# A Project Report
# On
# IoT based SMART HOME AUTOMATION SYSTEM

A project work submitted to the Department of Information & Communication Technology (ICT) in partial fulfillment of the requirements for the degree of
Bachelor of Science in ICT


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## CERTIFICATE FOR APPROVAL

This is to certify that the work embodied in this project entitled **IoT based SMART HOME AUTOMATION SYSTEM** submitted by Mobarak Hosen to the Department of **Information & Communication Technology**, have carried out under my direct supervisions and guidance.

The project work has been prepared as per the regulations of department and I strongly recommend that this project work will be accepted in partial fulfillment of the requirement for the degree of Bachelor of Science in ICT.

.....

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Dedicated to My Parents &
Honorable Teachers.

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# Abstract

Internet of Things (IoT) is known as the network of interconnected devices, machines, vehicles, home appliances and other objects embedded with sensors, software, switches and connectivity which enable these things to connect with a network server to collect and exchange data. The system generates the environment of connecting the non-internet-enabled physical devices and digital machines which are to be connected over the internet and remotely monitored and controlled. This project intends to propose an architecture using near field communication between Wi-Fi Router and mobile along with an Internet Protocol for home automation. In this project architecture, we will use MAC and Internet Protocol to communicate between Wi-Fi router and mobile. Along with smart control of the appliances, we will be focusing on the energy consumption management system through which consumers can reduce excess energy consumption by remotely controlling the devices.

**Keywords:** IoT**,** HAN, EMS, HOMER, HEMS, ICMP, HTTP, Automation, Smart Home.

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# Chapter 1

# Introduction

## 1.1 Introduction

Internet of Things (IoT) is known as the network of interconnected devices, mechanical and digital machines, vehicles, home appliances and other objects embedded with sensors, software, switches and connectivity which enable these things to connect with a network server and collect and exchange data. The system generates the environment of connecting the non-internet enabled physical devices and machines to be connected over the internet and remotely monitored and controlled. A thing in the Internet of Things can also be a person with a heart monitoring implant or an automobile with obstacle sensor or home appliances connected to an application platform. This is also applicable to industrial machines like drill of an oil rig or a jet engine of an airplane. These things are assigned to an IP address and are able to transfer data over internet. Basically, this is the concept of connecting any devices or machines we can think of today with the internet. Previously, home-mechanized gadgets were somewhat essential and basic, with choices running from light clocks to programmable indoor regulators. Presently, these frameworks are consolidating information from home exercises, neighborhood climate frameworks and then some; to acclimate to optimal way of life and help for better deal with home. Even better, they can interface with one another to shape a firm unit to enable to work entire house. This project intends to propose an architecture using near field communication and mobile communication along with a mobile application for home automation. The basic architecture or framework consists of connecting devices which will use protocol (MQTT or Zigbee) to connect Edge gateway; and cloud stores the data information using backend storage system. Along with smart control of the appliances, we will be focusing on energy consumption management system through which consumers can reduce excess energy consumption by remotely controlling the devices. This project can save excessive use of any appliance energy, time and simultaneously abate extra wealth expenditure.

## 1.2 Internet of Things (IoT) Basic Concept

The intercommunication between the device to device or machine learning connected through the internet with embedded technology systems using wireless sensors, actuators which is remotely controlled, monitor and optimized by the user for automation is referred to as the Internet of things (IoT). Here the term “Things” means physical devices such as chips, cameras, sensors, and other such devices. These physical devices are responsible to communicate, collect information and exchange data by connecting a network. The embedded technology of these physical devices makes this exchange of information with each other possible. There is an assortment of home robotization includes that can help to make life at home increasingly advantageous and simpler to oversee, particularly for occupied, huge families. Suppose you could consequently manage and control the gadgets that you ordinarily turn on and off each day. With a home computerization framework, you can manage appliances when you’re out of the house and wondering if you remembered to turn off light or not, smart system will be there to answer the question. The developing nearness of the Internet of Things in individual's lives

has made development and advancement in the savvy home space, enabling clients to associate their gadgets through the web to their phones and tablets and make better than ever benefits for family units. In addition, as house owner are adjusting their gadgets to one focal application, gadget or center, they further understand the worth these home robotization items can bring to a family. It is the connectivity apart from conventional devices using the internet such as desktop, laptops, smartphones, tablets, etc.

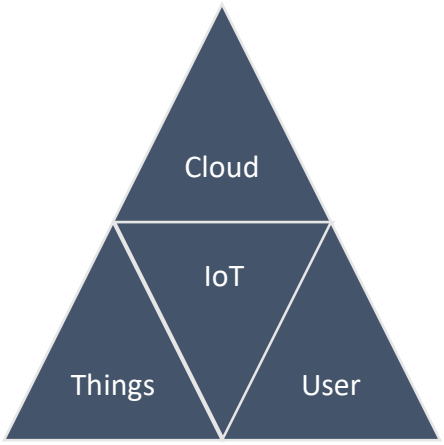



*Figure 1: Basic Concept of IoT*

## 1.3 IoT Characteristics

IoT is one of the most popular terms in this modern era of the world. Internet of things (IoT) explains the network of different devices like home appliances or office works that contains software, electronics, sensor, and connectivity to allow them to exchange data with connections. Several sensors and actuators are used to connect those devices and give feedback to them according to self-operations. IoT has convinced the world with its worldwide features and human beings are fully dependable on it. In the near future, this IoT will make an unimaginable impact on the daily life of human beings which will make the life of human easier, smarter and safe. At present, it has already grabbed the promising and large digital fields of modernization which is rapidly increasing.

