East West University

IoT (Internet of Things) Home Automation

Presented by
Fazlay Rabbi Talukder
ID: 2014-1-53-023

Md. Kobir Hosan
ID: 2013-2-50-016

Faisal Ahamed
ID: 2014-2-50-003

Supervised by
Dr. Nahid A. Jahan
Associate professor
Department of Electronics and Communications Engineering(ECE)
East West University

This Project submitted in partial fulfillment of the Requirement for the Degree of Bachelors of Science in B.Sc. in Electronics and Communication Engineering (ECE)

To the

Department of Electronics and Communication Engineering (ECE)
East West University
Dhaka, Bangladesh

Declaration

We, hereby, declare that the work presented in this Project is the outcome of the investigation performed by me under the supervision of Dr. Nahid. Akhter Jahan**,** Associate Professor, Department of Electronics and Communication Engineering (ECE), East West University. We also declare that no part of this Project has been or is being submitted else where for the award of any degree or diploma.

……...
Dr. Nahid Akhter Jahan
Supervisor
Department of ECE
East West University

……..
Fazlay Rabbi Talukder
2014-1-53-023
Department of ECE
East West University

……..
Md. Kobir Hosan
2013-2-50-016
Department of ECE
East West University

……..
Faisal Ahamed
2014-2-50-003
Department of ECE
East West University

Acknowledgements

First we are grateful to almighty Allah for blessing me with such opportunity of learning and ability to successfully complete the task.
A special thanks with honor to our supervisor Dr. Nahid. A. Jahan who was kind enough to allocate his valuable time provide us with is humble guidance motivating thought and encouragement.

……..
Fazlay Rabbi Talukder
2014-1-53-023
Department of ECE
East West University

……..
Md. Kobir Hosan
2013-2-50-016
Department of ECE
East West University

……..
Faisal Ahamed
2014-2-50-003
Department of ECE
East West University

Acceptance

This research report presented to the department of Electronics and Communication Engineering. East West University submitted to partial fulfillment to the requirement for the degree of B.Sc in Electronics and Communications Engineering under complete supervision of the undersigned.

Supervisor:

……..

Dr. Nahid Akhter Jahan
Associate Professor
Department of Electronics and Communications Engineering (ECE)
East West University

Chairperson:

……

Dr. M. Mofazzal Hossain
Professor
Department of Electronics and Communications Engineering (ECE)
East West University

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. 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

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 theswitchboard 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 toturn on/off a light or fan at their own might be difficult to perform, and s/he may have tobe 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 theroom 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, automobiles with built-in sensors.

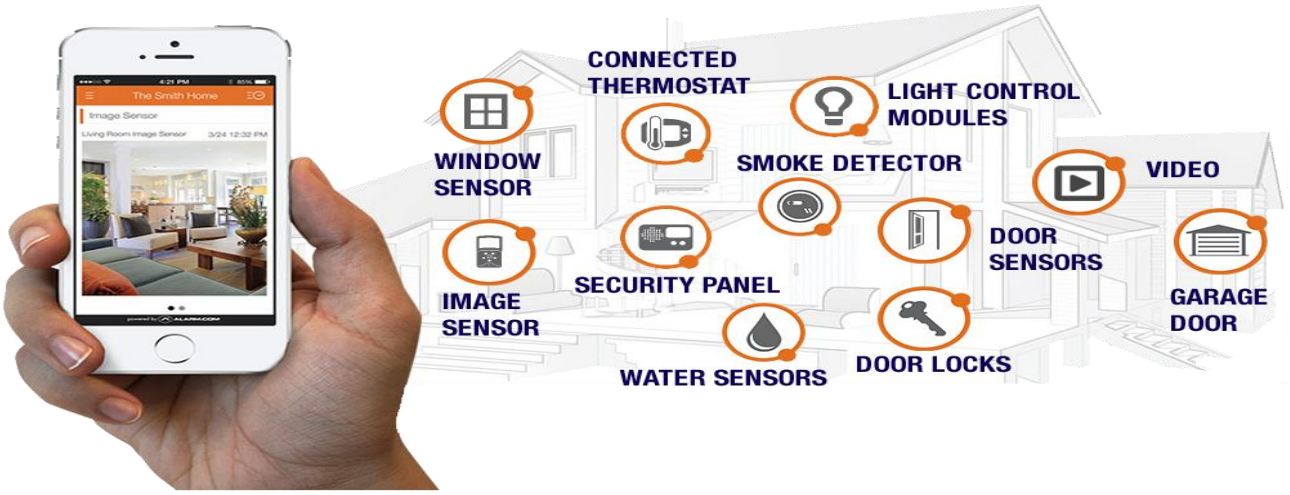

Figure: Emerging trends IoT based home automation

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 tele care 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 amix of M2M, person-to machine (P2M) and person-to-person (P2P) traffic flows.

