control any appliance that is connected to our system by messages. Request the temperature degree Change the recipient number.

One important part of any technology process is to make people comfortable and enhance their home devices flexibility. This is usually done by providing more methods and applying more technological systems at their homes. Some countries suffer from the long term current cut off. So, a double edged system needs to be introduced to solve this problem, a system that informs the user when the real current is on and which device to turn on or off. The smart appliances controller that we have created will help us to control our appliances remotely even if we are outdoor and use the electricity in beneficial way. Also, it allows us to get more specific details about our electrical device in run.

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.

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.

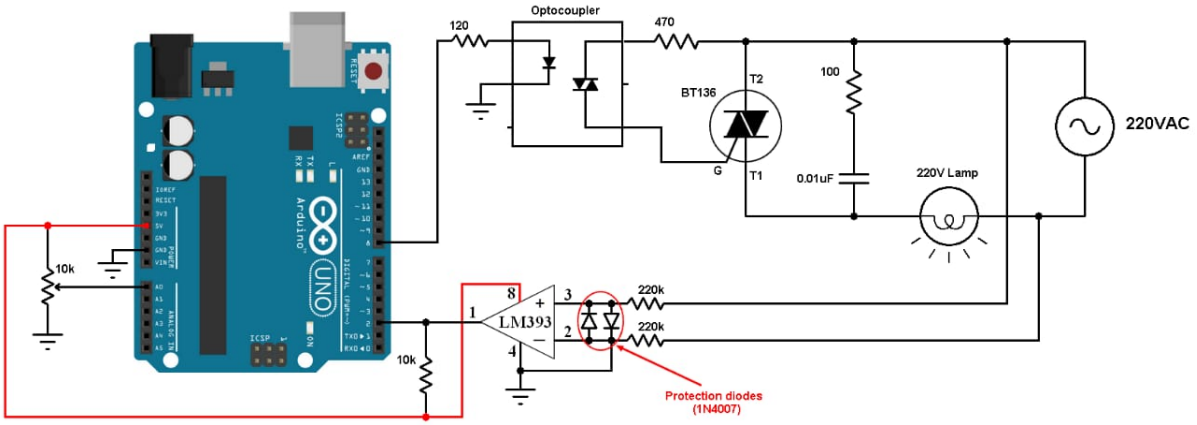

Figure 4.1: Pin Diagram

Chapter 5

System Design and Working

5.1 System Design

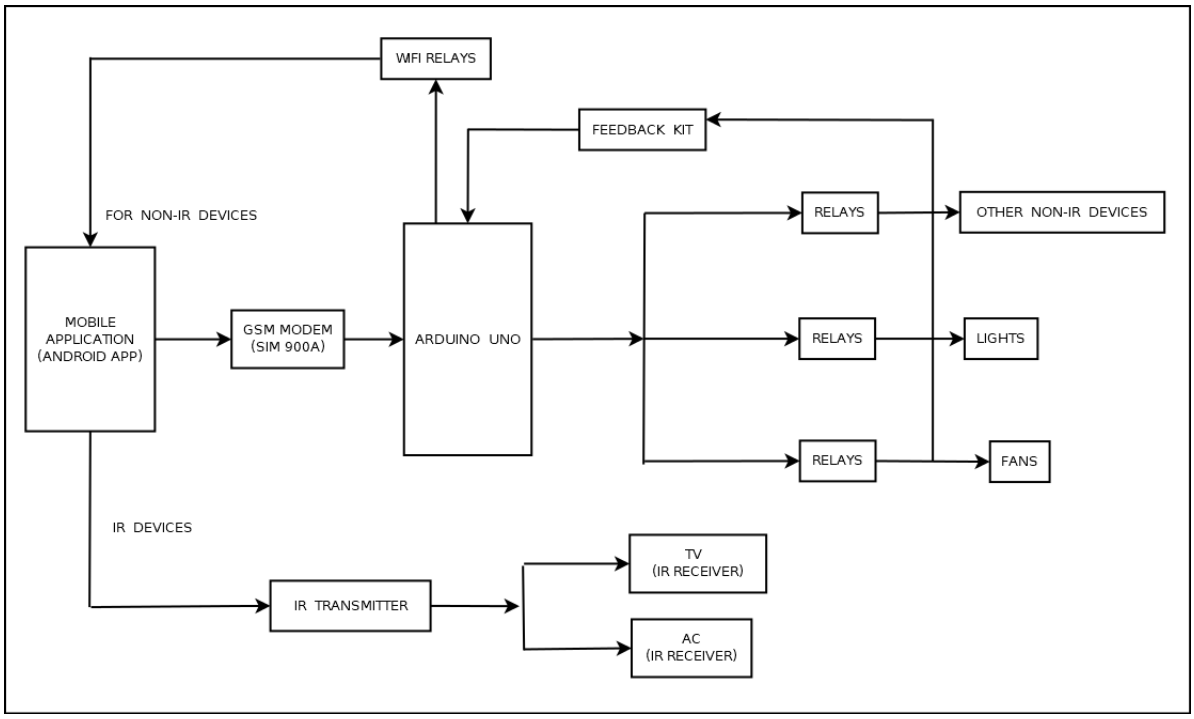

Figure 5.1: Block Diagram

5.2 Working

5.2.1 Module 1 : Controlling Appliances through GSM

In this project, Arduino is used for controlling whole the process. Here we have used GSM wireless communication for controlling home appliances. We send some commands like RON, ROFF and so on for controlling AC home appliances. After receiving given commands by Arduino through GSM, Arduino send signal to relays, to switch ON or OFF the home appliances using a relay driver.
