EAST WEST UNIVERSITY

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IoT Based Switching And Data Observation For Home Appliance

A Project Submitted

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August, 2017

DECLARATION

We hereby declare that we have completed project on the topic entitled "IOT based switching and data observation". This project is our original work.

We further assert that this report in question is based on our original exertion having never been produced fully and/or partially anywhere for any requirement.

Signature:

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ACCEPTANCE

We hereby declare that this project is from the student's own work and best effort of us, and all other source of information used have been acknowledged. This project has been submitted with our approval.

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ABSTRACT

The Internet of things (IoT) is the inter-networking of physical devices, vehicles, buildings, and other items embedded with electronics, software, sensors, and network connectivity which enable these objects to collect and exchange data. In this project, IoT based switching and data observation for home appliances as the topic since every device can be controlled from any position in the presence of internet. Again, if anyone wants to observe the data of the devices related to activation of every instance then s/he can also use this integrated device. In this project ESP8086 driver is used as the controller of the whole device as control board, magnetic relay as switch, and ESP Wi-Fi module for interfacing device with Wi-Fi. A software named as thinger.io is also developed for the betterment and ease of communication with cloud server and ESP driver module. By this software anyone can control the device and also observe data of each and every moment, if s/he away from room. It can also show us the rate of darkness as well as temperature in the room through LDR (Light Dependent Resistor) & Thirstier, whose functionality rely on light intensity & temperature respectively. The emergency switch on/off can be performed in that case. The goal of this project is to provide a low-cost and flexible solution to control and monitor home appliances. The extension cannot be completed due to the limitation of resources& enough time.

INDEX

LIST OF FIGURES

Page No.

Chapter 1
Introduction

1.1 Introduction

 The Internet of Things refers to the ever-growing network of physical objects that feature an IP address for internet connectivity, and the communication that occurs between these objects and other Internet-enabled devices and systems. The term "Internet of Things" has come to describe a number of technologies and research disciplines that enable the Internet to reach out into the real world of physical objects. It gave us the idea to build smart home. Smart home is that kind of home where everything can be controlled without the presence of a human.

This project is about designing & implementation of a "IoT based switching and data observation". We choose the topic of the project concerning both the modern age technology and present condition of the busy life style of the people. It has increased the comfort level of the people. IoT based smart monitoring and controlling system is a system by which we can control and monitor any kind of device like lights, fans, AC, TV, cars etc. from anywhere.

Inside our home, whenever we want to turn a light or fan on/off, we walk toward the switch board and push a switch. This is not so difficult for a physically fit person. But for a physically handicapped person, however, this simple task of pushing a switch to turn on/off a light or fan at their own might be difficult to perform, and s/he may have to be dependent on someone else for doing this menial job. If these tasks could be performed using a remote control, then it would lessen their dependence on another person and would benefit them greatly. We can also control these devices when we go to our offices or elsewhere and thus it will greatly reduce the complexity of managing the house or the office or other places also.

1.2 Introduction of the project

Our goal was to make an IoT based switching and data observation project. We planned to make a device control and monitoring system by IoT. The microcontroller will control the device and by using IoT we will switch and observe the data.

Our main aim was to monitor any devices from anywhere. Thus we can make smart home, smart industry and so on. Actually smart home refers to a home equipped with lighting, heating, and electronic devices that can be controlled remotely by phone or computer. You can contact your smart home on the Internet to make sure the dinner is cooked, the central heating is on, the curtains are drawn, and a gas fire is roaring in the grate when you get home. Suppose you are on vacation but you can use a Touchtone phone to arm a home security system, control temperature gauges, switch appliances on or off, control lighting, program a home theater or entertainment system, and perform many other tasks. It can also be implemented on office or other places.

But our project is data switching and observation so we can actually control any device from far apart with the help of IoT.in our project we have used microcontroller, ESP 8266 Wi-Fi module, magnetic relay.

1.3 Features of our proposed project

We have developed a control and monitoring system which can be used in multiple ways which are the features of our project and they are shown below:

✦   Password protected electronic lock at the main entrance for security.

✦   A computer based software for monitoring and control of the whole system has been developed to monitor the fixtures (i.e. lights, fans and window) of the room and the window. It also monitors the room temperature to determine fire hazards.

✦   Office maintenance.

✦   Control multiple device at a time in an event.

✦   An alarm for fire hazard protection.

✦   Motion detection.

Chapter 2
IoT (Internet of things)

2.1 Introduction of IoT

The concept of the Internet of Things first became popular in 1999, through the Auto-ID Centre at MIT and related market-analysis publications.

Radio-frequency identification (RFID) was seen as a prerequisite for the IoT at that point. If all objects and people in daily life were equipped with identifiers, computers could manage and inventory them. Besides using RFID, the tagging of things may be achieved through such technologies as near field communication, barcodes, QR codes, Bluetooth, and digital watermarking.

The Internet of Things (IoT) is the network of physical objects or "things" embedded with electronics, software, sensors, and network connectivity, which enables these objects to collect and exchange data. IoT allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct integration between the physical world and computer-based systems, and resulting in improved efficiency, accuracy and economic benefit. "Things", in the IoT sense, can refer to a wide variety of devices such as heart monitoring implants, biochip transponders on farm animals, cameras streaming live feeds of wild animals in coastal waters,[1] automobiles with built-in sensors, DNA analysis devices for environmental/food/pathogen monitoring,[2] or field operation devices that assist firefighters in search and rescue operations.[3] Legal scholars suggest regarding "things" as an "inextricable mixture of hardware, software, data and service".[4]
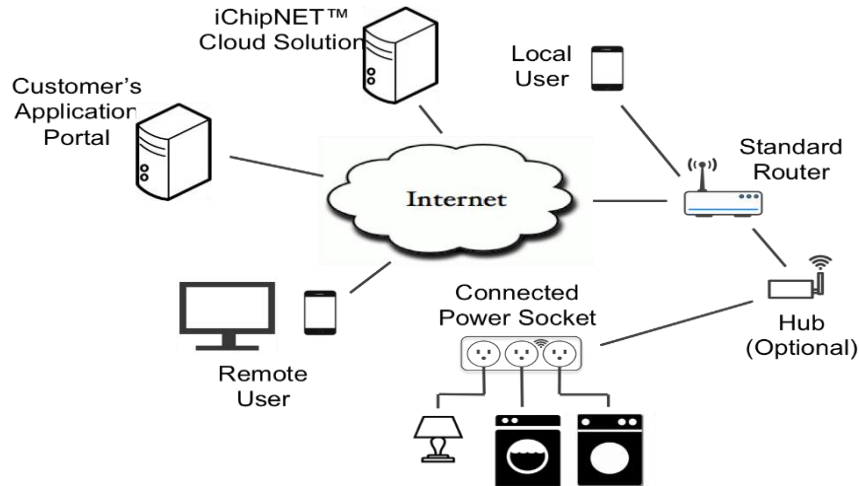
Figure 2.1: IoT-overall-block-diagram

These devices collect useful data with the help of various existing technologies and then autonomously flow the data between other devices. A growing number of physical objects are being connected to the Internet at an unprecedented rate realizing the idea of the Internet of Things (IoT).A basic example of such objects includes thermostats and HVAC (Heating, Ventilation, and Air Conditioning) monitoring and control systems that enables smart homes. There are also other domains and environments in which the IoT can play a remarkable role and improve the quality of our lives. These applications include transportation, healthcare, industrial automation, and emergency response.

The IoT offers a great market opportunity for equipment manufacturers, Internet service providers and application developers. The IoT smart objects are expected to reach 212 billion entities deployed globally by the end of 2020. By 2022, M2M traffic flows are expected to constitute up to 45%of the whole Internet traffic. Beyond these predictions, McKinsey Global Institute reported that the number of connected machines (units) has grown 300% over the last 5 years. Traffic monitoring of a cellular network in the U.S. also showed an increase of 250% for M2M traffic volume in 2011 .Economic growth of IoT-based services is also considerable for businesses. Healthcare and manufacturing applications are projected to form the biggest economic impact. Healthcare applications and related IoT-based services such as mobile health (m-Health) and telecare that enable medical wellness, prevention, diagnosis, treatment and monitoring services to be delivered efficiently through electronic media are expected to create out $1.1–$2.5 trillion in growth annually by the global economy by 2025. The whole annual