2.2 Layers of IoT

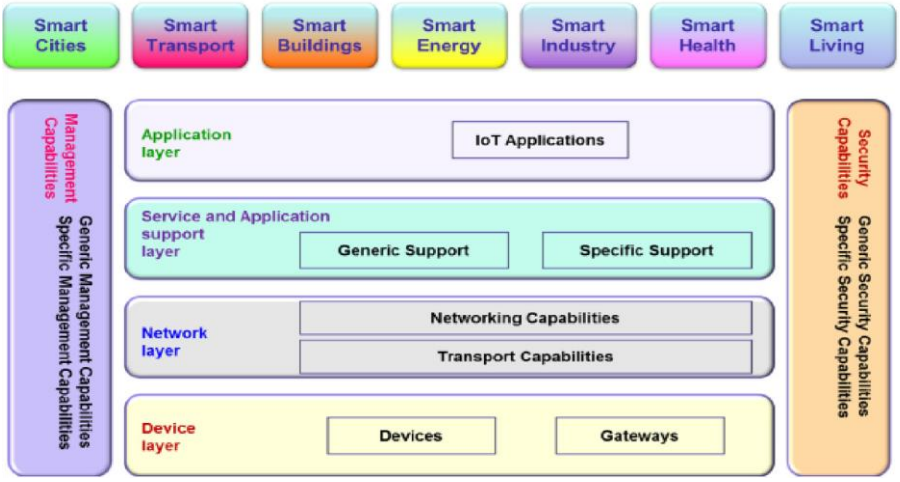

Figure: IoT Layered Architecture

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 IoTsystem 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's 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

Wearable's 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 Myo gesture control, or Look-see bracelet. Of all the IoT startups, wearable's 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 wearable's 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. The basic idea behind the smart grids is to collect data in an automated fashion and analyze the behavior or electricity consumers and suppliers for improving efficiency as well as economics of electricity use. Smart Grids will also be able to detect sources of power outages more quickly and at individual household levels like nearby solar panel, making possible distributed energy system.

- **IoT in agriculture**

With the continuous increase in world's population, demand for food supply is extremely raised. Governments are helping farmers to use advanced techniques and research to increase food production. Smart farming is one of the fastest growing field in IoT.

Farmers are using meaningful insights from the data to yield better return on investment. Sensing for soil moisture and nutrients, controlling water usage for plant growth and determining custom fertilizer are some simple uses of IoT.

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 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

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.

6. Peace of Mind

One of the biggest hidden benefits that comes with home automation is peace of mind. No more worrying if you turned of the lights, locked the door or turned off the television. For people who have a lot on their plates, being able to easily check these items off the to-do list and stop the obsessive worrying, home automation is reassuring and definitely worth the investment.

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 WiFi 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.