When we send SMS to GSM module by Mobile, then GSM receives that SMS and sends it to Arduino. Now Arduino reads this SMS and extract main command from the received string and stores in a variable. After this, Arduino compare this string with predefined string. If match occurred then Arduino sends signal to relay via relay driver for turning ON and OFF the home appliances. Here in this project we have used 3 zero watt bulb and 1 stepper motor for demonstration which indicates Fan, Light and TV,AC.

Components Required :

- Arduino UNO R3
- GSM SIM 900A Module
- SIM Card
- Jumper Wires
- Bread Board
- 4 LED'S
- 4 Zero Watt Bulb
- Stepper Motor
- 4 Sugar cube Relays (5V)

Connections :

- Connect 12V DC Charger to GSM SIM900A.
- GSM SIM990A connections :-
  - Connect GSM ground (Pin 1) to Arduino ground pin (Pin 14).
  - Connect GSM TX (Pin 2) to Arduino RX (Pin 0).
  - Connect GSM RX (Pin 3) to Arduino TX (Pin 1).

- Arduino Connections :
  - Connect 5-5.4V DC supply to Arduino and PCB.
  - Connect Arduino Input pins(4,5,6,7) to PCB's input pins(1,2,3,4).
  - Connect Stepper motor input pins to Arduino input pins(8,9,10,11,12).
  - Connect power supply of 240V to home appliances.

- Relay Connections :
  - Connect Normal open pins of relays to positive pin of bulb of respective bulbs.
  - Short negative pins of all bulbs and connect it to common pins of 1st relay.
  - Connect common pin to 1st relay to common pin of other relays.

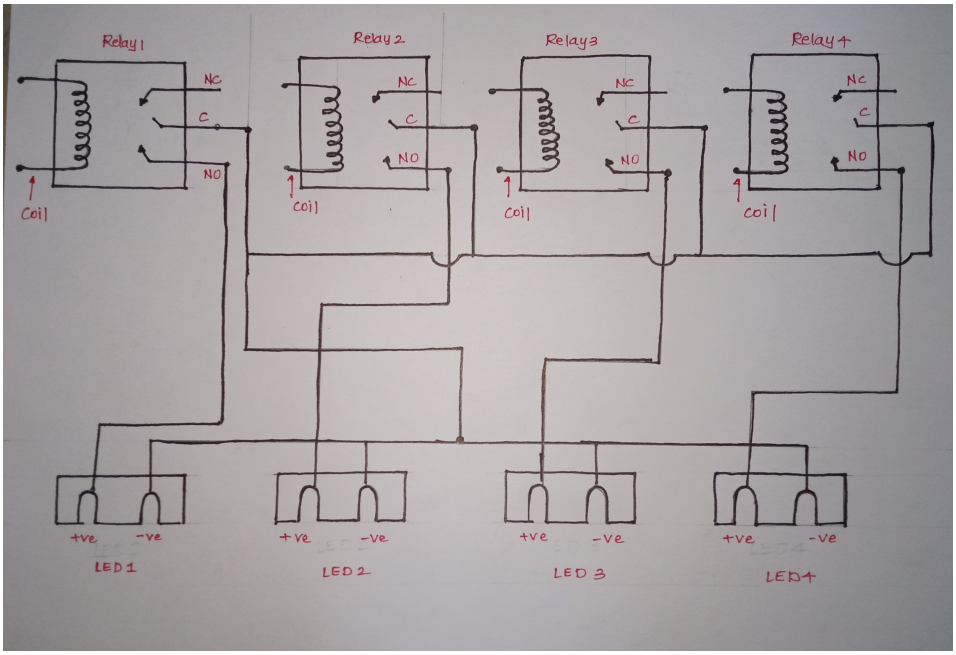

Figure 5.2: Relay Connections with Bulb

Kit :