economic impact caused by the IoT is estimated to be in range of $2.7 trillion to $6.2 trillion by 2025 .The projected market share of dominant IoT applications. On the other hand, Wikibon predicts that the value created from the industrial Internet to be about $1279 billion in 2020 with Return on Investment (ROI) growing to 149% compared to 13% in 2012 .Moreover, Navigant recently reported that the Building Automation Systems (BAS) market is expected to rise from $58.1 billion in 2013 to reach $100.8 billion by 2021; a 60% increase. All these statistics, however, point to a potentially significant and fast-pace growth of the IoT in the near future, related industries and services. This progression provides a unique opportunity for traditional equipment and appliance manufacturers to transform their products into "smart things." Spreading the IoT and related services globally requires Internet Service Providers (ISPs) to provision their networks to provide QoS for a mix of M2M, person-to machine (P2M) and person-to-person (P2P) traffic flows.
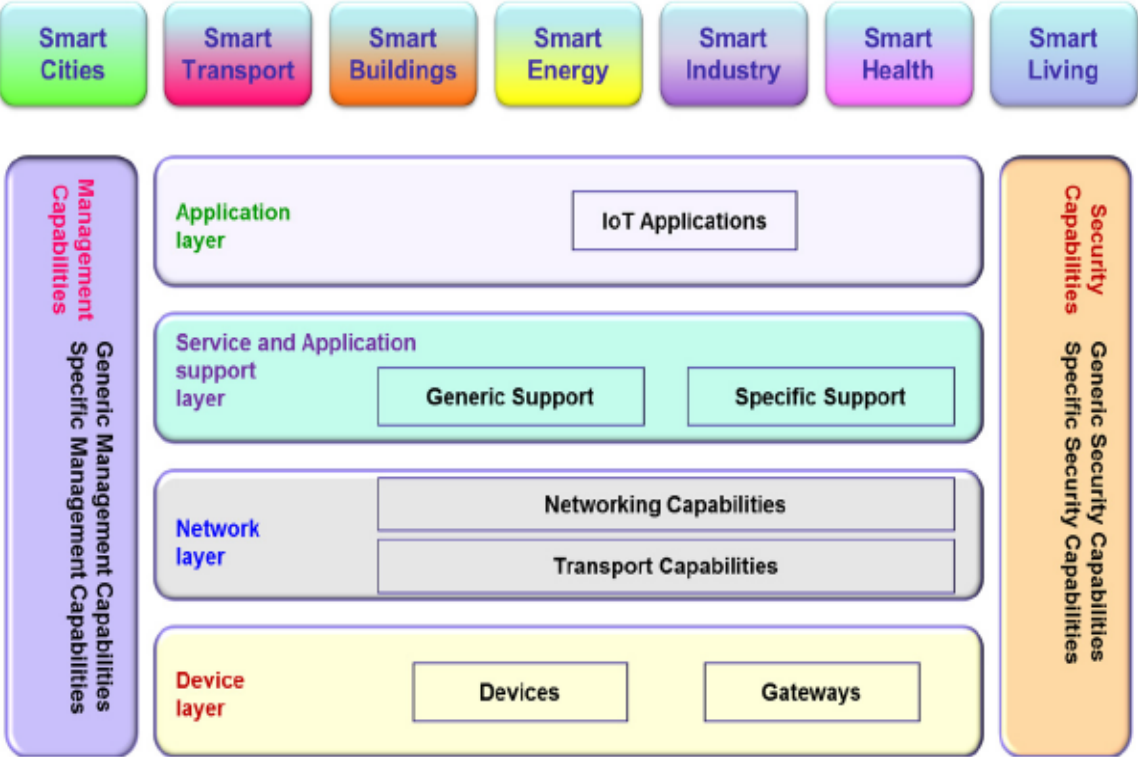
2.2 Layers of IoT

Figure 2.2: IoT Layered Architecture[5]

A.Objects Layer

The first layer, the Objects (devices) or perception layer, represents the physical sensors of the IoT that aim to collect and process information. This layer includes sensors and actuators to perform different functionalities such as querying location, temperature, weight, motion, vibration, acceleration, humidity, etc. Standardized plug-and-play mechanisms need to be used by the perception layer to configure heterogeneous objects. The perception layer digitizes and transfers data to the Object Abstraction layer through secure channels. The big data created by the IoT are initiated at this layer.

B. Object Abstraction Layer

Object Abstraction transfers data produced by the Objects layer to the Service Management layer through secure channels. Data can be transferred through various technologies such as RFID, 3G, GSM, UMTS, Wi-Fi, Bluetooth Low Energy, infrared, ZigBee, etc. Furthermore, other functions like cloud computing and data management processes are handled at this layer.

C. Service Management Layer

Service Management or Middleware (pairing) layer pairs a service with its requester based on addresses and names. This layer enables the IoT application programmers to work with heterogeneous objects without consideration to a specific hardware platform. Also, this layer processes received data, makes decisions, and delivers the required services over the network Wire protocol.

D. Application Layer

The application layer provides the services requested by customers. For instance, the application layer can provide temperature and air humidity measurements to the customer who asks for that data. The importance of this layer for the IoT is that it has the ability to provide high-quality smart services to meet customers' needs. The application layer covers numerous vertical markets such as smart home, smart building, transportation, industrial automation and smart healthcare.

E. Business Layer

The business (management) layer manages the overall IoT system activities and services. The responsibilities of this layer are to build a business model, graphs, flowcharts, etc. based on the received data from the Application layer. It is also supposed to design, analyze, implement, evaluate, monitor, and develop IoT system related elements. The Business Layer makes it possible to support decision-making processes based on Big Data analysis. In addition,

monitoring and management of the underlying four layers —is achieved at this layer. Moreover, this layer compares the output of each layer with the expected output to enhance services and maintain users' privacy.

2.3 Applications of IoT

- **Smart home**

Smart Home has become the revolutionary ladder of success in the residential spaces and it is predicted Smart homes will become as common as smartphones. Smart Home clearly stands out, ranking as highest Internet of Things application on all measured channels. More than 60,000 people currently search for the term "Smart Home" each month. This is not a surprise. The IoT Analytics company database for Smart Home includes 256 companies and startups. More companies are active in smart home than any other application in the field of IT.

- **Smart city**

Smart city is another powerful application of IoT generating curiosity among world's population. Smart surveillance, automated transportation, smarter energy management systems, water distribution, urban security and environmental monitoring all are examples of internet of things applications for smart cities. Smart city spans a wide variety of use cases, from traffic management to water distribution, to waste management, urban security and environmental monitoring. Its popularity is fueled by the fact that many Smart City solutions promise to alleviate real pains of people living in cities these days. IoT solutions in the area of Smart City solve traffic congestion problems, reduce noise and pollution and help make cities safer.

- **Smart grids**

Smart grids is a special one. A future smart grid promises to use information about the behaviors of electricity suppliers and consumers in an automated fashion to improve the efficiency, reliability, and economics of electricity. 41,000 monthly Google searches high lights the concept's popularity. However, the lack of tweets (Just 100 per month) shows that people don't have much to say about it.

- **Wearables**

Wearable devices are installed with sensors and software which collect data and information about the users. This data is later pre-processed to extract essential insights about user. These devices broadly cover fitness, health and entertainment requirements. The pre-requisite from internet of things technology for wearable applications is to be highly energy efficient or ultra-low power and small sized

Wearables remains a hot topic too. As consumers await the release of Apple's new smart watch in April 2015, there are plenty of other wearable innovations to be excited about: like the Sony Smart B Trainer, the Mayo gesture control, or Look-see bracelet. Of all the IoT startups, wearables maker Jawbone is probably the one with the biggest funding to date. It stands at more than half a billion dollars!

- **Industrial internet**

Industrial Internet is the new buzz in the industrial sector, also termed as Industrial Internet of Things (IIOT). It is empowering industrial engineering with sensors, software and big data analytics to create brilliant machines. The industrial internet is also one of the special Internet of Things applications. While many market researches such as Gartner or Cisco see the industrial internet as the IoT concept with the highest overall potential, its popularity currently doesn't reach the masses like smart home or wearables do. The industrial internet however has a lot going for it.

IIOT holds great potential for quality control and sustainability. Applications for tracking goods, real time information exchange about inventory among suppliers and retailers and automated delivery will increase the supply chain efficiency. According to GE the improvement industry productivity will generate $10 trillion to $15 trillion in GDP worldwide over next 15 years.

- **Smart supply chain**

Supply chains have been getting smarter for some years already. Solutions for tracking goods while they are on the road, or getting suppliers to exchange inventory information have been on the market for years. So while it is perfectly logic that the topic will get a new push with the Internet of Things, it seems that so far its popularity remains limited.

- **Smart farming**

Smart farming is an often overlooked business-case for the internet of Things because it does not really fit into the well-known categories such as health, mobility, or industrial. However, due to

the remoteness of farming operations and the large number of livestock that could be monitored the Internet of Things could revolutionize the way farmers work. But this idea has not yet reached large-scale attention. Nevertheless, one of the Internet of Things applications that should not be underestimated. Smart farming will become the important application field in the predominantly agricultural-product exporting countries.

- **Smart retail**

Proximity-based advertising as a subset of smart retail is starting to take off. But the popularity ranking shows that it is still a niche segment. One LinkedIn post per month is nothing compared to 430 for smart home.

- **Connected car**

A connected car is a vehicle which is able to optimize its own operation, maintenance as well as comfort of passengers using onboard sensors and internet connectivity. The connected car is coming up slowly. Owing to the fact that the development cycles in the automotive industry typically take 2-4 years, we haven't seen much buzz around the connected car yet. But it seems we are getting there. Most large auto makers as well as some brave startups are working on connected car solutions. And if the BMWs and Fords of this world don't present the next generation internet connected car soon, other well-known giants will: Google, Microsoft, and Apple have all announced connected car platforms.