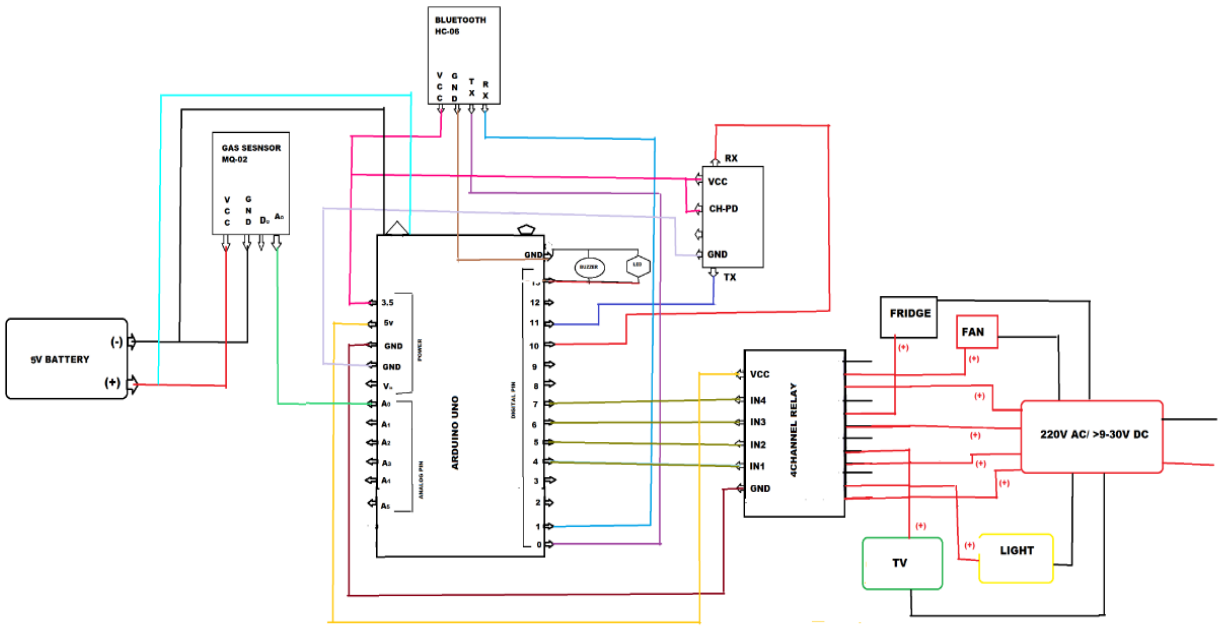

Figure**:** Block circuit diagram design of the project

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 Flow chart

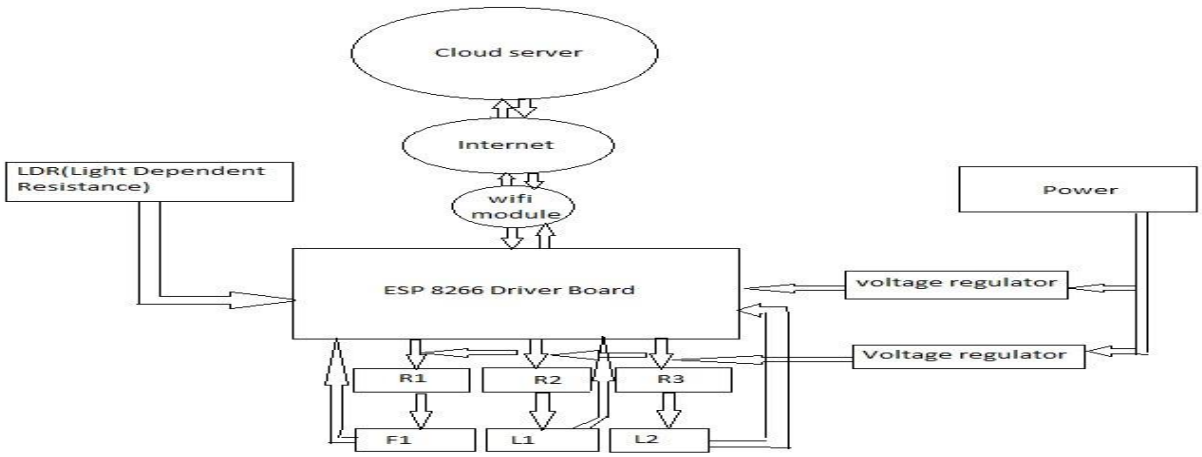

Figure: flow chart of the project

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: 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. 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 nondigital 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.

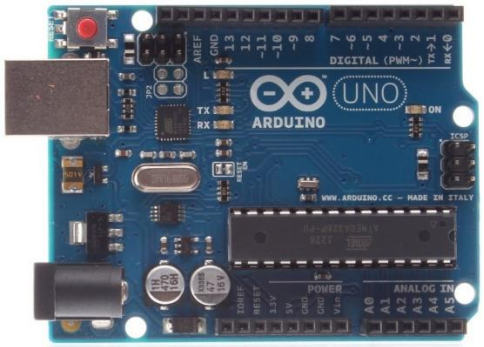

Figure 5.1: Microcontroller driver board

5.1.2 Basic structure of Microcontroller

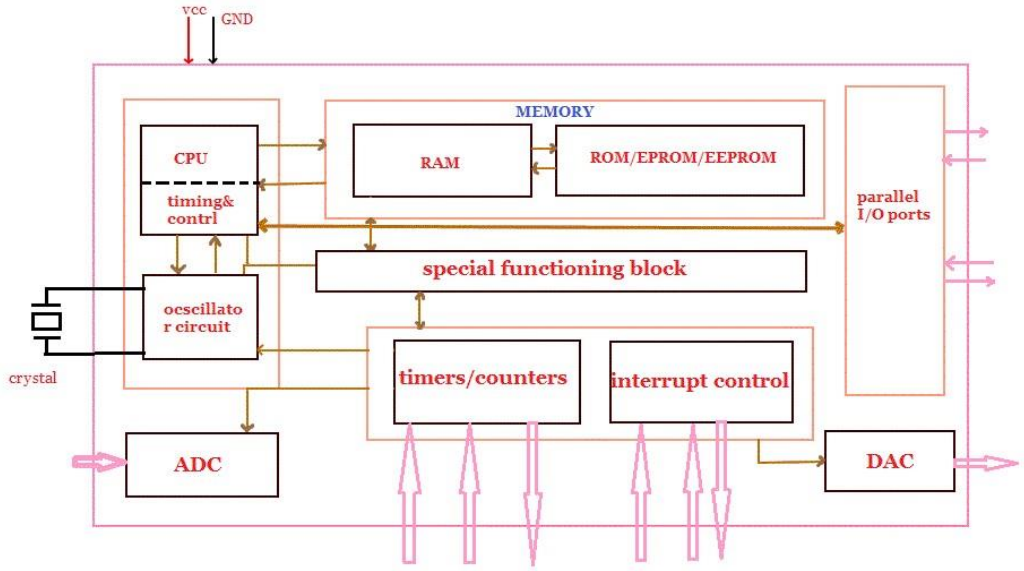

Figure 5.2: Structure of Microcontroller

- 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. Thisinterpret 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.