The characteristic of IoT includes the synthesis of hardware and software abiding by complex algorithms and computation techniques in which intelligence authorizes them to behave and act accordingly to the situations. The connectivity of IoT devices allows connecting various objects by creating a network and comprehensive intelligence systems. The dynamic nature of IoT devices tells the state of the device whether it is on or off. An IoT device also collects dynamic change of data information from its neighboring environment. The essence of IoT is diversity and heterogeneity because of using distinct platforms and networks. Finally, security issues of IoT are being very important because of its delicate information and enormous action being taken to prevent security problems. In the future, IoT components enormity will increase at such level so that it becomes very difficult to deal or manage it.

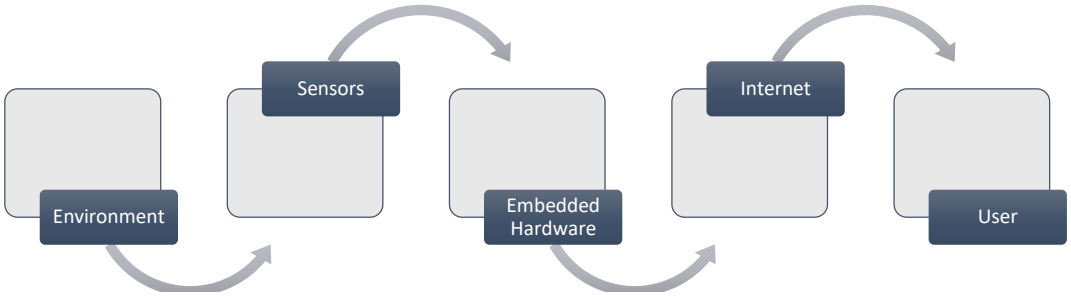



*Figure 2: IoT Enabling Technique*

## 1.4 Why IoT is Rising?

In recent years, IoT plays a momentous role to reduce human exertions. The rapid growth of IoT devices and application day by day increasing which is disciplined by using the internet and people are getting benefited. The scope of IoT is the amalgamation of the physical world into computer base by amplifying the efficiency of the technology, abate human lessens and economic benefits. The basic characteristics of IoT devices are nearly identical and shared but the technology behind every device specifies from one device to another. Because of its having ambiance intelligence and self-explanatory control make IoT more popular nowadays. In the coming days, advanced technology of IoT devices becomes more intelligent, unimaginable, automatic systematized, non-determined to work independently anticipates conditions and atmosphere.

Internet of Things (IoT) is going to be successful and very popular in near future. As the telecommunication sector is becoming more efficient and extensive, wireless and broadband internet connection is now widely available. With the advent of more sophisticated fabrication technology, it is now much cheaper to produce devices and sensors with built-in Wi-Fi capabilities making connecting devices less costly [1]. Most importantly, smartphone usage has been increased to such a level that it is being used to every possible aspect of our life nowadays. As for the IoT based systems, there is no need for a separate communication system rather we can use the existing technology through smartphones which makes the system cheaper and highly achievable. Because of this technology now we can think of a fully automated home or a whole smart city with the monitoring of energy consumption rate or a traffic monitoring system for higher efficiency.

## 1.5 IoT Architecture

The basic architecture of IoT consists of some stages including device, gateway connectivity, data processing, and cloud or user interface. Firstly, physical devices such as sensors, appliances, devices, and actuators assemble raw data from the neighboring environment and convert it into useful data. Actuator and sensors work as a transducer which converts energy into one form to another form are used in IoT architecture. Actuators convert energy into motion besides sensor which is a device that receives and respond to the signal. In the meantime, there comes internet-gateway. Sensors use a specific protocol like Modbus, ZigBee,

Bluetooth, near field communication (NFC), Wi-Fi or along with that proprietary protocol to connect Edge gateway. Edge gateway converts raw data from analog to digital using data acquisition system besides data aggregation. The internet gateway received aggregated data as an example preprocessing and provides routing detaining connectivity to the cloud using system, for instance, web sockets, the event hub, edge analytics, advance messaging queuing protocol (AMQP), Message queuing telemetry protocol (MQTT), the Constrained application protocol (COAP) or fog computing. Further, details analyzing of data and processing by IT systems onsite or offsite. Finally, data stored in the database or cloud. The cloud application handles the communication which transpires in all stages [2].