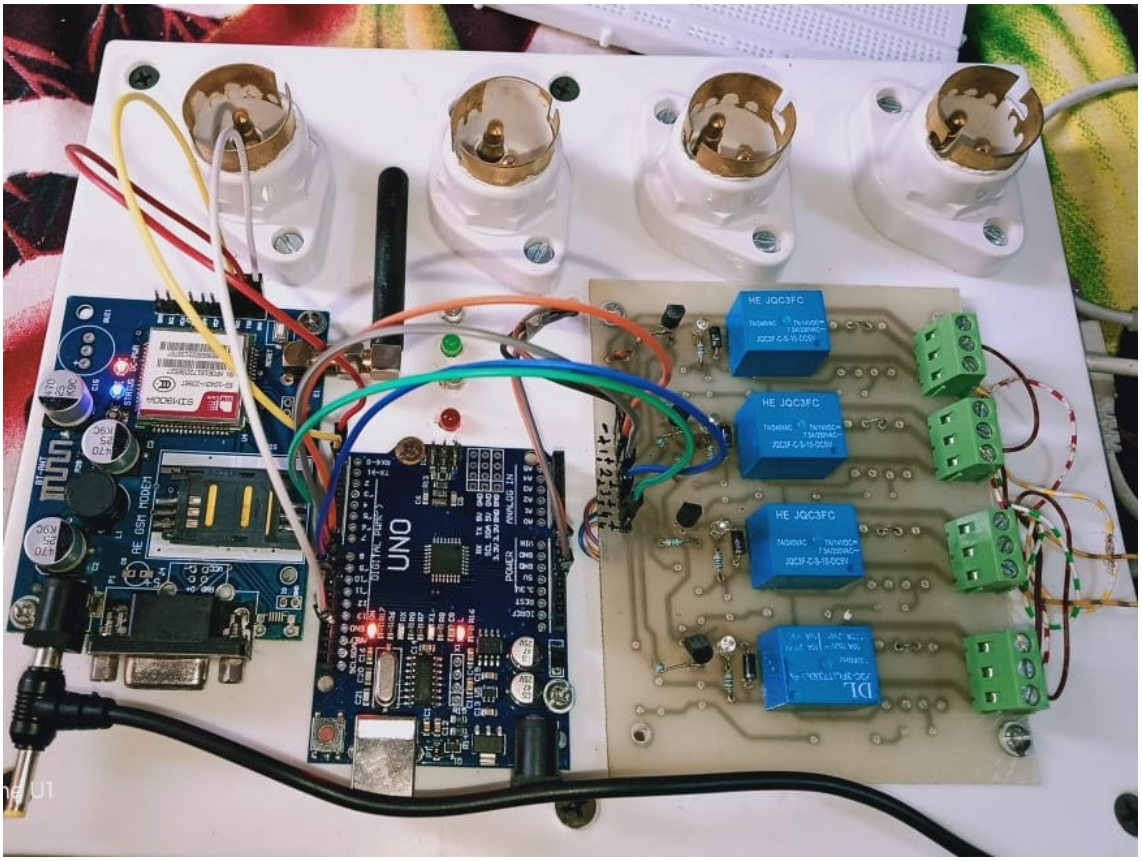

Figure 5.3: Kit

Commands / Operations :

Sr.No	Message	Operation
1.	Ron	Red Led On
2.	Gon	Green Led On
3.	Bon	Blue Led On
4.	Allon	All Led On
5.	Roff	Red Led Off
6.	Goff	Green Led Off
7.	Boff	Blue Led Off
8.	Alloff	All Led Off
9.	Allon	All Led On
10.	Aon	Anti-Clockwise
11.	Con	Clockwise

Table 5.1: Commands / Messages used to control LED'S Stepper Motor using Android App

5.2.2 Module 2 : Controlling IR devices using app

As many will know , the mechanism of regulation of various settings between user and conditioner , is via a remote control , which is based on sending infrared signals . For this reason, as the first phase of the work , is to do the procedure that is called reverse engineering , that is to obtain the codes for your device , using the sensor TSOP1738 .Once the codes are obtained , we need to put that codes on the android button so that whenever user presses the button the signals are sent to the device via mobile;s IR transmitter, which could be received by device IR receiver .

Components Required :

- IR Receiver
- Jumper Wires
- Mobile App

5.2.3 Module 3 : IR Blaster for Non-IR Mobiles

The IR in IR blaster stands for infrared. Most remotes use infrared to communicate instructions to different devices. TVs, receivers, and media players like Blu-ray also use this. Some Android devices come with an IR blaster built into them. This allows you to control different devices in a easy manner.

- 1 X 3.5mm AUX Cable.
- 2 X IR Led
- Heat Shrinking Tube .

Figure 5.4: IR Blaster

5.2.4 Module 4 : Calculating Power Consumption

This is the feedback kit from where the feedback for each and every appliance will be reverted. If the user clicks on status button of android app then arduino gets +5v from PCB which indicates that the appliance is on and reverts the feedback to user.

It calculates power consumption by the formula :

Energy consumption calculation :

The energy E in kilowatt-hours (kWh) per day is equal to the power P in watts (W) times number of usage hours per day t divided by 1000 watts per kilowatt:

$$\mathbf{E(kWh/day) = P(W)\ \ t(h/day)\ /\ 1000(W/kW)}$$

Electricity cost calculation :