5.1.3Advantage 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

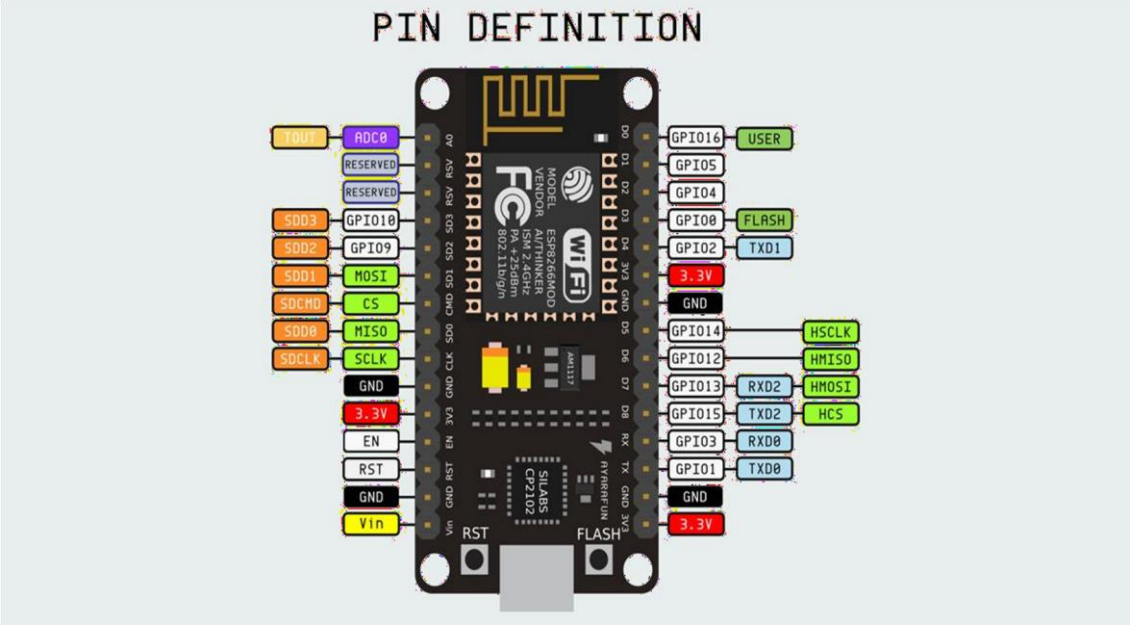

Figure 5.3: Pin Diagram of Microcontroller

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**

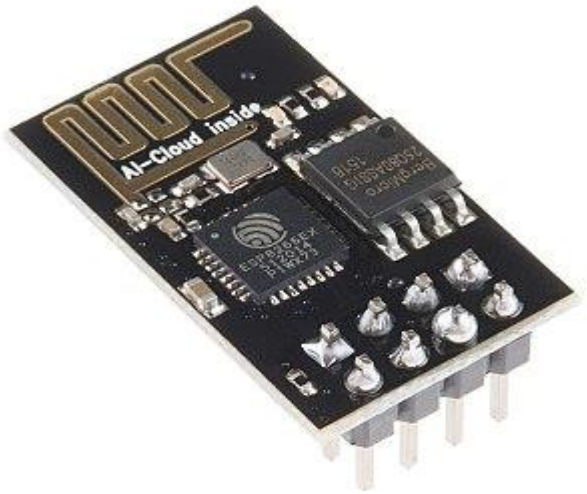

Figure 5.4: ESP8266 Wi-Fi module

ESP 8266EX integrates Ten silica 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.

5.3 Relay

5.3.1Introduction

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 retransmitted 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 AVRC 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. Arduinoprojects 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.

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.

```
 if (readData=="relay2")
 {
val2=digitalRead(Relay2);
 if(val2==0)
 {
 digitalWrite(Relay2,HIGH);
 val2=1;
 }
 else
{
 digitalWrite(Relay2,LOW);
 val2=0;
 }
 delay(200);
 }

if (readData=="relay3")
 {
 val3=digitalRead(Relay3);
 if(val3==0)
 {
 digitalWrite(Relay3,HIGH);
 val3=1;
 }
 else
{
 digitalWrite(Relay3,LOW);
val3=0;
val3=0;
 }
 delay(200);
 }
 if (readData=="relay4")
 {
 val4=digitalRead(Relay4);
 if(val4==0)
 {
  digitalWrite(Relay4,HIGH);
 val4=1;
  }
  else
  {
 digitalWrite(Relay4,LOW);
 val4=0;
  }
  delay(200);
  }
 readData="";
  }

 }
```

Figure: Program from Bluetooth control screenshot-1

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 Processinglanguage. 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.

```
 if (readData=="relay2")
 {
val2=digitalRead(Relay2);
 if(val2==0)
 {
 digitalWrite(Relay2,HIGH);
 val2=1;
 }
 else
{
 digitalWrite(Relay2,LOW);
 val2=0;
 }
 delay(200);
 }

if (readData=="relay3")
 {
 val3=digitalRead(Relay3);
 if(val3==0)
 {
 digitalWrite(Relay3,HIGH);
 val3=1;
 }
 else
{
 digitalWrite(Relay3,LOW);
val3=0;
```

```
val3=0;
 }
 delay(200);
 }
 if (readData=="relay4")
 {
 val4=digitalRead(Relay4);
 if(val4==0)
 {
  digitalWrite(Relay4,HIGH);
 val4=1;
  }
  else
  {
 digitalWrite(Relay4,LOW);
 val4=0;
  }
  delay(200);
  }
 readData="";
  }

 }
```

Figure: Program from Bluetooth control screenshot-2

➢ 6.2 Configuration of Thing speak & Push bullet

6.2.1 Introduction to Think speak & push bullet

Thing Speak is an open data platform for the Internet of Things. Your device or application can communicate with Thing Speak using a Restful API, and you can either keep your data private, or make it public. In addition, use Thing Speak to analyze and act on your data. Thing Speak provides an online text editor to perform data analysis and visualization using MATLAB. You can also perform actions such as running regularly scheduled MATLAB code or sending a tweet when your data passes a defined threshold. Thing Speak is used for diverse applications ranging from weather data collection and analysis, to synchronizing the color of lights across the world.

At the heart of Thing Speak is a time-series database. Thing Speak provides users with free time-series data storage in channels. Each channel can include up to eight data fields. This tutorial provides an introduction to some of the applications of thing Speak, a conceptual overview of how thing Speak stores time-series data, and how MATLAB analysis is incorporated in thing Speak.

Push bullet's enables developers to build on the Push bullet infrastructure. Our goal is to provide a full API that enables anything to tap into the Push bullet network.
This is important to us because we believe everything, not just smartphones and computers, should be able to exchange information in real time. Here are some of the things you can build with Push bullet:

- Have a website and want to offer push notifications? We've built everything you need.
- Want to build a Push bullet client for a platform we don't officially support yet? Everything you need is here.
- Working on a home automation system? Push bullet can get everything chatting.
- Working with sensors and want to send messages to another device? Push bullet is just what you need.
- Manage IT/servers and want to get updates and alerts no matter where you are or what device you're using? Push bullet makes it easy.