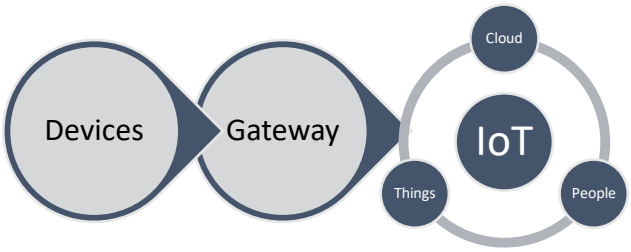



*Figure 3: IoT Architecture*

## 1.6 IoT Applications

IoT application changes our life and made our life easy, comfortable and simple. The sector and area that IoT covers are huge. IoT has extensive applications in different sectors for instance commercial, industrial, and medical and consumers. In all these cases IoT left its footprint and in the future, it surprises more. Here some of its real-world application irradiates, which are smart home, smart city (parking, waste management), utilities (smart grid, smart metering), wearable gadgets, Transports & logistics (connected cars, fleet management, goods tracking), industrial (process monitoring & control, manufacturing, maintenance), agriculture (agriculture monitoring, climate, livestock tracking), telemedicine and healthcare, elder care, and environment(environment) monitoring. Smart home among them is the most wanted sector that people are trying to get in the more modernized way day by day. We are focusing on smart home automation system to manage extra consumption of energy and monitoring. A smart home means an automated home which could manage and control smart device and other home appliances automatically or manually by the user. A smart home consists of so many things like lighting, heating, air conditioning, domestic robot, thermostat, wireless speaker, home security and monitoring, smoke detector, water detector, washing machine, and refrigerator. The power consumption of smart home electrical device certainly change demand response (DR) to consumer and find a good match not only demand for power but also for supply. DR responsible for finding a better match by adjusting power against supply helps consumers to redeem auxiliary outlay. Consumer plays a very vital role to reduce extra power consumption by participating in and conducting their household.

At this present stage, human beings are consuming more and more energies like electrical or other sectors. The rapid growth of human beings is needed for these energies which are a part

of their life. This unlimited consume of energies are in question as these energies are also in a loss. Directly or indirectly, people are misusing energy like switching on electricity in a vacant room for several times, etc. IoT is trying to reduce this energy loss that can make this more efficient. By using IoT devices, we can easily control the energy of a home automatically from a distant place. Our presence is not mandatory but an internet connection can make it possible with automation to reduce the excess energy loss and consume more effective energy. Like in the official hour, we do not need to switch on the devices of our home always. We can control it from our office by using an IoT system or device only via the internet or wireless connection. That will save the energy definitely.

By doing optimal scheduling skills, users can save more energy and their extra expense of money at the same time. IoT home energy management system gives users maximum satisfaction against minimum cost. The demand model using demand response gives higher gratification using time interval optimization. Sometimes scheduling is not applicable for all users so need balance. This type of advantage not only can save energy but also make our time more efficient for thinking about more things. Thus, we find the concept IoT based energy-saving home automation system which is discussed in this paper in an easy and expense consuming way. We are focusing on price response, time of use pricing (TOUP), critical peak pricing (CPP), real-time pricing (RTP) and demand-side management (DSM).

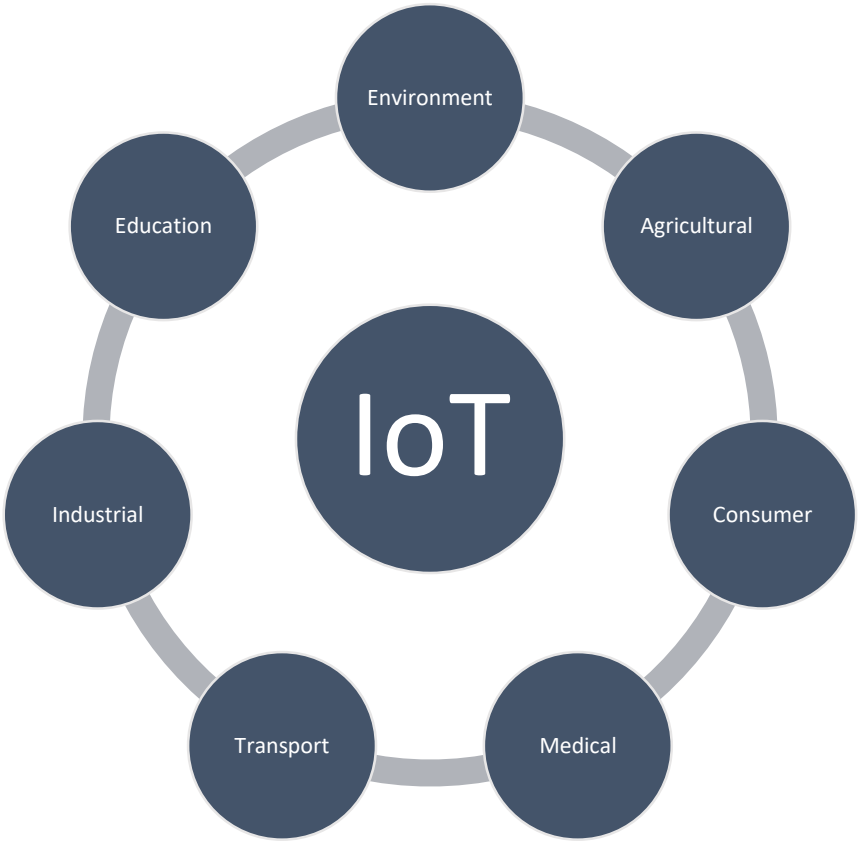



*Figure 4: IoT Applications*

### 1.6.1 Home Automation

Home Automation is the process in which all the household appliances can be controlled, monitored and maintained automatically by the intelligence of device far from home regardless is typically called home automation which makes home smart. It connects everything in the network through the internet. The idea of house being totally mechanized used to be numerous. Presently, it is a reality. Shrewd homes and penetrating home items are prominent in light of the fact that they offer more accommodation and security for family. Users can check the update status of a device from time to time. These gadgets can convey, track and send data, and react according to the user command. In this technology, we can control household appliances like lighting, AC, fan, washing machine, TV, Fridge, security system, etc. By using artificial intelligence, it can also be self-controlled and monitored by itself. These frameworks additionally help increment home's vitality effectiveness, which can lessen vitality bills.