The electricity cost per day in dollars is equal to the energy consumption E in kWh per day times the energy cost of 1 kWh in cents/kWh divided by 100 cents per dollar:

$$\mathbf{Cost(per/day) = E(kWh/day)\ \ Cost(cent/kWh)\ /\ 100(cent)}$$

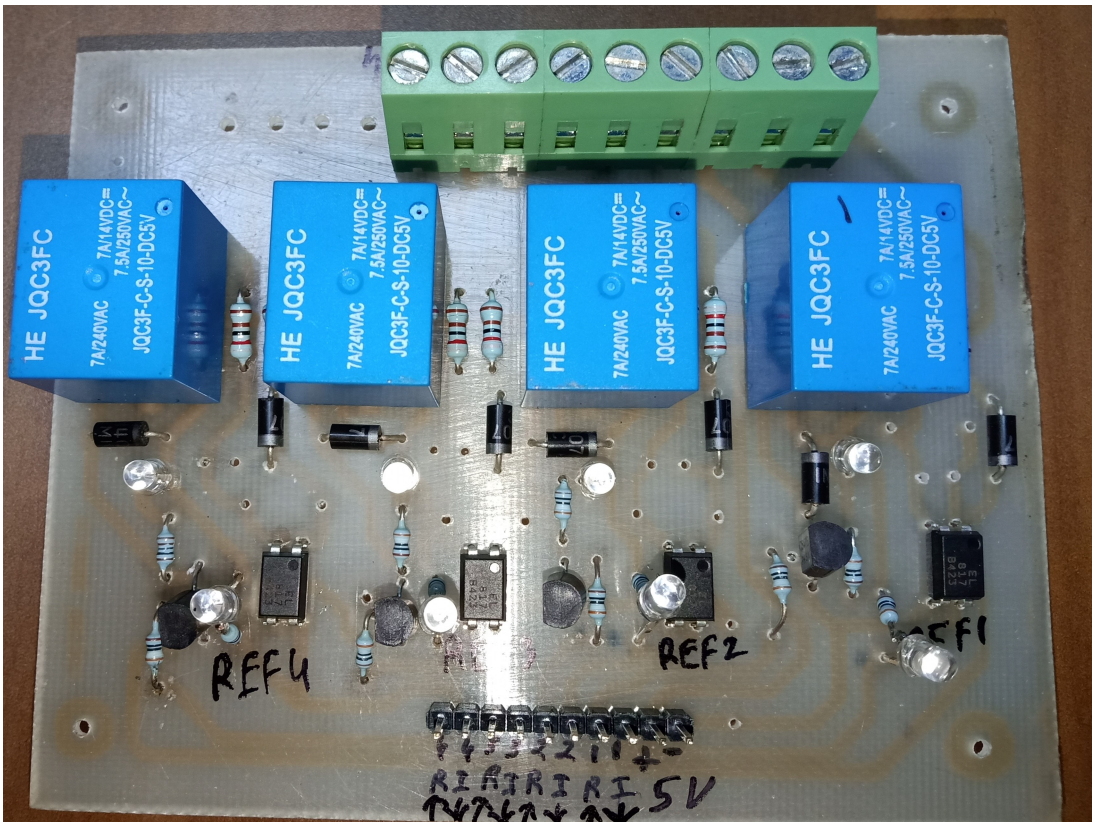

Figure 5.5: Feedback Kit / PCB

5.3 Use Case Diagram

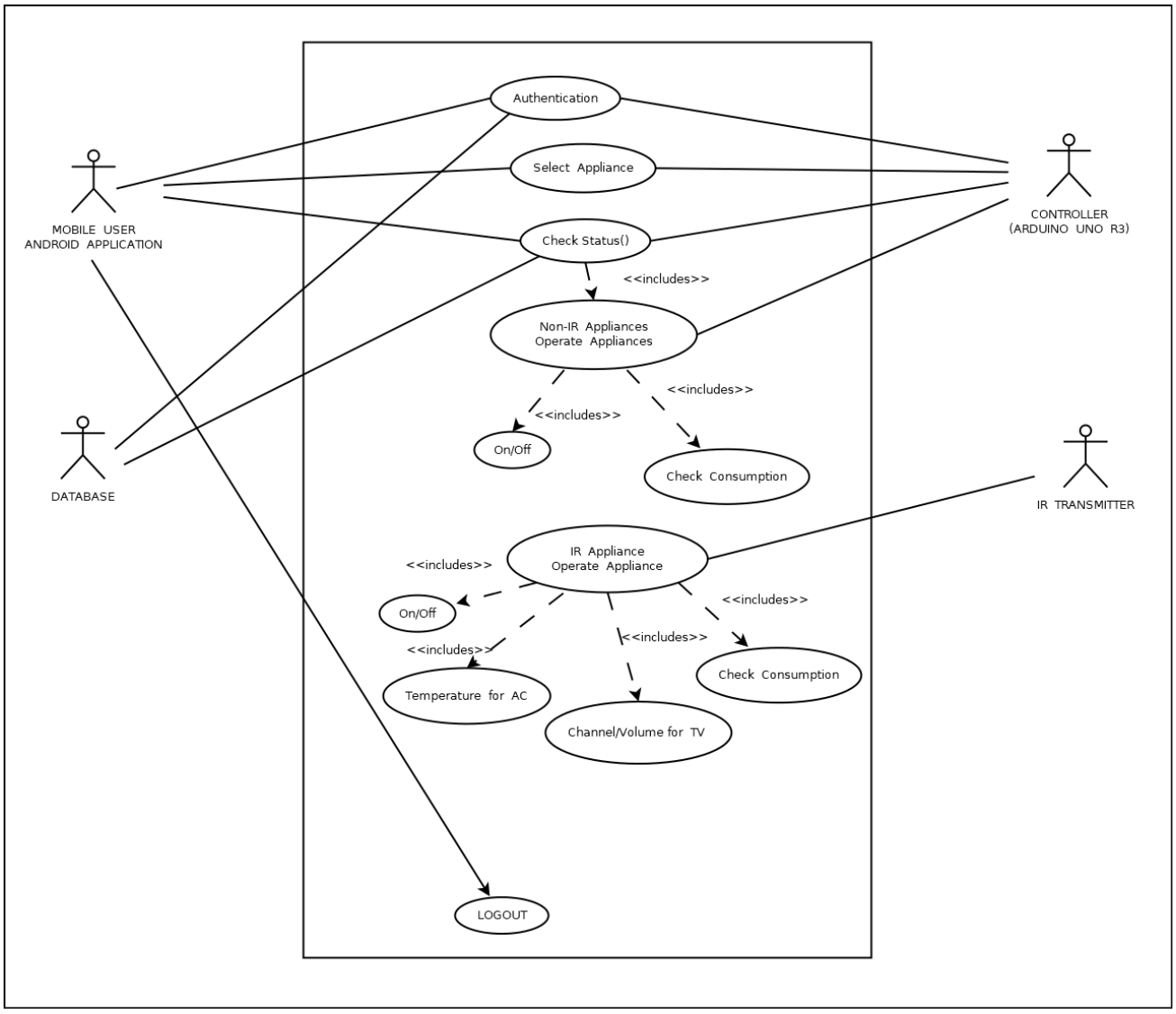

Figure 5.6: Use Case Diagram

USE CASE NAME	POWER CONSUMPTION MONITORING
SCENARIO	1. Users will login into the app and select the appliance on which they want to perform the operation. 2 . System will provide the analysis of power consumed by the appliance
TRIGGERING EVENT	1 . User needs to select the appliance. 2 . User gets the notification regarding the current status of the appliance.
BRIEF DESCRIPTIONS	1. User needs to login to the system . 2 . Users select the appliance i.e Ir and Non-Ir. 3 . If user selects Non_Ir then a message will be sent from the app to the GSM modem which in turn triggers arduino. 4. Arduino then triggers relays to perform the operation. 5 . If user selects IR appliance,then Mobile;s Ir sends infrared signals to the Appliance's Ir receiver to perform specified action. 6 . Power Consumption report will be generated for each of the appliance .
ACTORS	1 . User-One who will use the system to automate the appliance 2 . Arduino - Performing actions specified by user 3 . Database - Stores User credentials. 4 . Ir Transmitter - Sends infrared signals
STAKEHOLDERS	User
PRECONDITION	User need to perform specified actions
POST CONDITION	Power consumption report will be generated for each appliance.