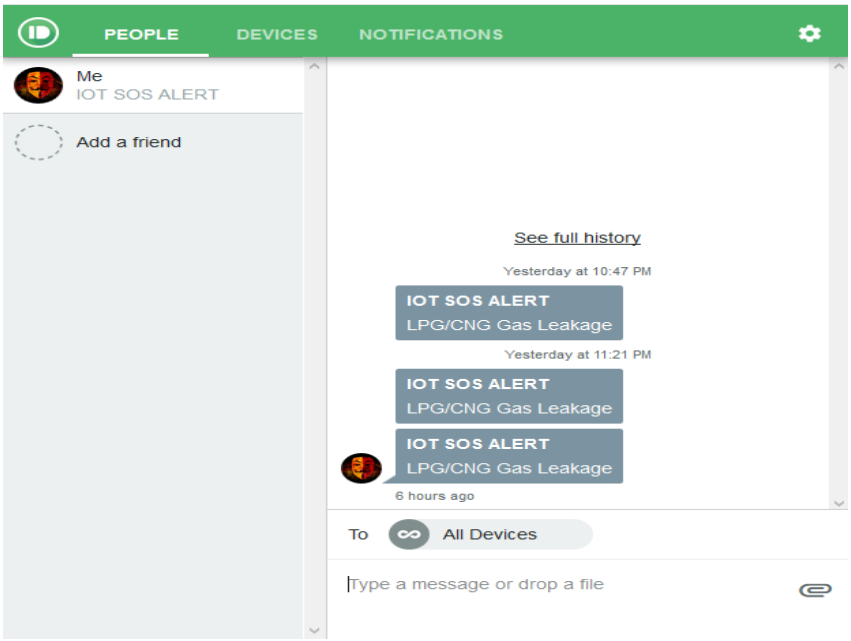

Figure: Screenshot push bullet command

6.3 Data analysis for gas ditection

The Grove - Gas Sensor(MQ2) module is useful for gas leakage detection (home and industry). It is suitable for detecting H2, LPG, CH4, CO, Alcohol, Smoke or Propane. Due to its high sensitivity and fast response time, measurement can be taken as soon as possible. The sensitivity of the sensor can be adjusted by potentiometer.

Figure: Gas Detector MQ2

The sensor value only reflects the approximated trend of gas concentration in a permissible error range, it DOES NOT represent the exact gas concentration. The detection of certain components in the air usually requires a more precise and costly instrument, which cannot be done with a single gas sensor. If your project is aimed at obtaining the gas concentration at a very precise level, then we don't recommend this gas sensor.

Item	Parameter	Min	Typical	Max	Unit
VCC	Working Voltage	4.9	5	5.1	V
PH	Heating consumption	0.5	-	800	mW
RL	Load resistance		adjustable		
RH	Heater resistance	-	33	-	Ω
Rs	Sensing Resistance	3	-	30	kΩ

Figure: Specification gas sensor mq2

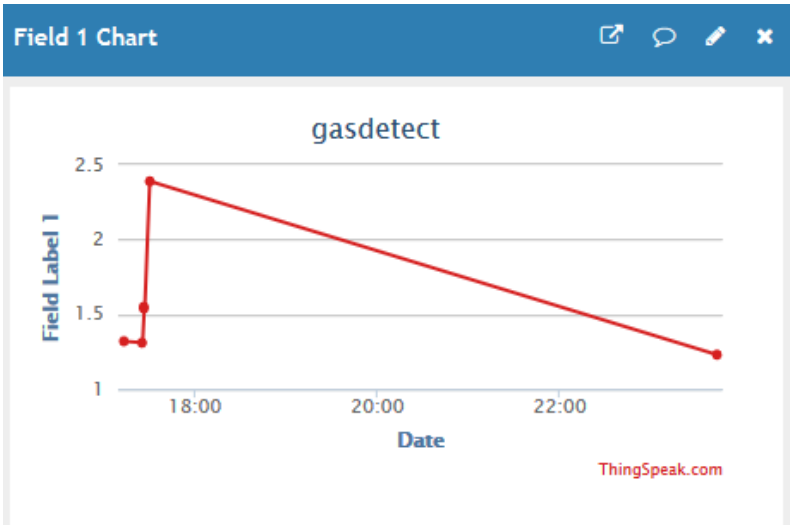

Figure: flowchart gas detector 1

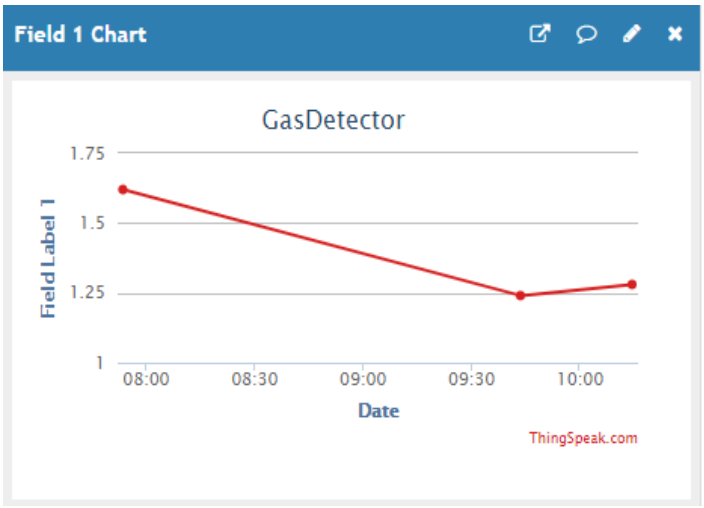

Figure: Flow chart gas detector 2

Chapter 7

Develop android application

7.1 Android

> Android is a mobile operating system developed by Google. It is based on a modified version of the Linux kernel and other open source software, and is designed primarily for touchscreen mobile devices such as smartphones and tablets. In addition, Google has further developed Android TV for televisions, Android Auto for cars, and Wear OS for wrist watches, each with a specialized user interface. Variants of Android are also used on game consoles, digital cameras, PCs and other electronics.