## 1.7 Project overview

The main focus of this project is – home automation and energy management from its artificial intelligence coordinateness of maintenance according to the need. An intelligent system which given a timely update about the peak and off-peak hours; based on this if applied, user can save more than predetermined energy, the automation system which allows to assists the user. In this project, we have used the absence of users in the defined certain area to control & saving energy of user's office or home. This is done using the home Wi-Fi Router with its coverage area. If the user is presented at home with connected the home network, then the system will be updated as the peak of energy & auto control of home appliances will be powered 'ON'. When the user will be moved far from its coverage area the system will be updated as off-peak of energy & home appliances will be updated as powered 'OFF'.

At the beginning of the project, the automation technique which is used for the appliances for managing and maintenance being seen to apply inside prototype resident for types of equipment. This was done to avoid hassle-free household apparatus management with monitoring and most importantly finding all components together without having any problem, which can be time-consuming for the commercial user. On the following, the generation of green energy generation for the existing system to implement the automation technique works in a scheduled manner. After installation of the apparatus and calculation of their nature, the prototype came under test where its feasible execution was tested and its efficiency over the similar automation project was assumed using practical data.

## 1.8 Summary

In the second chapter of this paper is discussed about home automation and its vast area, the existing improved models and protocols also the management of energy for home, scheduling, and the difference of solar system and the supply power of solar system efficiency. Following that third chapter describes the automation process and its characteristics. Then chapter four is about the hardware and software implementation process and technique. Later, chapter five is the development of control algorithms. Corresponding to each of this technique the solar power generation and simulation process are being discussed in chapter six. After that, the energy

management, scheduling, and power consumption calculation and analogy examine in chapter seven. Suddenly, the uniqueness, substantiate goal and how the client will get benefited from this project sift canvas in chapter eight. Finally, in chapter nine the paper was compacted enlightening the home customization with power administration and the forthcoming work on this engineering.

# Chapter 2

# Literature Review

## 2.1 Introduction

Living in the age of the internet, life has become smarter and more convenient for us today. The internet has brought unthinkable and remarkable options for the human being that is connecting us with the think of building an automatic smart system. The automatic smart system concept that came from the rapid spread of the internet can reduce the danger in any system as well as human involvement. The worldwide researches are going on to consume the power of an electrical system or device efficiently so that the waste of it made by human involvement manually can be reduced. The efficiency of such energy management system can take us to the appropriate goal of automation system that can be used continuously with safety without the involvement of human beings. For this worldwide promising concept in the electrical sector, planning was going in our mind to work on this that can be useful in this area. The Internet of Things (IoT) system has a vast area to research or work on. The home automation system is one of the most talkative, promising and worldwide researching sectors of IoT. This home automation system has already created a significant impact in our technological area that is now looking for reducing the total power wastage reduction theory. Home Energy Management System (HEMS) is now in headline to conduct reduction of the loss of power, dangerous system disaster and the life loss of human beings. So, many research papers and some projects from IEEE and online published sides share a broad and major idea on these things that how we can save our energy and reduce the danger of system. These concepts and their research made us to think on the vision of our research more widely. That's how the mission and goals to work on for this research paper has been aimed. These papers and journals concepts visualized the details of IoT, its applications and vast area of research, home automation, smart appliances at home, home energy management system, smart meters, scheduling with smart appliances, the difference between supplied power and solar power, the power consumption of our country. All these concepts are effective for this thesis paper to come to a conclusion and make a decision on the project of total energy-saving management.

## 2.2 IoT and Home Automation

As the IoT has a vast chamber to discuss on mentioned earlier, it has been described briefly in a moderate way to show the concept of it in several research papers. A journal on "IoT-Home Automation" researched by S Bharat et al., published on International Journal at Computer Technology and Research (IJCTR) in 2016 showed a detail home automation appliance with a short and clear view writing [4]. The advantages of home automation, such as - reduced installation cost, system stability, easy extension, aesthetical benefits, integration of mobiles devices are discussed here. The appliances of home automation like light and devices, webcam surveillance, magnetic doors etc. are needed to be present. Some of the hardware and software 10 based applications and components like Radio Frequency Identification (RFID), Wireless Sensor Networks (WSN), addressing schemes are discussed too. This paper also suggests a model of the utilization of home automation appliances properly at on and off-peak hours.