- **Connected Health**

Connected health remains the sleeping giant of the Internet of Things applications. The concept of a connected health care system and smart medical devices bears enormous potential (see our analysis of market segments), not just for companies also for the well-being of people in general. Yet, Connected Health has not reached the masses yet. Prominent use cases and large-scale startup successes are still to be seen. Might 2015 bring the breakthrough?

- **IoT in Poultry**

Livestock monitoring is about animal husbandry and cost saving. Using IoT applications to gather data about the health and wellbeing of the cattle, ranchers knowing early about the sick animal can pull out and help prevent large number of sick cattle.

Energy Engagement

Power grids of the future will not only be smart enough but also highly reliable. Smart grid concept is becoming very popular all over world.

Chapter 3
Home Automation

3.1 introduction

The "Home Automation" concept has existed for many years. The terms "Smart Home", "Intelligent Home" followed and has been used to introduce the concept of networking appliances and devices in the house. Home automation Systems (HASs) represents a great research opportunity in creating new fields in engineering, and computing. HASs includes centralized control of lighting, appliances, security locks of gates and doors and other systems, to provide improved comfort, energy efficiency and security system. HASs becoming popular nowadays and enter quickly in this emerging market. However, end users, especially the disabled and elderly due to their complexity and cost, do not always accept these systems. Imagine how helpful it will be to be able to switch on your air conditioning system ten minutes before you get home on a hot afternoon in January. How about having a security system that will detect smoke, excessive electrical power usage, burglar attempts and unauthorized movements in your house and alert you? This is what home automation is about and there is no end to its application. Home automation has made it possible to have what is often referred to as a 'smart home', a home that can detect and identify you, automatically adjust the lighting to your predefined taste, open doors automatically, play your favorite music, water your flowers in the morning, switch on the security lights at night and switch them off in the morning, heat water for bathe and tea, stream to you anywhere in the world via the internet a live video of what is happening in and around your house. It makes it possible to link lighting, entertainment, security, telecommunications, heating, and air conditioning into one centrally controlled system. This allows you to make your house an active partner in managing your busy life.

3.2 Description of Home Automation

Home automation is becoming more and more popular day by day due to its numerous advantages. This can be achieved by local networking or by remote control. Our Aim is to design a kit that can be used for controlling AC Loads from Android phone. Home automation refers to the use of computer and information technology to control home Appliances and features (such as windows or lighting). Systems can range from simple remote control of lighting through to complex computer/micro-controller based networks with varying degrees of intelligence and automation. Home automation is adopted for reasons of ease, security and energy efficiency.

In modern construction in industrialized nations, most homes have been wired for electrical power, telephones, TV outlets (cable or antenna), and a doorbell. Many household tasks were automated by the development of specialized Appliances. For instance, automatic washing machines were developed to reduce the manual labor of cleaning clothes, and water heaters reduced the labor necessary for bathing. Home automation or domotics[6] is building automation for a home, called a smart home or smart house. It involves the control and automation of lighting, heating (such as smart thermostats), ventilation, air conditioning (HVAC), and security, as well as home appliances such as washer/dryers, ovens or refrigerators/freezers. Wi-Fi is often used for remote monitoring and control. Home devices, when remotely monitored and controlled via the Internet, are an important constituent of the Internet of Things. Modern systems generally consist of switches and sensors connected to a central hub sometimes called a "gateway" from which the system is controlled with a user interface that is interacted either with a wall-mounted terminal, mobile phone software, tablet computer or a web interface, often but not always via Internet cloud services. The home automation market was worth US$5.77 billion in 2013, predicted to reach a market value of US$12.81 billion by the year 2020.[7]

3.3 Advantages of Home Automation

1. Security

Tap your finger to turn on the lights when you get home so you worried about what's hiding in the shadows, or in your pathways. Door locks are another automated home product that can increase your home security. If you worried that the kids didn't lock the doors before they ran off to play or that someone will discover your not-so-secret hiding place for the extra key then take control of your home safety from a simple app. With some products, you can even get an alert every time someone enters your home.

2. Energy Efficiency

Increase your home's energy efficiency by remotely powering off systems and appliances when they aren't in use. In addition to the standard home automation products that give you active control, some products actively monitor systems and arm the homeowner with knowledge, insight and guidance to achieve greater control and energy efficiency.

3. Savings

Home automation literally pays off. When you are able to use home systems and appliances only when needed, the savings will be apparent in the first utility bill. No more wasting money on lights left on when you aren't home, or spending money on gas to drive home because you forgot to lock the door. Monetary savings are apparent, but you'll also be saving time. No wasted trips home, no running through the house turning everything off, no time spent worrying about what was or wasn't turned off.

4. Convenience

Don't you hate having to rely on neighbors to watch your house when you're gone? With home automation, convenient control of your home is at your fingertips. You don't have to trust someone else with your most valued possessions.

5. Comfort

Ever leave for work in the morning when it was a comfortable 68° outside only to come home to a sweltering house because the temperature shot up to 90°? Connected home products like the Sensi™ Wi-Fi Thermostats let you conveniently adjust your home temperature from the mobile app so your family is always comfortable.

Chapter 4

Working Principle

4.1 circuit design

Relay is a switch and it control the microcontroller for switching on and off. 5 volt 1 Amp current is needed for the relay to turn on. At first when we turn the switch on the high side part of relay is carrying power but lower side part does not carry any power thus low side voltage is zero. From the high side part the power is passing through switch towards light, fan or other devices. So the low side is just controlling and connecting server and the high side is connecting the nodes. And this low side is working as switch basically. For applying power we have to connect one wire to Vdc and other to Vcc micro ohm and the last one is for giving input voltage and when the input voltage is high, the switch turned on and when the input voltage is low, the switch turned off. So server actually serves the power.

In this project the main device controller is ESP 8266 driver board. We have used ESP 8266 Wi-Fi module but it is attached upon the ESP 8266 driver board. Thus the circuit is compressed and the device is simple because the more the device is simple the more it will be efficient. We have used ESP 8266 Wi-Fi module which works for interfacing the Wi-Fi or internet connection to device. When we are install the code, the ESP 8266 driver board controls the code by connecting with server. When we are connecting the server and switching the devices on then the server connects with internet protocol system and then it connects with Wi-Fi. The user device and the device that is going to be controlled must be connected with Wi-Fi. The power of adopter is 12 volt 2 amp. We use 8266 Wi-Fi module for connect the system with internet. We use also 8266 driver board with microcontroller 3 pin voltage regulator 7805 use for the relay and microcontroller. Voltage regulator regulates the voltage that means it minimize the voltage and make the power constant. There are many types of voltage regulator but here we have used this voltage regulator because it returns 5 volt 1 amp current and that's what we need for our switch.
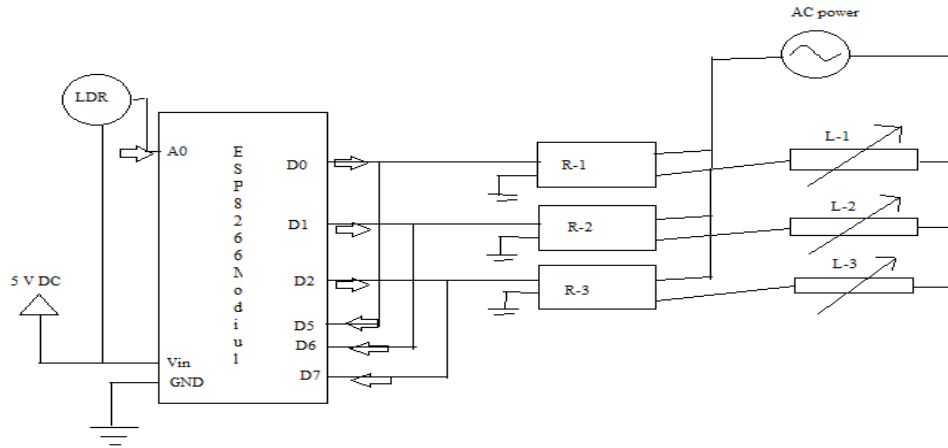
Figure 4.1: circuit design of the project

Waste of electricity is one of the main problems which we are facing now a days. In our home, school, college or industry we see that fan light we kept on even if there are nobody or there is no need. The main concept behind the project is known as device controller like as light.