Android's default user interface is mainly based on direct manipulation, using touch inputs that loosely correspond to real-world actions, like swiping, tapping, pinching, and reverse pinching to manipulate on-screen objects, along with a virtual keyboard. Game controllers and full-size physical keyboards are supported via Bluetooth or USB. The response to user input is designed to be immediate and provides a fluid touch interface, often using the vibration capabilities of the device to provide haptic feedback to the user. Internal hardware, such as accelerometers, gyroscopes and proximity sensors are used by some applications to respond to additional user actions, for example adjusting the screen from portrait to landscape depending on how the device is oriented, or allowing the user to steer a vehicle in a racing game by rotating the device, simulating control of a steering wheel.

Android devices boot to the home screen, the primary navigation and information "hub" on Android devices, analogous to the desktop found on personal computers. Android home screens are typically made up of app icons and widgets; app icons launch the associated app, whereas widgets display live, auto-updating content, such as a weather forecast, the user's email inbox, or a news ticker directly on the home screen. A home screen may be made up of several pages, between which the user can swipe back and forth. Third-party apps available on Google Play and other app stores can extensively re-theme the home screen, and even mimic the look of other operating systems, such as Windows Phone.[74] Most manufacturers customize the look and features of their Android devices to differentiate themselves from their competitors.

7.1.1 Mit App inventor

App Inventor for Android is an open-source web application originally provided by Google, and now maintained by the Massachusetts Institute of Technology (MIT).

It allows newcomers to computer programming to create software applications for the Android operating system (OS). It uses a graphical interface, very similar to Scratch and the StarLogo TNG user interface, which allows users to drag-and-drop visual objects to create an application that can run on Android

devices. In creating App Inventor, Google drew upon significant prior research in educational computing, as well as work done within Google on online development environments.

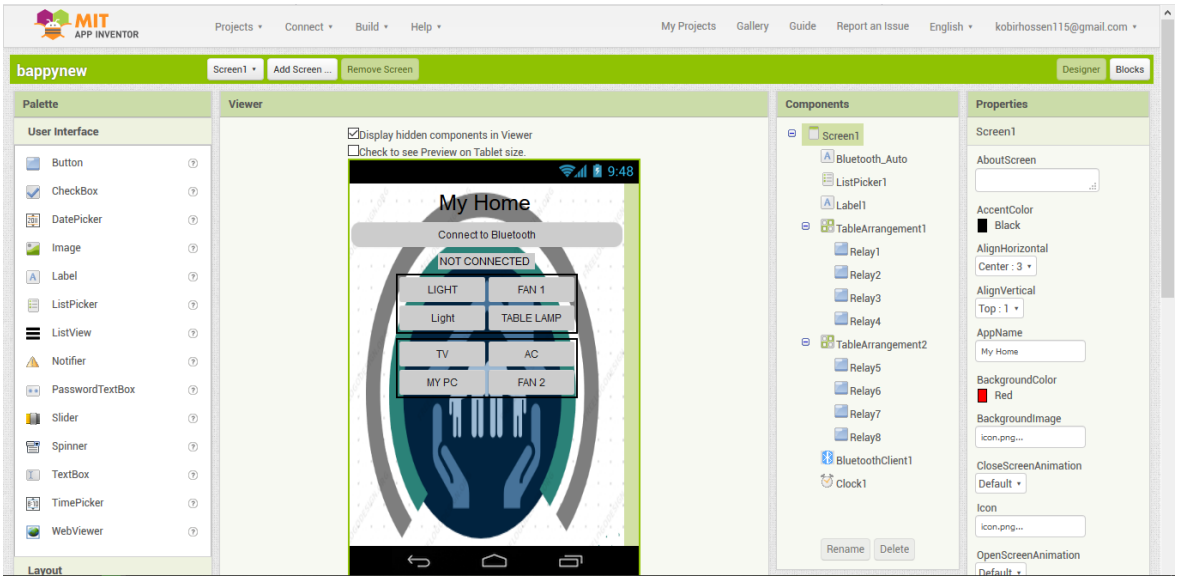

Figure: Mit app inventor tools

App Inventor and the projects on which it is based are informed by constructionist learning theories, which emphasizes that programming can be a vehicle for engaging powerful ideas through active learning. As such, it is part of an ongoing movement in computers and education that began with the work of Seymour Papert and the MIT Logo Group in the 1960s and has also manifested itself with Mitchel Resnick's work on Lego Mindstorms and StarLogo.