Another paper on “Research and Applications on the Smart Home-Based Component Technologies and Internet of Things” written by Baoan Li and Jianjun Yu found in Sciverse Science Direct has elaborately discussed these RFID and WSN appliances [5]. The present research of USA, Europe, China, Korea, and Japan on nanotechnology, sensor-based appliances, intelligence embedded technology, RFID’s future appliances, and sea computing applications are being shortly involved in this paper to give us the idea of the broad application range of RFID. The paper focused on the security and intelligence system of home and offices of the foreign nations that have been developing day by day. Family automatic appliances, medical appliances, environmental automatic appliances are also mentioned here. Another paper on “The Internet of Things: How the Next Evaluation of Internet is Changing Everything”- authored by Dave Evans basically focused on the IoT aspects and its future. The author showed how the impact of IoT is grabbing people and how the user of smart home appliances are increasing from 500 million to 50 Billion within just 15 years from 2005 to 2020. It also focused on the IoT covered fields, such as - business, education, transport, energy, home, earth, etc. In a word, there are hardly options that can’t be covered by IoT or may be invisible. The author ended up with the emerging of IoT from the very early moment when the computer and spread of its appliances to the present vast areas of IoT based devices and sectors. There are also some journals and trustworthy sources from the internet have been visualized the same idea with these details regarding IoT and home automation concepts. The basic concept of a wireless connection network from device to device and human-friendly channel that is presented as the term of IoT has been accepted gradually in societies. The impact of it has been significant in our world that it has covered all the sectors in our daily life. There are unlimited IoT applications that can’t be covered definitely. In the sector of agriculture, education, industry, business, home, security and many more are directly related to IoT. The reason behind this boom is the smart and auto user-friendly devices that are helpful, time-consuming and riskless. The home automation concept- a major part of IoT has been flourished due to this consumption and user-friendly concept. It has deducted our manual home works to save time, less risk and automated command. We do not need to wait or stay in our home to operate everything now a day as a home automation system is working smoothly with a user-friendly manual concept. Such advantages motivated on this thesis paper to think about outside work rather than thinking of home factors. At this present stage, more power-consuming concepts are in research as this IoT and home automation reduces rapidly the wastage of energy so that people can take the best benefit of IoT and home automation. Thus, the broaden concepts of IoT and its home automation through these journals, papers, and internet embedded our concept that can lead to work with such concepts.

## 2.3 Home Energy Management

To get the more efficient consumption result of IoT, we also need to think about the management system of IoT that is present in our home and buildings. These systems must be power efficient and consumer effective to get a better output as a result. Several systems are being proposed everyday by researchers and students but all the systems are in further experiment for the highest reduction of power loss. Junior Kim’s “HEMS-Home Energy Management System” paper visualized a general automatic smart home picture in front of us that lists the basic components for home automation system [6]. Components like LED, CCTV, speakers, IR Sensors, Ultrasonic sensors, smartphones and devices for networking among and

outside the home have been used here to give a proper idea of a home automation management system. In our project, we were looking for the most effective concept to reduce energy management wastage. Ravi Kodali et al. created a user-friendly smart home automation system operated by the microcontroller and described it in their conference paper "IoT Based Smart Security and Home Automation System" which was presented on International Conference on Computing, Communication, and Automation [7]. A microcontroller TI CC3200 launchpad operates the total security system of a home gets the command from the PIR motion sensor by accessing the network via Wi-Fi. This simple design can easily be figured out and give a visualization of a simple circuit for our paper-based project in a thesis. Thus, a conclusion can be obtained to create a very simple design for this project that can be accessible, cheap for everyone and further can be modified. Home energy management system design is very important first to initialize and get better project output but the output data needs to be more specific and conditional. For example, if we switch on a machine or device at peak hours, the power consumption and further electric bill will be increased. If it can be used at off-peak hour, then the pressure on the load will be decreased. Besides, supply power from the grid is costly in this generation of solar. Though it's little bit costly in the very first to build up a PV cell for a system, it can easily be operated with a very low maintenance cost further on. On the other hand, the power from grid supply is dependable on usage as more usage costs more bill. For these problems, it's in thought how to reduce the power loss or the efficiency of the system that people are on research. An IEEE paper "An Internet of Things Framework for Smart Energy in Buildings: Design, Prototypes, and Experiments" written by Jianli Pan and Jain showed a year observed data of energy conversion for different times at home and official buildings in the USA [8]. They observed the electricity consumed by people in two different places- office buildings and homes of a certain area. The observation came for two different times- one for winter and another is for summer. After analyzing all these consumption rates, they came to a suggestion to use an alternate method so the pressure on the supply grid minimizes and consumers get benefits on usage pay. This paper suggested an automation system like automatic switching on/off with the move of people in the room, manual operation by the consumer after reading the peak hour rates, etc. A brief of this paper focused the target on this project to minimize the energy loss with more appropriate automated features. It enlarged the work criteria to work on with automation for energy saving.

## 2.4 Scheduling

Another IEEE paper on "Survey on Smart Grid Technologies- Smart Metering, IoT and EMS" by Shobhit Jain et al., proposed a power scheduling based connecting protocol for home appliances connected over Home Area Network (HAN) receiving real-time electricity price [9]. An Energy Management System (EMS) consists of Smart Metering Architecture (SMA) or Advance Metering Infrastructure (AMI) which enables two-way communications provides information to the consumer by measuring power consumption. It can provide the information remotely using an IP based wireless network. All the mathematical calculations and data processing are controlled by a microcontroller so the serial communication controller must be compatible with protocols like Zigbee, GSM, Wi-Fi, etc. Zuang [10]. That also visualized the smart meter efficiency in this field. There are also some journals for the scheduling method of smart home and smart home appliances like air conditioning, heating, etc. Though a view on

Zigbee, DLMS, DPWS, 6LowPan and other wireless communication technologies were taken but it didn't work in this project as they are costly and some are not available in the country.