4.2 Fl ow chart
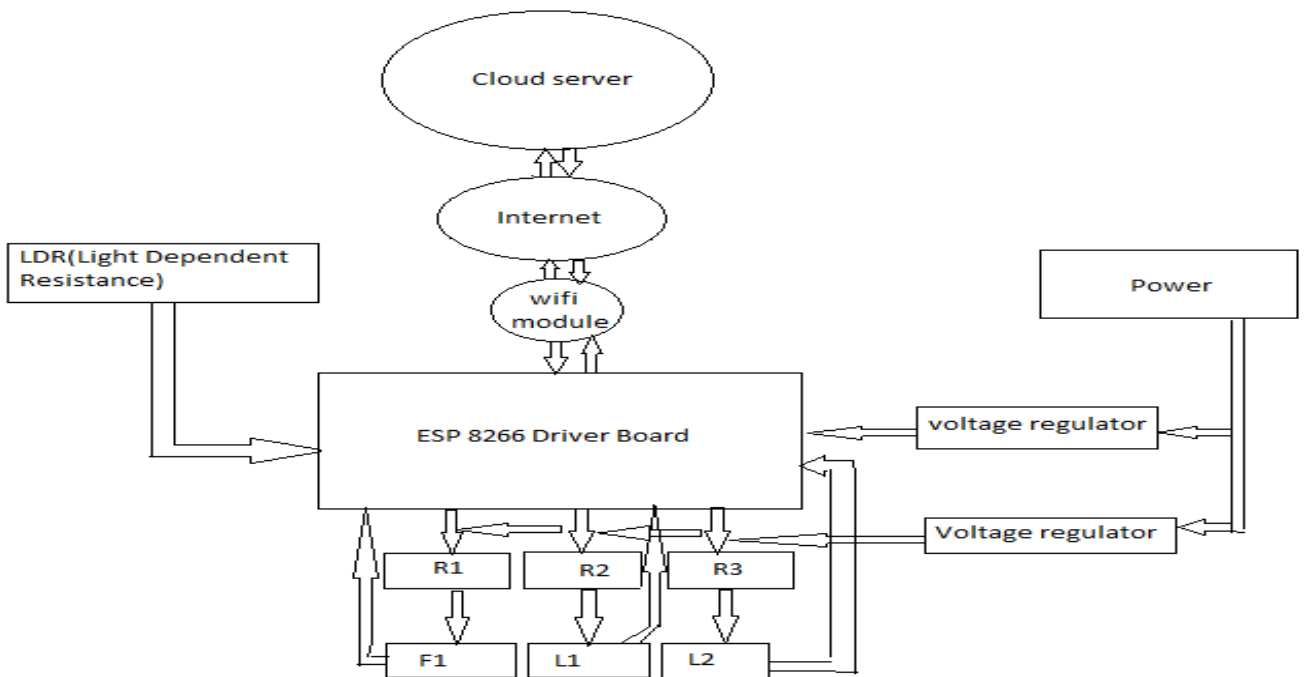
Figure 4.2: flow chart of the project

4.3 Hardware design

The hardware design shows the figure of our proposed project. At first the adapter supplies power to the circuit. We have a 8266 ESP driver board in our circuit which works as microcontroller.

Then we have a Wi-Fi module attached on the microcontroller board. We also have voltage regulator to stable the current and voltage and this fixed value is 5 volt.so that the microcontroller keeps protected from burning. We have also used a LDR (Light Dependent Resistor) which is a sensor having the behavior of inversely proportional to light and resistivity.
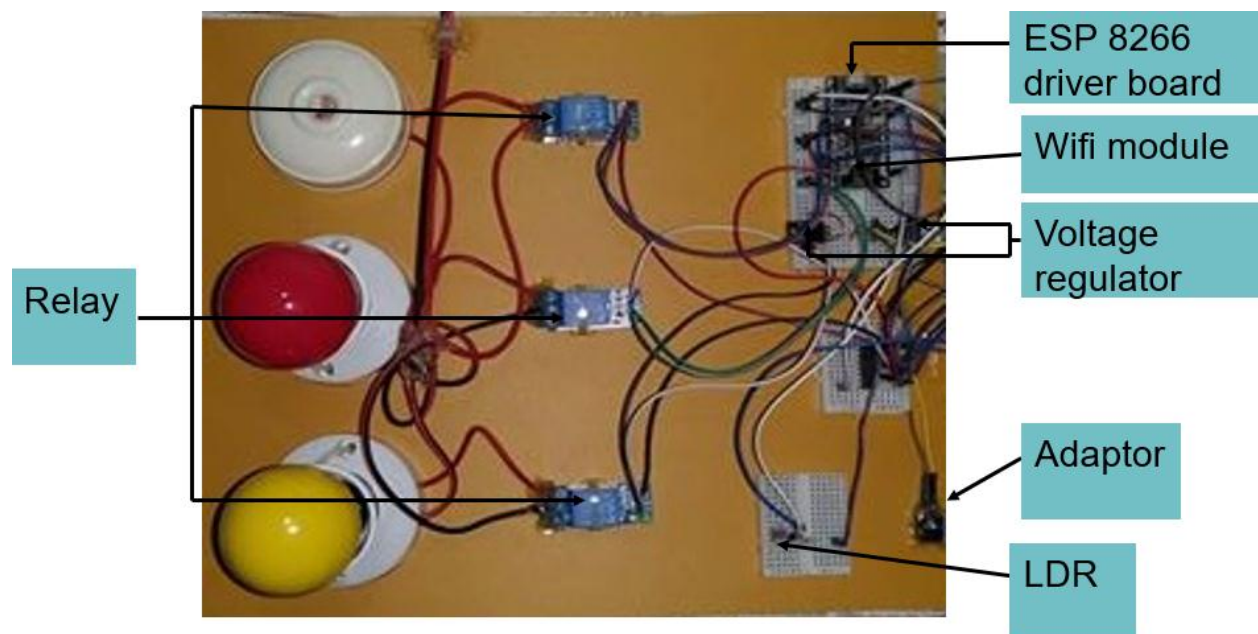
Figure 4.3: hardware design of the project

Chapter 5
Description of hardware

5.1. Microcontroller

5.1.1 Introduction

The main component in our system is the microcontroller. A microcontroller is a small computer on a single integrated circuit. In modern terminology, it is a system on a chip or SoC. A micro controller is also known as embedded controller. A microcontroller contains one or more CPUs (processor cores) along with memory and programmable input/output peripherals. Program memory in the form of Ferroelectric RAM, NOR flash or OTP ROM is also often included on chip, as well as a small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers other general purpose applications consisting of various discrete chips.

Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, toys and other embedded systems.

Figure 5.1: ESP 8266 driver board

By reducing the size and cost compared to a design that uses a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to digitally control even more devices and processes. Mixed signal microcontrollers are common, integrating analog components needed to control non-digital electronic systems. Microcontrollers used in a wide number of electronic systems such as: Engine management systems in automobiles, Keyboard of a PC, Electronic measurement instruments (e.g., digital mustimeters, frequency synthesizers, and oscilloscopes), Printers, Motor controls, Security systems, Cordless and cellular phones, Televisions, radios, CD players, tape recording equipment, Hearing aids, Security alarm systems, fire alarm systems, and building services systems, Microwave ovens, Handheld tools, Remote control devices many, many more.
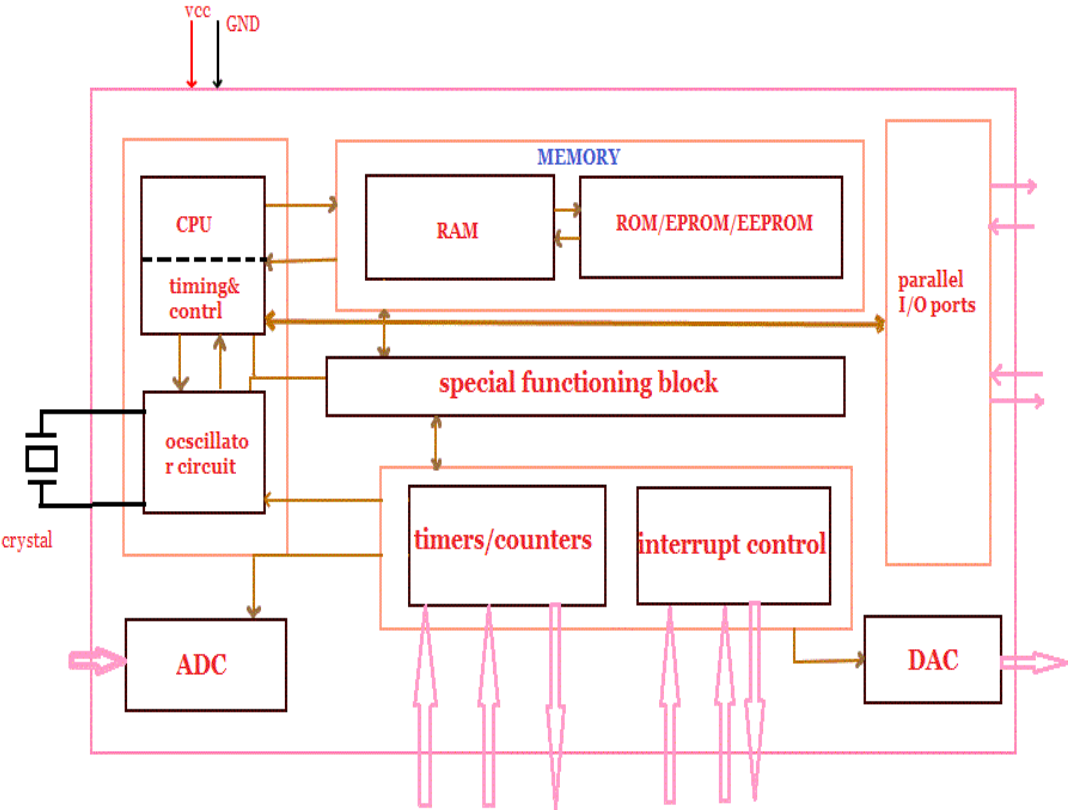
5.1.2 Basic Structure of Microcontroller

Figure 5.2: Structure of Microcontroller

• CPU – Microcontrollers brain is named as CPU. CPU is the device which is employed to fetch data, decode it and at the end complete the assigned task successfully. With the help of CPU all the components of microcontroller is connected into a single system. Instruction fetched by the programmable memory is decoded by the CPU.