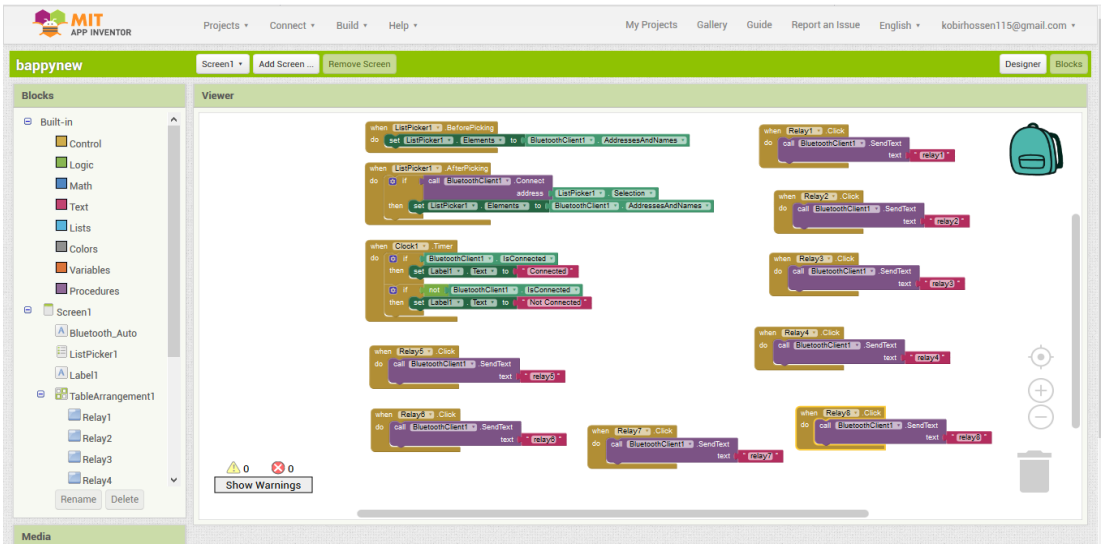

Figure: App inventor to block

MIT App Inventor is also supported with the Firebase Database extension. This allows people to store data on Google's firebase.

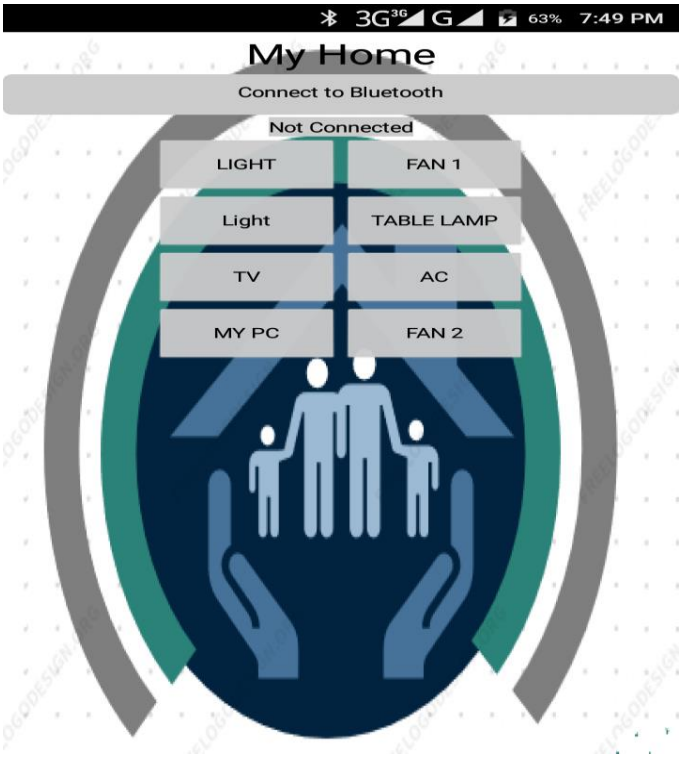

Figure: Android application

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: 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.

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 person's 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. A smart city may therefore be more prepared to respond to challenges than one with a simple "transactional" relationship with its citizens. **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 anytime 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.

References

1. *"Molluscan eye". Retrieved 26 June 2015.*
2. *Erlich, Yaniv (2015). "A vision for ubiquitous sequencing". Genome Research. **25** (10):411–1416. ISSN 1088 051. PMC 4579324 . PMID 26430149. doi:10.1101/gr.191692.115.*
3. *Wigmore, I. (June 2014). "Internet of Things (IoT)". TechTarget.*
4. *Noto La Diega, Guido; Walden, Ian (1 February 2016). "Contracting for the 'Internet of Things': Looking into the Nest". Queen Mary School of Law Legal Studies Research Paper No. 219/2016. SSRN 2725913*
5. ITU-Twebsite. [Online]. Available:http://www.itu.int/en/ITU-T/gsi/IoT/Pages/default.aspx
6. *Hill, Jim (12 September 2015). "The smart home: a glossary guide for the perplexed". T3. Retrieved 27 March 2017.*
7. "Research and Markets: Global Home Automation and Control Market 2014-2020 - Lighting Control, Security & Access Control, HVAC Control Analysis of the $5.77 Billion Industry". *Reuters.* 2015-01-19. Archived from the original on 2016-05-05.
8. *Komninos, Nicos (2013-08-22), "What makes cities intelligent?". In Deakin, Mark. Smart Cities: Governing, Modeling and Analyzing the Transition. Taylor and Francis. p. 77. ISBN 9781135124144.*
9. https://en.wikipedia.org/wiki/App_Inventor_for_Android
10. https://thingspeak.com/apps
11. https://www.analyticsvidhya.com/blog/2016/08/10-youtube-videos-explaining-the-real-world-applications-of-internet-of-things-iot/
12. 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