## 2.5 Supplied Power & Solar Power in Bangladesh

An important IEEE paper that worked mostly for this project and broadens work criteria is "An Optimized Stand Alone Green Hybrid Grid System for an Offshore Island, Saint Martin, Bangladesh" written by Khandakar Haque et al., as it is for an island of our country and matches with the system of our country [11]. The paper enriched the difference between power supply and solar system energy management efficiency as they work on a solar electric system of Saint Martin Island. The difference easily ensured feedback on how the solar panel can be power and cost-efficient especially for a developing country like ours. So, a view on the depth of that project paper led to set up this thesis project merging with PV solar management, power consumption, and cost.

## 2.6 Summary

After reviewing all these and some more papers and journals, the concept of home automation system on IoT, its energy management system, scheduling energy management system and some alternate automation methods to consume power in an effective way are mostly cleared. To establish a little project and paper for this thesis, those are quite enough to enlarge and fix vision at our work. Thus, the review of these papers and journals also points to the future works of the paper. A summary of these working papers and criteria that matched with our project paper are in next: -

***Table 1: Lists of Review Papers***

| Topic | Paper Details | Reference no. |
|---|---|---|
| IoT & Home Automation | Bharath,S. Pasha, M.Y., & Deepth, J.(2017, April). IoT Home Automation. *International Journal of Computer Technology and Research*, *5*, 4-6. | 4 |
| | Li, B., & Yu, J. (2011). Research and application on the smart home based on component technologies and Internet of Things. *Procedia Engineering*, *15*, 2087-2092. | 5 |

| | | |
|---|---|---|
| Home Energy Management | Kim, J. (2016). HEMS (home energy management system) base on the IoT smart home. *Contemporary Engineering Sciences*, *9*(1), 21 - 28. | 6 |
| | Kodali, R. K., Jain, V., Bose, S., & Boppana, L. (2016, April). IoT based smart security and home automation system. In *2016 international conference on computing, communication and automation (ICCCA)* (pp. 1286-1289). IEEE. | 7 |
| | Pan, J., Jain, R., Paul, S., Vu, T., Saifullah, A., & Sha, M. (2015). An internet of things framework for smart energy in buildings: designs, prototype, and experiments. *IEEE Internet of Things Journal*, *2*(6), 527-537. | 8 |
| Scheduling | Jain, S., Kumar, V., Paventhan, A., Chinnaiyan, V. K., Arnachalam, V., & Pradish, M. (2014, March). Survey on smart grid technologies-smart metering, IoT and EMS. In *2014 IEEE Students' Conference on Electrical, Electronics and Computer science* (pp. 1-6). IEEE | 9 |
| | Zhao, Z., Lee, W. C., Shin, Y., & Song, K. B. (2013). An optimal power scheduling method applied in home energy management system based on demand response. *Etri Journal*, *35*(4), 677-686. | 10 |
| Solar Power in Bangladesh | Haque, K. F., Saqib, N., & Rahman, M. S. (2019, March). An Optimized Stand-alone Green Hybrid Grid System for an Offshore Island, Saint Martin, Bangladesh. In *2019 International Conference on Energy and Power Engineering (ICEPE)* (pp. 1-5). IEEE.2019. | 11 |

# Chapter 3

# Model Architecture

## 3.1 Automation and Features

The purpose of this work is to develop an automatic system which is the ductile, cost-effective, energy-saving remote control of home appliances. The web application governs the system for maintenance. Automatic controlling and remotely monitoring systems compose our everyday life more satisfied and simultaneously save unnecessary dissipation of electrical energy. For the economic growth of any country, electricity plays a very vital role. A progressive country like Bangladesh does not have enough sufficiency of electricity. Due to having a lack of natural resources and pecuniary exigency the up-gradation and launch more new power plant paramount abridgement. The reason behind rising energy cost is negative usage of energy and unawareness of optimization of energy usages. The consequence results, the power plants do not provide the demand of power within the capacity of a power station. Although Bangladesh government continuously trying to increase its capacity by installing new power plants and the overall settled electricity production retention tumid 20,000MW (combining solar power) in energy sector. Another 2.4GW power plant which is known as "Rooppur Nuclear Power Plant" hoped to go in production in 2023. Especially the comprehensive power clients in Bangladesh are industries, residential sectors followed by commercial and agricultural sectors. Despite having the limitation of power generation and increased demand the negligent use of heavy home appliances causes more impact on the power grid. On our daily basis, we mostly repose the lights, fans and other electric household appliances on while it is no use or nobody is in the apartment. Indeed, sometimes we are in a hurry or sometime our inadvertency causes this wastage of energy. Whatever the condition is as a consequence the energy consumption requirement amplifies. To summaries, eliminate this entire residence problem this project shows a way out of this situation which saves unnecessary energy consumption by the efficient use of home useable devices and appliances.