• Memory – In a microcontroller memory chip works same as **microprocessor**. Memory chip stores all programs & data. Microcontrollers are built with certain amount of ROM or RAM (EPROM, EEPROM, etc) or flash memory for the storage of program source codes.

• Input/output ports – I/O ports are basically employed to interface or drive different appliances such as- printers, LCD's, LED's, etc.

• Serial Ports – These ports give serial interfaces amid microcontroller & various other peripherals such as parallel port.

• Timers – A microcontroller may be in-built with one or more timer or counters. The timers & counters control all counting & timing operations within a microcontroller. Timers are employed to count external pulses. The main operations performed by timers' are- pulse generations, clock functions, frequency measuring, modulations, making oscillations, etc.

• ADC (Analog to digital converter) – ADC is employed to convert analog signals to digital ones. The input signals need to be analog for ADC. The digital signal production can be employed for different digital applications (such as- measurement gadgets).

• DAC (digital to analog converter) – this converter executes opposite functions that ADC perform. This device is generally employed to supervise analog appliances like- DC motors, etc.

• Interpret Control- This controller is employed for giving delayed control for a working program. This interpret can be internal or external.

• Special Functioning Block – Some special microcontrollers manufactured for special appliances like- space systems, robots, etc, comprise of this special function block. This special block has additional ports so as to carry out some special operations.

5.1.3 Advantage of Microcontroller

- Small
- Portable
- no computer required
- programmable logic
- vast range of applications
- cheap

5.1.4 Disadvantage of Microcontroller

- limited by ADC
- limited processing power
- no data storage

5.1.5 Applications of Microcontroller

Microcontrollers are mostly used in following electronic equipment:

- Mobile Phones
- Auto Mobiles
- CD/DVD Players
- Washing Machines
- Cameras
- In Computers-> Modems and Keyboard Controllers
- Security Alarms
- Electronic Measurement Instruments.
- Microwave Oven.

5.1.6 Pin Diagram
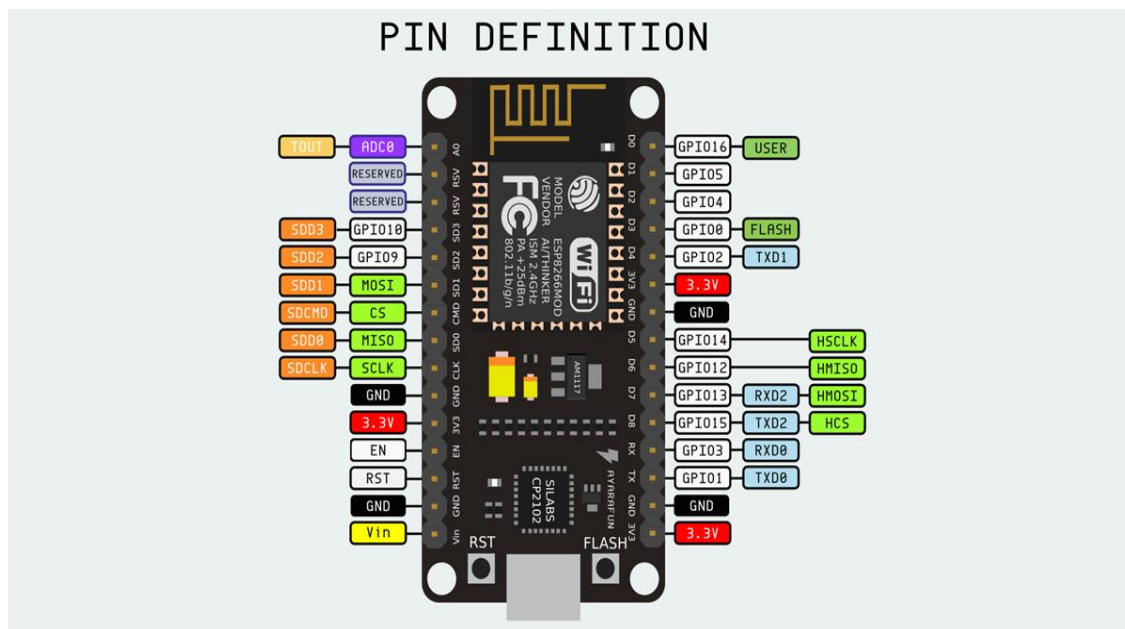
Figure 5.3: Pin Diagram of Microcontroller

5.1.7 Pin Definition

Name	Type	Function
VCC	P	Power 3.0 ~ 3.6V
GND	P	Ground
RESET	I	External reset signal (Low voltage level: Active)
ADC(TOUT)	I	ADC Pin Analog Input 0 ~ 1V
CH_PD	I	Chip Enable. High: On, chip works properly; Low: Off, small current
GPIO0(FLASH)	I/O	General purpose IO, If low while reset/power on takes chip into serial programming mode
GPIO1(TX)	I/O	General purpose IO and Serial TXd
GPIO3(RX)	I/O	General purpose IO and Serial RXd
GPIO4	I/O	General purpose IO
GPIO5	I/O	General purpose IO

GPIO12	I/O	General purpose IO
GPIO13	I/O	General purpose IO
GPIO14	I/O	General purpose IO
GPIO15(HSPI_CS)	I/O	General purpose IO, Connect this pin to ground through 1KOhm resistor to boot from internal flash.

5.2 ESP 8266 Wi-Fi module

5.2.1. Introduction

The ESP8266 Wi-Fi Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your Arduino device and get about as much Wi-Fi ability as a Wi-Fi Shield offers. The ESP8266 module is an extremely cost effective board with a huge, and ever growing, community.

This module has a powerful enough on-board processing and storage capability that allows it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime. Its high degree of on-chip integration allows for minimal external circuitry, including the front-end module, is designed to occupy minimal PCB area. The ESP8266 supports APSD for VoIP applications and Bluetooth co-existence interfaces, it contains a self-calibrated RF allowing it to work under all operating conditions, and requires no external RF parts.

There is an almost limitless fountain of information available for the ESP8266, all of which has been provided by amazing community support. In the *Documents* section below you will find many resources to aid you in using the ESP8266, even instructions on how to transforming this module into an IoT (Internet of Things) solution.

5.2.2. Overview of ESP 8266 Wi-Fi module

- **High Level of Integration**

ESP8266EX is among the most integrated Wi-Fi chips in the industry. Measuring just 5mm x 5mm, ESP8266EX requires minimal external circuitry and integrates a 32-bit Tensilica MCU, standard digital peripheral interfaces, antenna switches, RF balun, power amplifier, low noise receive amplifier, filters and power management modules - all in one small package.

- **32-bit Tensilica MCU**

ESP 8266EX integrates Tensilica L106 32-bit micro controller (MCU) which features extra low power consumption and 16-bit RSIC,reaching a maximum clock speed of 160 MHz. With the Real Time Operation System (RTOS) enabled and Wi-Fi stack functional, about 80% of the processing power is still available for user application programming and development.

- **Low Power Management**

Engineered for mobile devices, wearable electronics and the Internet of Things (IoT) applications, ESP8266EX achieves low power consumption with a combination of several proprietary technologies. The power saving architecture features three modes of operation -active mode, sleep mode and deep sleep mode, thus allowing battery-powered designs to run longer.

- **Robust Design**

Featuring the widest operating temperature range of -40°C to +125°C in the industry, ESP8266EX is capable of functioning in industrial environments. With highly integrated on-chip features and minimal external discrete component count, the chip offers reliability, compactness and robustness critical in end products.
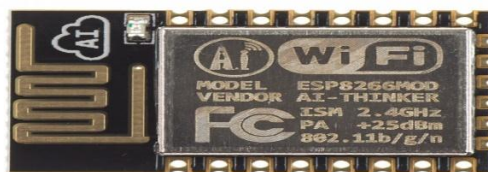
Figure 5.4: ESP8266 Wi-Fi module

5.3 Relay

5.3.1 Introduction

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits as amplifiers: they repeated the signal coming in from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations.

A type of relay that can handle the high power required to directly control an electric motor or other loads is called a contactor. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called "protective relays".

Figure 5.5: Solid State Relay

Magnetic latching relays require one pulse of coil power to move their contacts in one direction, and another, redirected pulse to move them back. Repeated pulses from the same input have no effect. Magnetic latching relays are useful in applications where interrupted power should not be able to transition the contacts.

Magnetic latching relays can have either single or dual coils. On a single coil device, the relay will operate in one direction when power is applied with one polarity, and will reset when the

polarity is reversed. On a dual coil device, when polarized voltage is applied to the reset coil the contacts will transition. AC controlled magnetic latch relays have single coils that employ steering diodes to differentiate between operate and reset commands.