Table 5.2: Use Case Description

5.4 Activity Diagram

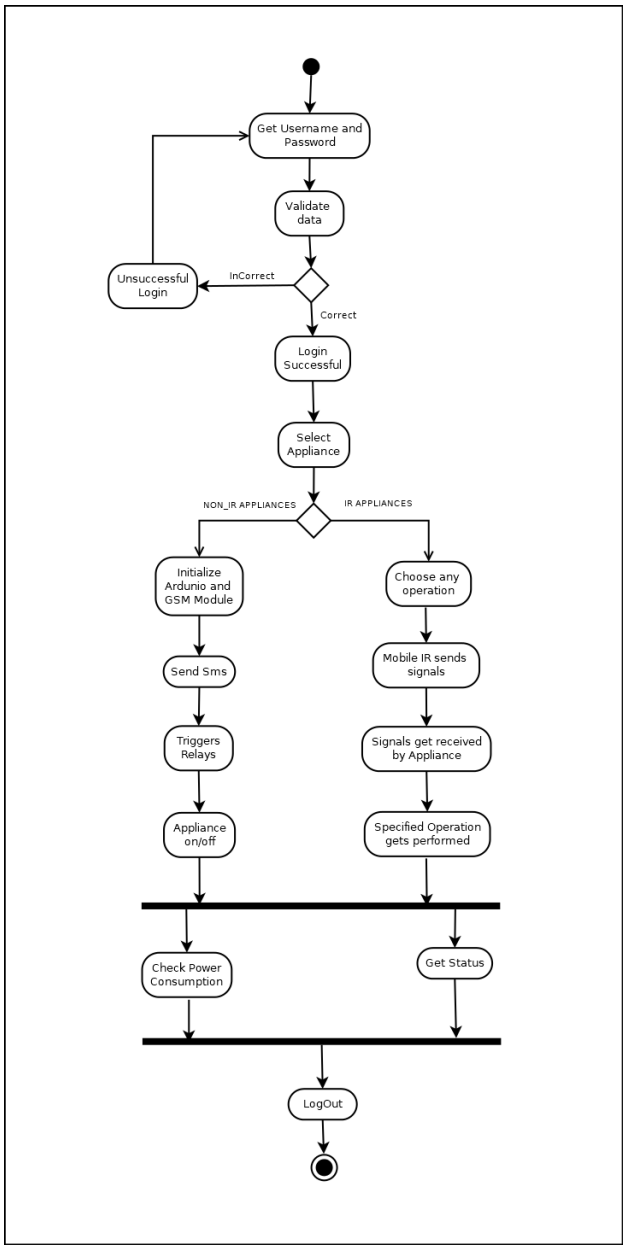

Figure 5.7: Activity Diagram

5.5 Class Diagram

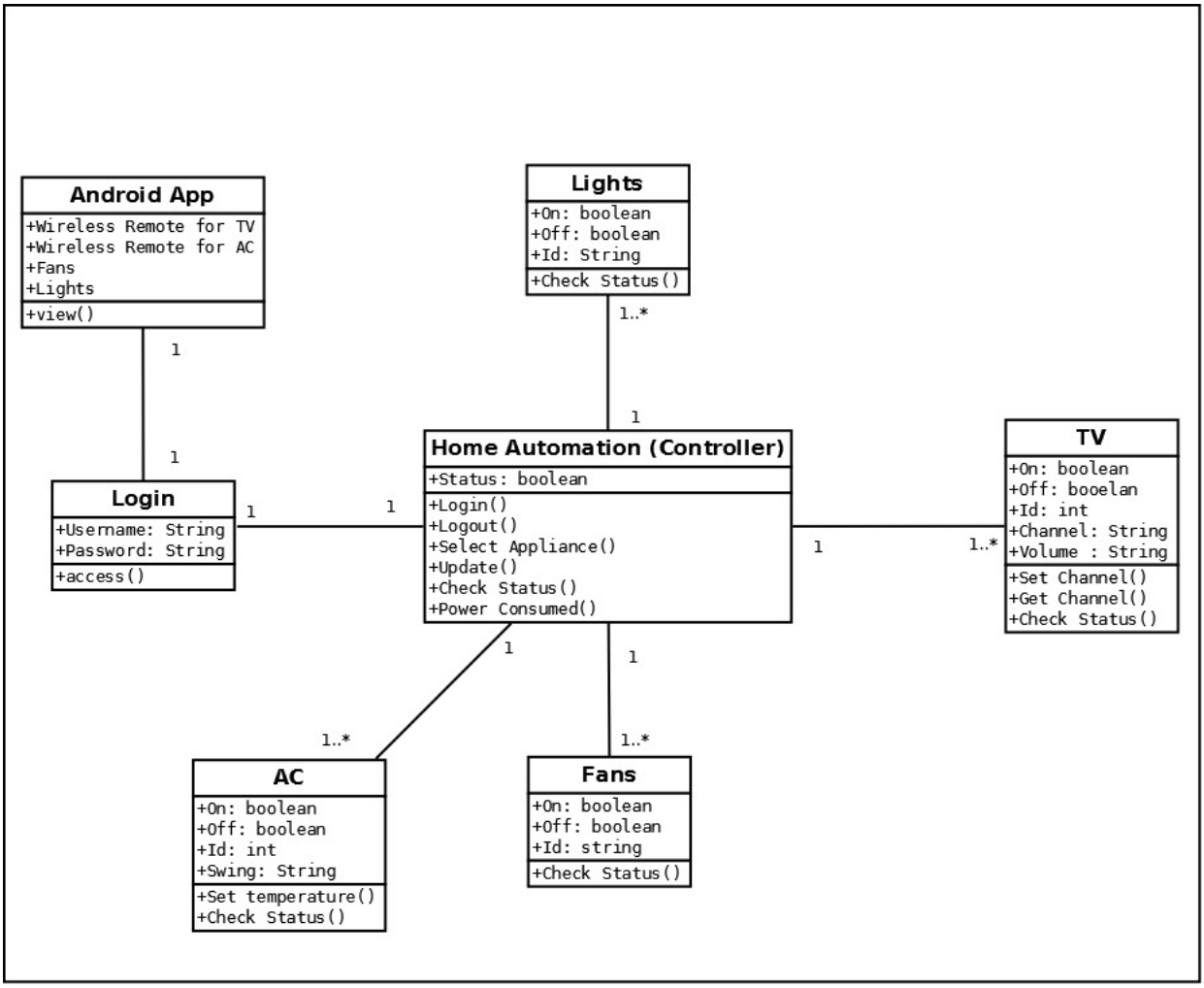

Figure 5.8: Class Diagram

Chapter 6

Technology Stack and Dependencies

6.1 Technology Stack

6.1.1 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.

6.1.2 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.

6.2 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 7

Implementation Process of Project

7.1 Graphical User Interface (Mobile Application)

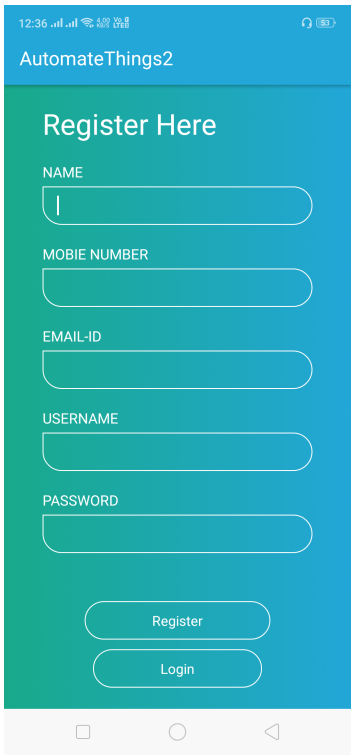

Figure 7.1: Registration page

This is the main page of the mobile application named Automate-Things . Whenever the user starts the application this will be the first page displayed . In this page , user can register themselves to the application so that they can access and use the application . If any of the user has already registerd they can directly login by clicking on the login button .