## 3.2 Block Diagram of Home Auto Control

The figure shows the block diagram of smart automation system of IoT and describes how it works. In the flowing figure, it is shown that there is a connection between Node MCU, Wi-Fi Router & User Smartphone. All the home appliances (i.e. fan, light, AC) are connected to the Node MCU through the channel relay. Node MCU loaded energy from the power supply.

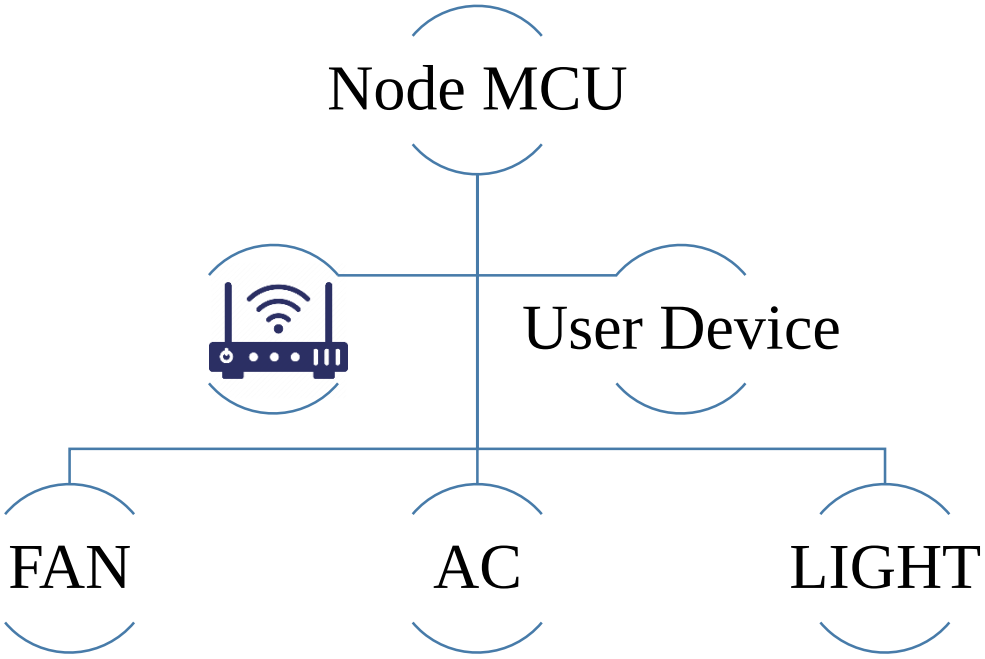



*Figure 5: Block diagram of Auto control system*

### 3.3 Block Diagram of Relay with Node MCU

The following figure shows the model of connection between Node MCU & Relay. All the home appliances are connected to the relay. The following figure describe 2 channel relay

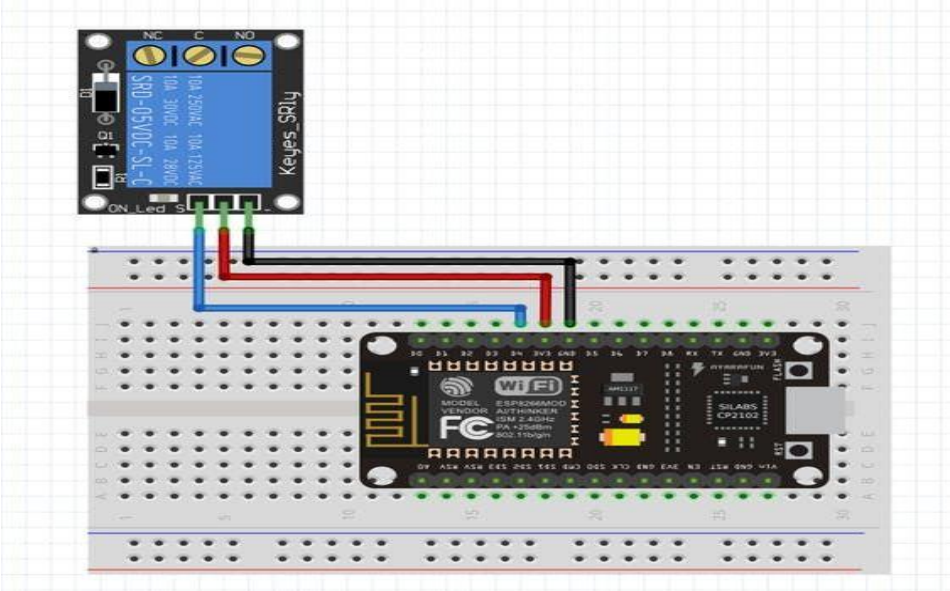



*Figure 6: Relay with Node MCU*
*Source: [Figure 6 source link]*

connection with Node MCU where 1 pin is used to connect GND (Ground) and others two pin is connected with GPIO. This GPIO pin is used to transmit signal of **HIGH** & **LOW** voltage.

## 3.4 Protocol

### 3.4.1 Transmission Control Protocol (TCP)

The transmission control protocol is a transport layer protocol which is defined for segmentation and reassembly of data, multiplexing, connection control, flow and error control of data. In this layer data unit is known as segments. To control the flow of segments a port address and sequence number are assigned with the data unit.