Figure 5.6: Magnetic Relay

5.3.2 Application of relay

Relays are used wherever it is necessary to control a high power or high voltage circuit with a low power circuit, especially when galvanic isolation is desirable. The first application of relays was in long telegraph lines, where the weak signal received at an intermediate station could control a contact, regenerating the signal for further transmission. High-voltage or high-current devices can be controlled with small, low voltage wiring and pilots switches. Operators can be isolated from the high voltage circuit. Low power devices such as microprocessors can drive relays to control electrical loads beyond their direct drive capability. In an automobile, a starter relay allows the high current of the cranking motor to be controlled with small wiring and contacts in the ignition key.

# Chapter 6
Description of software

6.1 Arduino IDE

6.1.1 Introduction to Arduino

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board. Arduino has been used in thousands of different projects and applications. The Arduino software is easy-to-use for beginners, yet flexible enough for advanced users. It runs on Mac, Windows, and Linux. Arduino also simplifies the process of working with microcontrollers. Arduino boards are relatively inexpensive compared to other microcontroller platforms. The Arduino Software (IDE) runs on Windows, Macintosh OSX, and Linux operating systems. Most microcontroller systems are limited to Windows. The Arduino software is published as open source tools, available for extension by experienced programmers. The language can be expanded through C++ libraries, and people wanting to understand the technical details can make the leap from Arduino to the AVR C programming language on which it's based. Similarly, you can add AVR-C code directly into your Arduino programs if you want to.

The origin of the Arduino project started at the Interaction Design Institute Ivrea (IDII) in Ivrea, Italy. At that time, the students used a BASIC Stamp microcontroller at a cost of $100, a considerable expense for many students. In 2003 Hernando Barragán created the development platform *Wiring* as a Master's thesis project at IDII, under the supervision of Massimo Banzi and Casey Reas, and then In 2003, Massimo Banzi, with David Mellis, another IDII student, and David Cuartielles, added support for the cheaper ATmega8 microcontroller to Wiring. But instead of continuing the work on Wiring, they forked the project and renamed it Arduino.

6.1.2 What is it used for

The Arduino Integrated Development Environment or Arduino Software (IDE) hat runs on your computer, used to write and upload computer code to the physical board. Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension .ino. It is an open-source project, software/hardware is extremely accessible and very flexible to be customized and extended. It is flexible, offers a variety of digital and analog inputs, *SPI* and serial interface and digital and *PWM* outputs. It is easy to use, connects to computer via USB and communicates using standard serial protocol, runs in standalone mode and as interface connected to PC/Macintosh computers. It is inexpensive, around 30 euro per board and comes with free authoring software. Arduino is backed up by a growing online community, lots of source code is already available and we can share and post our examples for others to use. Arduino is a great tool for developing interactive objects, taking inputs from a variety of switches or sensors and controlling a variety of lights, motors and other outputs. Arduino projects can be stand-alone or they can be connected to a computer using USB. The Arduino will be seen by the computer as a standard serial interface. There is serial communication APIs on most programming languages so interfacing Arduino with a software program running on the computer should be pretty straightforward. Using the IDE the program we wrote is converted to C language. This process produce binary code with the microcontroller on the Arduino board will be able to understand and execute. When the Arduino board is connected to a computer using the USB cable, by using the IDE we are able to compile and upload to the board the program.
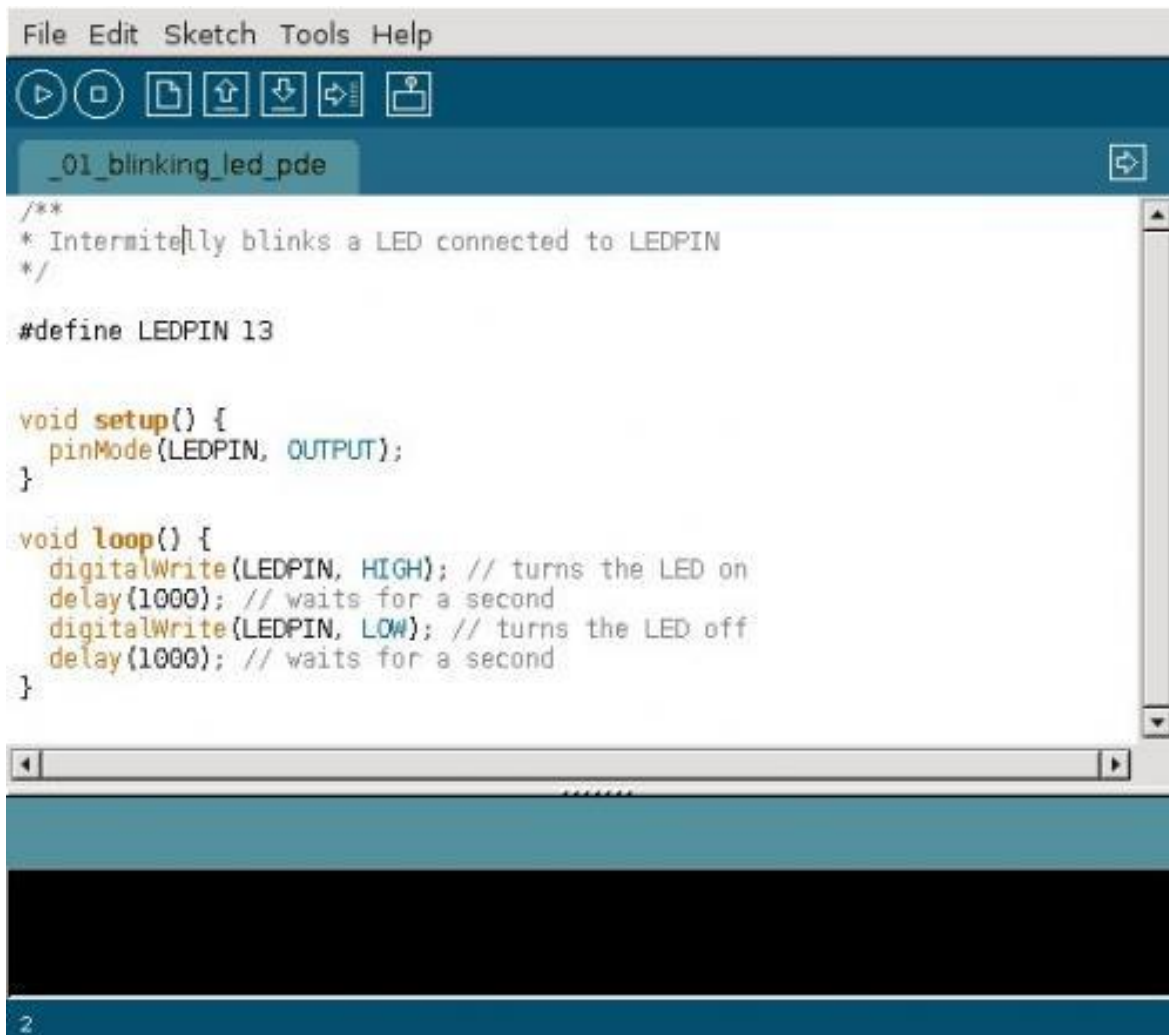
Figure 6.1: Arduino IDE

Arduino is a embedded prototype device which can be easily programmed without having much knowledge on electronics. One can make many DIY (Do it yourself) experiments on referring online tutorials. Microprocessor knowledge or embedded C knowledge is not required. Arduino gives intelligence to your circuit or your design. It can take input from sensors, understand the data and do assigned tasks. As simple example: Street lights Use a light sensor to detect the intensity of light and give it to Arduino. Arduino is programmed to understand the light intensity, If it is darker outside it turns on the street light, If it is lighter it turns off to save power. Arduino is a microcontroller which do **n** number of

programs which are written in **C** language. Uses are many, Arduino has digital and analog pin on the board. We have many Shields which can be attached to the board. E.g. you can write program for banking of led alternatively.

6.1.3 Programming environment of Arduino IDE

Arduino IDE contains all the software which will run a computer in order to program and communicate with an Arduino board. The Arduino IDE contains an editor which we can use to write sketches (that's the name of Arduino programs) in a simple programming language modeled after the Processing language. Using the IDE the program we wrote is converted to C language and then compiled using avr-gcc. This process produce binary code which the microcontroller on the Arduino board will be able to understand and execute. Arduino IDE contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them. Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension .ino. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom righthand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor. Additional commands are found within the five menus: File, Edit, Sketch, Tools, Help. The menus are context sensitive, which means only those items relevant to the work currently being carried out are available.

File

- New

Creates a new instance of the editor, with the bare minimum structure of a sketch already in place.
- Open

Allows to load a sketch file browsing through the computer drives and folders.

- Recent

Provides a short list of the most recent sketches, ready to be opened.

- Sketchbook

Shows the current sketches within the sketchbook folder structure; clicking on any name opens the corresponding sketch in a new editor instance.

- Examples

Any example provided by the Arduino Software (IDE) or library shows up in this menu item. All the examples are structured in a tree that allows easy access by topic or library.

- Close

Closes the instance of the Arduino Software from which it is clicked.

- Save

Saves the sketch with the current name. If the file hasn't been named before, a name will be provided in a "Save as.." window.