Android app:

```
#include<SoftwareSerial.h>
 SoftwareSerial BT(0,1); // Connect Tx to pin 10 and Rx to pin 11 of HC-05/HC-06
 String readData; // String for storing data send from the Bluetooth device

 int Relay1=4;
 int Relay2=5;
 int Relay3=6;
 int Relay4=7;
 int val1=0;
 int val2=0;
 int val3=0;
 int val4=0;

 void setup()
 {
 BT.begin(9600);
 Serial.begin(9600);
 pinMode(Relay1,OUTPUT);
 pinMode(Relay2,OUTPUT);
 pinMode(Relay3,OUTPUT);
 pinMode(Relay4,OUTPUT);
 digitalWrite(Relay1,HIGH);
 digitalWrite(Relay2,HIGH);
digitalWrite(Relay3,HIGH);
digitalWrite(Relay4,HIGH);
 }

 void loop()
 {
while (BT.available())
{
delay(10);
 char c=BT.read();
readData +=c;
 }
```

```
 if(readData.length()>0)
 {
Serial.println(readData);

 if (readData=="relay1")
 {
val1=digitalRead(Relay1);
 if(val1==0)
 {
 digitalWrite(Relay1,HIGH);
 val1=1;
 }
 else
 {
 digitalWrite(Relay1,LOW);
 val1=0;
 }
 delay(200);
 }


 if (readData=="relay2")
 {
val2=digitalRead(Relay2);
 if(val2==0)
 {
 digitalWrite(Relay2,HIGH);
 val2=1;
 }
 else
{
 digitalWrite(Relay2,LOW);
 val2=0;
 }
 delay(200);
 }

if (readData=="relay3")
 {
 val3=digitalRead(Relay3);
 if(val3==0)
```

```
 {
 digitalWrite(Relay3,HIGH);
 val3=1;
 }
 else
{
 digitalWrite(Relay3,LOW);
val3=0;
 }
 delay(200);
 }
 if (readData=="relay4")
 {
 val4=digitalRead(Relay4);
 if(val4==0)
 {
  digitalWrite(Relay4,HIGH);
 val4=1;
  }
  else
  {
 digitalWrite(Relay4,LOW);
 val4=0;
  }
  delay(200);
  }
 readData="";
  }

 }
```

Gas detector programming code:

```
#include <SoftwareSerial.h>
SoftwareSerial espSerial =  SoftwareSerial(2,3);      // arduino RX pin=2  arduino TX pin=3
connect the arduino RX pin to esp8266 module TX pin   -  connect the arduino TX pin to esp8266
module RX pin
float sensor=A0;
float gas_value;
String apiKey = " 694U6F93PXGYNCN7";     // replace with your channel's thingspeak WRITE
API key
```

```
String ssid="walton";    // Wifi network SSID
String password ="1234567890";  // Wifi network password
boolean DEBUG=true;
#define VOLTAGE_MAX 5.0
#define VOLTAGE_MAXCOUNTS 1000.0
//================================================================
=== showResponse
void showResponse(int waitTime){
long t=millis();
char c;
while (t+waitTime>millis()){
if (espSerial.available()){
c=espSerial.read();
if (DEBUG) Serial.print(c);
}
}
}
//======================connection to
thinkspeak.com================================================
boolean thingSpeakWrite(float value1){
String cmd = "AT+CIPSTART=\"TCP\",\"";                  // TCP connection
cmd += "184.106.153.149";                               // api.thingspeak.com
cmd += "\",80";
espSerial.println(cmd);
if (DEBUG) Serial.println(cmd);
if(espSerial.find("Error")){
if (DEBUG) Serial.println("AT+CIPSTART error");
return false;
}
String getStr = "GET /update?api_key=";   // prepare GET string
getStr += apiKey;
getStr +="&field1=";
getStr += String(value1);
//getStr +="&field2=";
//getStr += String(value2);
// ...
getStr += "\r\n";
// send data length
cmd = "AT+CIPSEND=";
cmd += String(getStr.length());
espSerial.println(cmd);
if (DEBUG)  Serial.println(cmd);
```

```
delay(100);
if(espSerial.find(">")){
espSerial.print(getStr);
if (DEBUG)  Serial.print(getStr);
}
else{
espSerial.println("AT+CIPCLOSE");
// alert user
if (DEBUG)   Serial.println("AT+CIPCLOSE");
return false;
}
return true;
}
//================================================================
========== setup
void setup() {
DEBUG=true;          // enable debug serial
//----------my sensor code-----------
pinMode(LED_BUILTIN, OUTPUT);
pinMode(sensor,INPUT);
Serial.begin(9600);
espSerial.begin(115200);  // enable software serial
// Your esp8266 module's speed is probably at 115200.
// For this reason the first time set the speed to 115200 or to your esp8266 configured speed
// and upload. Then change to 9600 and upload again
//espSerial.println("AT+RST");         // Enable this line to reset the module;
//showResponse(1000);
//espSerial.println("AT+UART_CUR=9600,8,1,0,0");    // Enable this line to set esp8266 serial
speed to 9600 bps
//showResponse(1000);
espSerial.println("AT+CWMODE=1");   // set esp8266 as client
showResponse(1000);
espSerial.println("AT+CWJAP=\""+ssid+"\",\""+password+"\"");  // set your home router SSID
and password
showResponse(5000);
if (DEBUG)  Serial.println("Setup completed");
}
//
================================================================
= loop
void loop() {
//---------my gas sensor value reading--------------------
```

```
gas_value=analogRead(sensor);
Serial.println(gas_value);
delay(1);  //delay in between reads for stability
if(gas_value>250){
// initialize digital pin LED_BUILTIN as an output.
digitalWrite(LED_BUILTIN, HIGH);
//delay(250);
// digitalWrite(LED_BUILTIN, LOW);
//delay(250);
float t = gas_value*(VOLTAGE_MAX / VOLTAGE_MAXCOUNTS); //convert gas value to
voltages
if (isnan(t)) {
if (DEBUG) Serial.println("Failed to read from MQ2");
}
else{
if (DEBUG)  Serial.println("Voltage="+String(t));
thingSpeakWrite(t);            // Write values to thingspeak
}
// thingspeak needs 15 sec delay between updates, */
delay(20000);
}
else{
digitalWrite(LED_BUILTIN, LOW);
}
}
```