7.2 Login Page

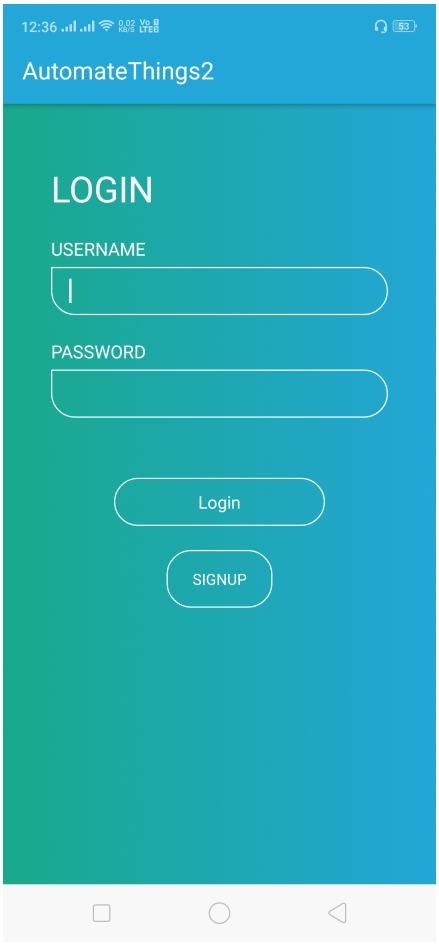

Figure 7.2: Login page

This is the login page where the user needs to enter their username and password which they had entered during registration . Login button will first check check the username and password entered by the user is correct or not ,If it is correct , user will be directed to the home page of the mobile application . If it is incorrect, user needs to enter the correct credentials to access the apps content and priviliges.

7.3 Home Page of Mobile App

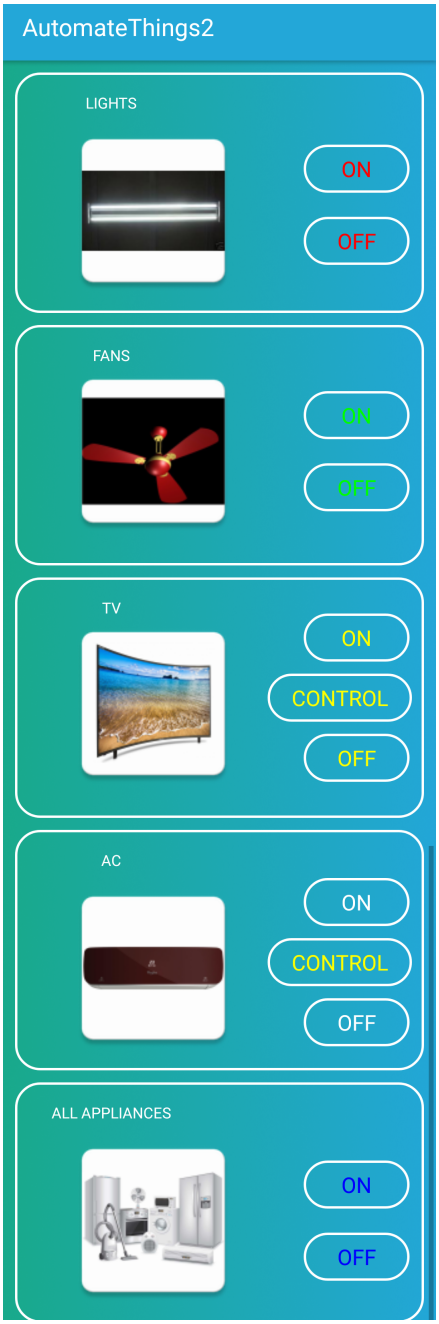

Figure 7.3: Home page

This is the home page of the mobile application where the user can choose the appliance on which they want to perform the operation.If the user wants to switch on any of the appliance they can just click the button of the appliance and the message will be forwarded to the kit and from the relays perform the operation of switch on and switch off operation.