- Save   as...

Allows to save the current sketch with a different name.

- Page   Setup

It shows the Page Setup window for printing.

- Print

Sends the current sketch to the printer according to the settings defined in Page Setup.

- Preferences

Opens the Preferences window where some settings of the IDE may be customized, as the language of the IDE interface.

- Quit

Closes all IDE windows. The same sketches open when Quit was chosen will be automatically reopened the next time you start the IDE.

Edit

- Undo/Redo

Goes back of one or more steps you did while editing; when you go back, you may go forward with Redo.

- Cut

Removes the selected text from the editor and places it into the clipboard.

- Copy

Duplicates the selected text in the editor and places it into the clipboard.

- Copy for Forum

Copies the code of your sketch to the clipboard in a form suitable for posting to the forum, complete with syntax coloring.

- Copy as HTML

Copies the code of your sketch to the clipboard as HTML, suitable for embedding in web pages.

- Paste

Puts the contents of the clipboard at the cursor position, in the editor.

- Select All

Selects and highlights the whole content of the editor.

- Comment/Uncomment

Puts or removes the // comment marker at the beginning of each selected line.

- Increase/Decrease Indent

Adds or subtracts a space at the beginning of each selected line, moving the text one space on the right or eliminating a space at the beginning.

- Find

Opens the Find and Replace window where you can specify text to search inside the current sketch according to several options.

- Find Next

Highlights the next occurrence - if any - of the string specified as the search item in the Find window, relative to the cursor position.

- Find Previous

Highlights the previous occurrence - if any - of the string specified as the search item in the Find window relative to the cursor position.

Sketch

Verify/Compile

Checks your sketch for errors compiling it; it will report memory usage for code and variables in the console area.

- Upload

Compiles and loads the binary file onto the configured board through the configured Port.

- Upload   Using   Programmer

This will overwrite the bootloader on the board; you will need to use Tools > Burn Bootloader to restore it and be able to Upload to USB serial port again. However, it allows you to use the full capacity of the Flash memory for your sketch. Please note that this command will NOT burn the fuses. To do so a Tools -> Burn Bootloader command must be executed.

- Export   Compiled   Binary

Saves a .hex file that may be kept as archive or sent to the board using other tools.

- Show   Sketch   Folder

Opens the current sketch folder.

- Include   Library

Adds a library to your sketch by inserting #include statements at the start of your code. For more details, see libraries below. Additionally, from this menu item you can access the Library Manager and import new libraries from .zip files.

- Add   File...

Adds a source file to the sketch (it will be copied from its current location). The new file appears in a new tab in the sketch window. Files can be removed from the sketch using the tab menu accessible clicking on the small triangle icon below the serial monitor one on the right side o the toolbar.

Tools

- Auto   Format

This formats your code nicely: i.e. indents it so that opening and closing curly braces line up, and that the statements inside curly braces are indented more.

- Archive   Sketch

Archives a copy of the current sketch in .zip format. The archive is placed in the same directory as the sketch.

- Fix   Encoding   &   Reload

Fixes possible discrepancies between the editor char map encoding and other operating systems char maps.

- Serial   Monitor

Opens the serial monitor window and initiates the exchange of data with any connected board on the currently selected Port. This usually resets the board, if the board supports Reset over serial port opening.

- Board

Select the board that you're using. See below for descriptions of the various boards.

- Port

This menu contains all the serial devices (real or virtual) on your machine. It should automatically refresh every time you open the top-level tools menu.

- Programmer

For selecting a hardware programmer when programming a board or chip and not using the onboard USB-serial connection. Normally you won't need this, but if you're burning a bootloader to a new microcontroller, you will use this.

- Burn   Bootloader

The items in this menu allow you to burn a bootloader onto the microcontroller on an Arduino board. This is not required for normal use of an Arduino or Genuino board but is useful if you purchase a new ATmega microcontroller (which normally come without a bootloader). Ensure that you've selected the correct board from the Boards menu before burning the bootloader on the target board. This command also set the right fuses.

Help

Here you find easy access to a number of documents that come with the Arduino Software (IDE). You have access to Getting Started, Reference, this guide to the IDE and other documents locally, without an internet connection. The documents are a local copy of the online ones and may link back to our online website.

6.2 Cloud server

6.2.1 Introduction to cloud server

A server that is built, hosted and delivered through a cloud computing platform over the Internet. Cloud servers possess and exhibit similar capabilities and functionality to a typical server but are accessed remotely from a cloud service provider. A cloud server may also be called a virtual server or virtual private sever. Technically a cloud server is primarily an Infrastructure as a Service (IaaS) based cloud service model. There are two types of cloud server: logical and physical. A cloud server is considered to be logical when it is delivered through server virtualization. In this delivery model, the physical server is logically distributed into two or more logical servers, each of which has a separate OS, user interface and apps, although they share physical components from the underlying physical server. Whereas the physical cloud server is also accessed through the Internet remotely, it isn't shared or distributed. This is commonly known as a dedicated cloud server. The idea of an "intergalactic computer network" was introduced in the sixties by J.C.R. Licklider, who was responsible for enabling the development of ARPANET (Advanced Research Projects Agency Network) in 1969. His vision was for everyone on the globe to be interconnected and accessing programs and data at any site, from anywhere, explained Margaret Lewis, product marketing director at AMD. "It is a vision that sounds a lot like what we are calling cloud computing. One of the first milestones in cloud computing history was the arrival of Salesforce.com in 1999, which pioneered the concept of delivering enterprise applications via a simple website. The next development was Amazon Web Services in 2002, which provided a suite of cloud-based services including storage, computation and even human intelligence through the Amazon Mechanical Turk. Then in 2006, Amazon launched its Elastic Compute cloud (EC2) as a commercial web service that allows small companies and individuals to rent computers on which to run their own computer applications. In 2009, Google and others started to offer browser-based enterprise applications, though services such as Google Apps.

6.2.2   Traditional Server Vs Cloud Server

Traditionally there are two main options for hosting; shared hosting and dedicated hosting.

Shared Hosting

The cheaper option, as servers are shared between the hosting provider's clients (e.g. one client's website will be hosted on the same server as those of other clients). Suitable for small enterprises, where the required capacity is relatively low. Setup is inflexible and cannot cope with a large amount of traffic.

Dedicated Hosting

A much more advanced form of hosting, whereby clients purchase whole physical servers. The entire server is dedicated to one client, with no one else sharing it. In some instances, a client may utilise multiple servers which are all dedicated to their use. Allows for full control over hosting. Capacity needs to be predicted, with enough resource and processing power to cope with expected traffic levels. If this is underestimated it can lead to a lack of necessary resource during busy periods, while overestimating will mean paying for unnecessary capacity.

Cloud Hosting

Clients get the best of both worlds: resource can be scaled up or scaled down accordingly, making it more flexible and, therefore, more cost-effective. When there is more demand placed on the servers, capacity can be automatically increased to match demand without needing to be paid for on a permanent basis. Cloud servers can run on a hypervisor. The role of a hypervisor is to control the capacity of operating systems so it is allocated where needed. There are multiple cloud servers which are available to each particular client. This allows computing resource to be dedicated to a client if and when it is necessary additional capacity is temporarily accessed when required, and then removed when no longer needed. Cloud servers offer more redundancy if one server fails, others will take its place.

Chapter 7
Result and Discussion

7.1 Result

The system allows the user to control appliances in their home or other places from a smart phones and PC from anywhere in the world through an internet connection. It also allows the user to control their units within their home from a wireless remote. After the successful connection to the server, the data of sensor are sent to the web server for monitoring of the system. The web server page will allow us to monitor and control the system. By entering the assigned IP address in the web browser this web server page will appear.
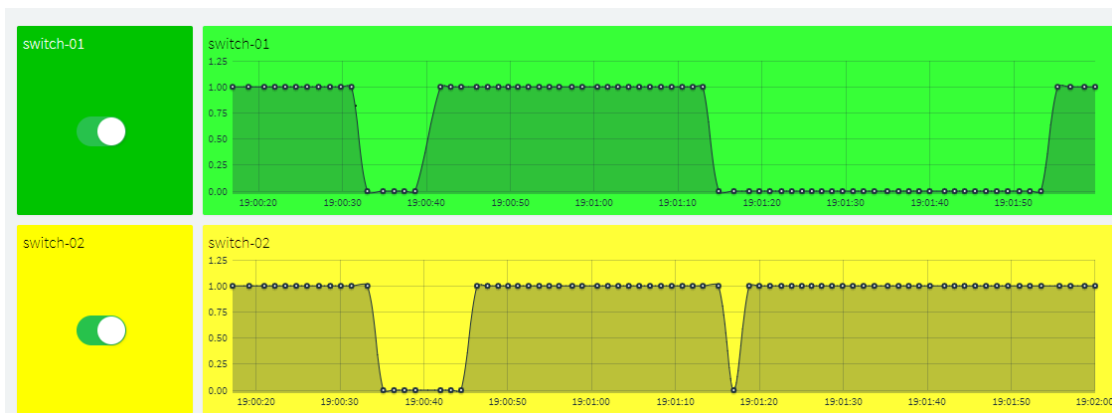

**Figure 7.1: Observation when switches are on**

Figure 7.2: Observation when switches are off

It also gives the status of the various electrical appliances like light, fan etc. which we can control remotely. We can also observe the time record. Figure 1 shows us the data shown in the server when all switches are on. In this figure we can see the graph has increased when time is 19:01:50. Figure 1 shows us the data shown in the server when all switches are off. In figure 2 we can see the graph has decreased when time is 19:02:00. We can see the time record of past 1 week.

The web server gives the information about the darkness in different places of the house. When lights fall on the sensor the graph decreases and when light stays away from the sensor the graph increases. Figure 3 shows the result when lights fall on the sensor and figure 4 shows the result when lights are away from the sensor.
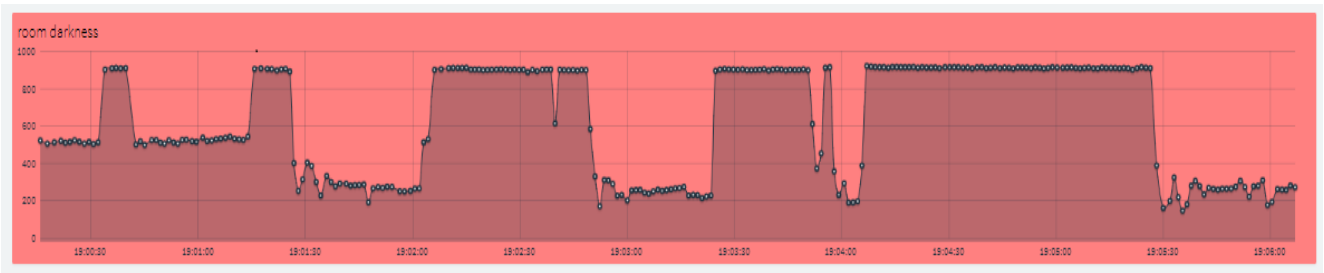
Figure 7.3: Observation when light fall on sensor
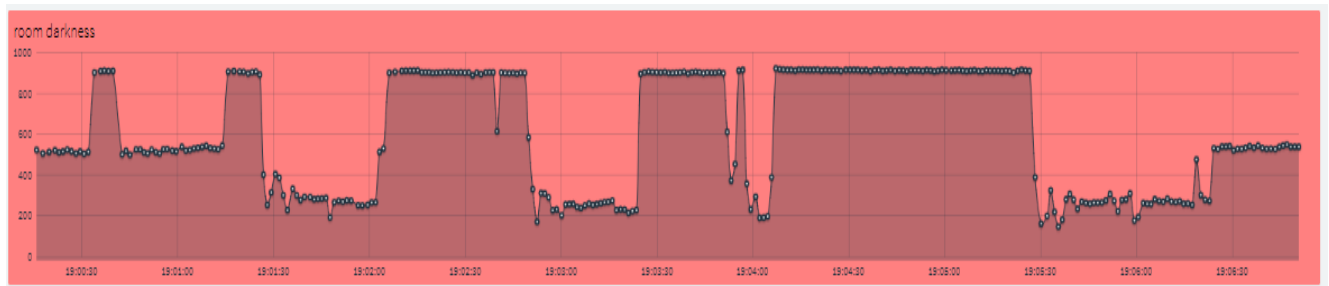
Figure 7.4: Observation when light is away from sensor

All the required data is stored in the cloud. The stored data can be analyzed at anytime and anywhere. This shows the darkness at different time intervals. The web server also shows a graph of the analysis of the darkness at different time. By seeing the graph we can come to know the change in the darkness. And at what time the darkness was low/ high.

7.2 Suggestion for future work

By demonstrating the prototype to numbers of users, issues emerged from the evaluation and feedback. One of the big problem is the infrared learning process is still difficult to normal users. The system should provide more flexible feature to let users set up there. There are still many opportunities to take advantage of current technologies to build more user-friendly platforms for appliances controlling.

This work attempts to propose a new approach for Home Appliances Controlling Environment, and will improve user experience by enhancing two main aspects: Compatibility Support products from different models, brands. Especially for existing old appliances. Usability Help users control appliances based on environment and activity, providing more possibility for automation. Smart appliances should not only be connectable and controllable by smartphones, but also be part of a user centered controlling environment. This environment should allow easy configuration and control of appliances based on their need. In this work, a scientific study was conducted; technology trends and related works were evaluated to seek new possibilities in appliance control. The expected results of the study are to verify the concept of activity based universal controlling environment and through the implementation and evaluation, provide a feasible model for related systems and products.

Security system improvement

In these papers we proposed a technique that will give us best result. Which include prediction by providing notifications to the user if problem occurs in any device. First of all we collect different sensor values and analyses it with the help of microcontroller. We can monitor and control it with pc or any android device connected to it. If problem found in any device we notify owner and the related technician about the problem. Thus we can provide a better security system.

Controlling vehicles

In future we can control vehicles with this project. User can park car or other vehicles remotely without their presence. They can also control multiple vehicles in the meantime.

Digital health care

Suppose a person left his/her sick parent at home. So he/she will be tensed for his/her parent.if a machine is attached to the sick person to read the heartbeat then in future we can develop such a feature that can give the user the data of sick persons health.

Smart city

We can develop a smart city in future where applications are developed to manage urban flows and allow for real-time responses.[8] A smart city may therefore be more prepared to respond to challenges than one with a simple "transactional" relationship with its citizens.[9]

Soldier protection

We can develop a voice control drone so that the soldier could be safe.

Chapter 8
Conclusion

The home automation using Internet of Things has been experimentally proven to work satisfactorily by connecting simple appliances to it and the appliances were successfully controlled remotely through internet. It also stores the sensor parameters in the cloud (Gmail) in a timely manner. This will help the user to analyze the condition of various parameters in the home any time anywhere. A Smart Home system integrates electrical devices in a house with each other. The techniques which are going to use in home automation include those in building automation as well as the control of domestic activities, such as TV, fan, electric, tubes. Our system not only just monitors environmental conditions but it acts according to inhabitant requirement. In this paper we are planning to eliminate most of the human interaction by providing intelligent system. Development of such Smart Home achieve by using Internet of Things technologies. By using these system we can actually manage to make low cost, flexible smart homes to adjust its environmental conditions and resolve its errors with energy saving. Home fixtures (i.e. lights, fans) are maintained and controlled by remote control system so physically handicapped persons can easily control home fixtures through remote control. S/he will not depend on other person for controlling those fixtures. If there are no persons in home, the lights and fans are turned off automatically. So we can reduce our power consumption. We monitor power consumption of the system through computer software. This feature will help us to estimate our electricity bill. By connecting with sensor technology and other web services, appliances controlling could become more user-friendly and enjoyable. There are also many limitations in the proposed design. However those limitations serve as a reminder to carefully consider the structure of our system, and give additional insights for future research. The relationship between users' activities and the environment needs to be studied further. With The proposed platform, more and more sensors can be connected and streamed data to the internet. Therefore not only appliances but also many more The approach discussed in the paper is novel and has achieved the target to control appliances remotely using the Wi-Fi technology to connects system parts, satisfying user needs and requirements. Wi-Fi

technology capable solution has proved to be controlled remotely, provide home security and is cost-effective as compared to the previously existing systems. Hence we can conclude that the required goals and objectives of automation system have been achieving. The system design and architecture were discussed, and prototype presents the basic level of appliance control and remote monitoring has been implemented. Finally, the proposed system is better from the scalability and flexibility point of view than the commercially available automation systems. Services will be involved in the future.

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9. Dept. Business(2013) Page 7 "As consumers of private goods and services we have been empowered by the Web and, as citizens, we expect the same quality from our public services. In turn, public authorities are seeking to reduce costs and raise performance by adopting similar approaches in the delivery of public services. However, the concept of a Smart City goes way beyond the transactional relationships between citizen and service provider. It is essentially enabling and encouraging the citizen to become a more active and participative member of the community"

APPENDIX

Programming code of this project

```
#include <ESP8266WiFi.h>
#include <ThingerWifi.h>

#define USERNAME "mehedi"
#define DEVICE_ID "control"
#define DEVICE_CREDENTIAL "controlsystem"

#define SSID "shaibal"
#define SSID_PASSWORD "55555555"

ThingerWifi thing(USERNAME, DEVICE_ID, DEVICE_CREDENTIAL);

void setup() {
 pinMode(16, OUTPUT);
 pinMode(5, OUTPUT);
 pinMode(4, OUTPUT);

 pinMode(14, INPUT);
 pinMode(12, INPUT);
 pinMode(13, INPUT);
 pinMode(0, INPUT);

 thing.add_wifi(SSID, SSID_PASSWORD);
 thing["led1"] << digitalPin(16);
 thing["led2"] << digitalPin(5);
```

```
  thing["led3"] << digitalPin(4);


 thing["count1"] >> outputValue(digitalRead(14));
 thing["count2"] >> outputValue(digitalRead(12));
 thing["count3"] >> outputValue(digitalRead(13));
 thing["count4"] >> outputValue(analogRead(0));
 }


void loop() {
 thing.handle();
}
```