7.4 Ac Remote

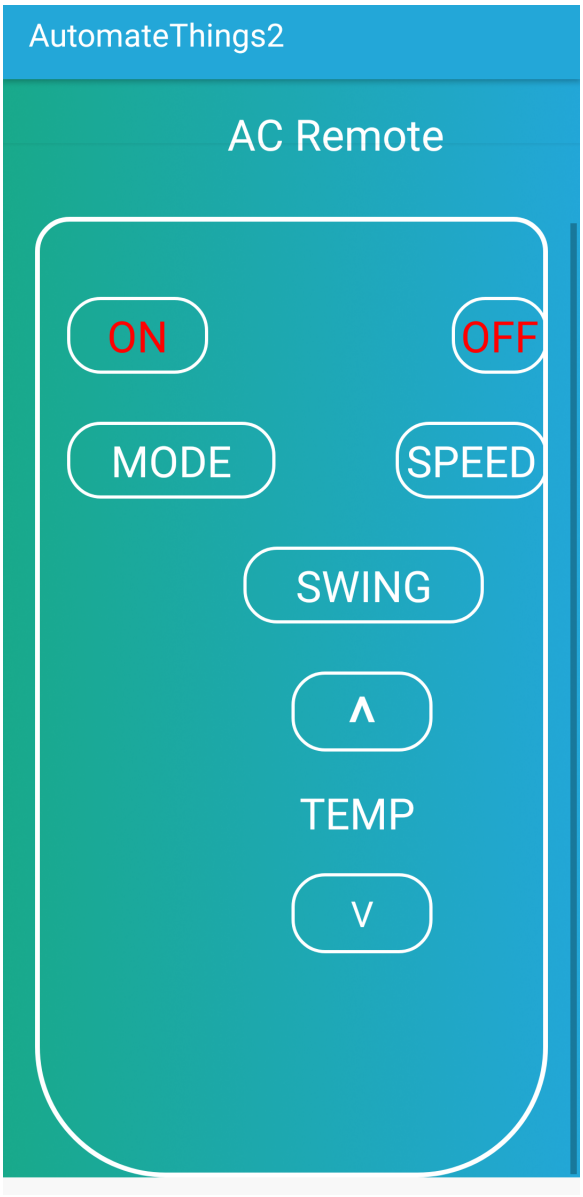

Figure 7.4: Ac Remote page

If the user clicks on control button of ac on home page. Then this page will appear , which contains all the basic controls of ac remote which user needs . User can use this remote if their mobile has an in-built Ir transmitter. If the mobile doesn't have an in-built Ir ,then they can attach an IR Blaster which provides an external Ir to the device . If any of the buttons get clicked Ir sends and infrared signal to the receiver and desired actions get performed.

7.5 TV Remote

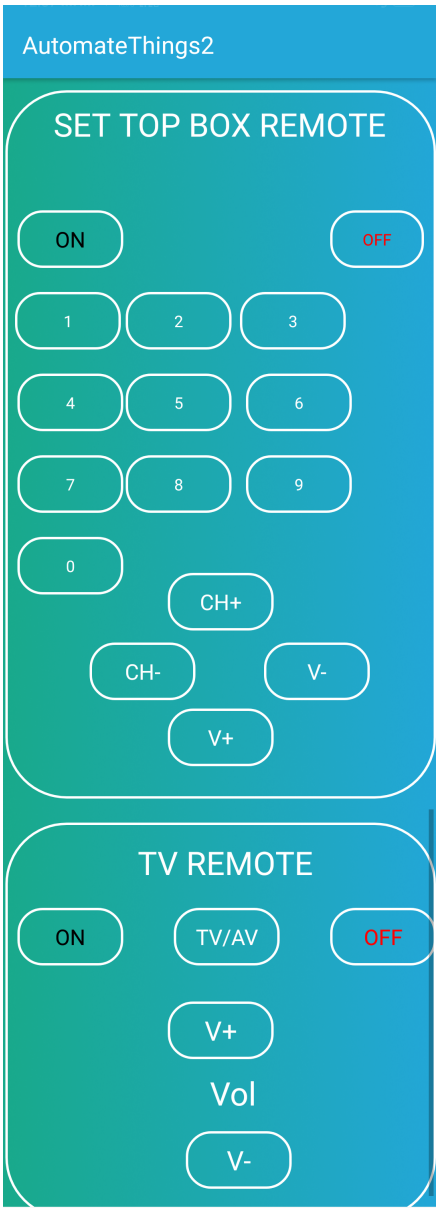

Figure 7.5: TV Remote page

If the user click the control button of tv on home page ,then this page will appear which contains basic controls of the tv remote as well ass the Set-Top box remote .Because of this, user need not require 2 remotes separately to control both the devices. They can control it using only a single remote,which decreases user's efforts to shuffle between the remotes .

Chapter 8

Result

The home automation system has been experimentally proven to work satisfactorily by connecting sample appliances to it and the appliances were successfully controlled from a wireless mobile device. The GSM Module was successfully tested on a multitude of different mobile phones from different manufacturers, thus proving its portability and wide compatibility. The IR Blaster also worked effortlessly with all manufacturers of IR appliances, thus providing IR facility to all Non-IR mobile phones. Power was also calculated for sample appliances using feedback kit which helps user to see the consumption of each and every appliance . Thus a low-cost home automation system was successfully designed, implemented and tested. .

Chapter 9

Conclusions and Future Scope

9.1 Conclusion

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.

9.2 Future Scope

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

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[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.

Appendix

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/in

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

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.

Publication

Paper entitled **"Power Consumption Monitoring using Home Automation"** is presented at **"International Conference on Innovations in Computer Technology and Application (IC2TA-2019)"** by **"Anish Salgia , Bhavana Gupta , Siddhesh Dalvi , Daisy Maniar ".**