### 3.4.2 Internet Protocol (IP)

Internet Protocol is predefined rule and convention which is used to govern the communication of digital data between a huge number of devices connected through the internet by assigning IP addresses to every single one. This is a Network layer protocol and data unit at this layer is known as Packets. So, to exchange packets between the exact sender and receiver a unique IP address is required for every device which given by the internet service providers (ISP) and governed by the Internet Engineering Task Force (IETF). An IP address is created by a 32-bit long binary number and written in four dotted decimal notations. For example, here 192. 168. 12.1 each decimal is represented by 8 bits.

### 3.4.3 Internet Control Message Protocol (ICMP)

Internet Control Message Protocol (ICMP) is a network layer protocol that reports errors and provides information related to IP packet processing. ICMP is used by network devices to send error messages indicating, for example, that a request service is not available or that the host is not reachable. ICMP is commonly used by network tools such as **ping** or **traceroute**.

In the following figure shows that host A is sending ICMP echo request to host B and in returning we get echo reply. Simply, if host B is reachable from host A that means host B is online means connected to the router. If host B is not reachable from host A then we got an error message.

In our project, we have used ‘ping tool’ service to detect a target device (with assigned an IP address) is connected or not to the router. We have discussed in **Chapter 5** how we can detect a device is connected or not.

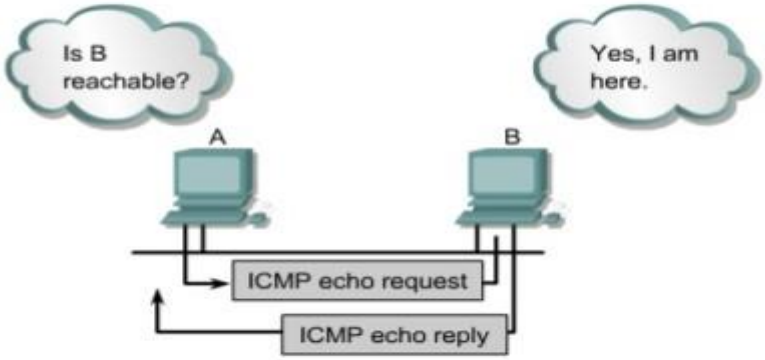



*Figure 7: Function of Internet Control Message Protocol (ICMP)*
*Source: Source Link*

## 3.5 Project Features

The main concept of this project is to detect a device is connected to a router or not using Node MCU micro-controller. This concept can be used in many project for home automation or also family tracking devices. We have used this concept in our project to save electric energy by detecting that the user is at home or not. Some features of this concept is given below:

- Automatic light, fan and AC control.
- Saving energy by controlling power supply.
- Easy installation
- Low cost project

### 3.5.1 Automatic Fan, Light and AC Control

Automatic light, fan, and AC of a smart home are very simple, helpful and safe, also important because of its energy efficiency and smartness. Automatic light, fan, and AC used for turning ON or OFF by sensing the presence of a person. If the person enters in router coverage area and his/her smartphone is connected with the Wi-Fi router then the system automatically turns ON the light, fan, and AC and if the person is moving out from the router coverage area which means his/her smartphone is disconnected from router network then the system automatically turns OFF the light, fan, and AC.

Automatic control of light, fan, and AC saves extra use of energy consumption and also as extra money at the same time [12]. The unnecessarily waste of energy consumption in a vacant room cause unnecessary cost, besides the power consumption of lighting in a typical house is a factor which cannot be ignored. Whereas some situation creates where the user forgets to turn OFF the lights and this deliberate factor consider one of the primary reasons that cause unnecessary energy waste. The automatic control system allows turning ON or OFF the light based on detecting the presence of a person in the space. It is an automatic light controlling technique that provides energy savings and security advantages. The controlling system composes our daily life easier, comfortable and saves the extra inessential waste of energy consumption. Therefore, we develop a system that optimizes in such an affordable and efficient way to conserve energy. Having an automation system technique of powering ON/OFF by detecting a person's presence makes the home smarter and efficient. For this, the person does not need to have any switch or button to turn ON/OFF the lights. So, it helps the person to move easily without hesitation and does not have to keep in mind whether the room light is turned ON or OFF left behind.

### 3.5.2 Automatic Power Supply

The automatic power supply of smart home/office is very simple, helpful, safe & energy saving. We can control the whole power supply of home according to the presence of the user. When the user will be moved far from home for a long time then the system will detect his/her absence and then the whole power supply can be shut down.

# Chapter 4

# Hardware and Software

## 4.1 Hardware Implementation

### 4.1.1 ESP 8266 Node MCU

In our project, we use many devices like the ESP8266 Node MCU module v3. The ESP8266 is the name of a microcontroller structured by Espressif Systems. The ESP8266 itself is an independent Wi-Fi organizing arrangement offering as an extension from existing smaller scale controller to Wi-Fi and is likewise fit for running independent applications. This module accompanies an inherent USB connector and a rich arrangement of stick outs. With a smaller scale USB link, you can associate Node MCU devkit to our laptop and glimmer it with no inconvenience, much the same as Arduino. It is likewise promptly bread boarded inviting.

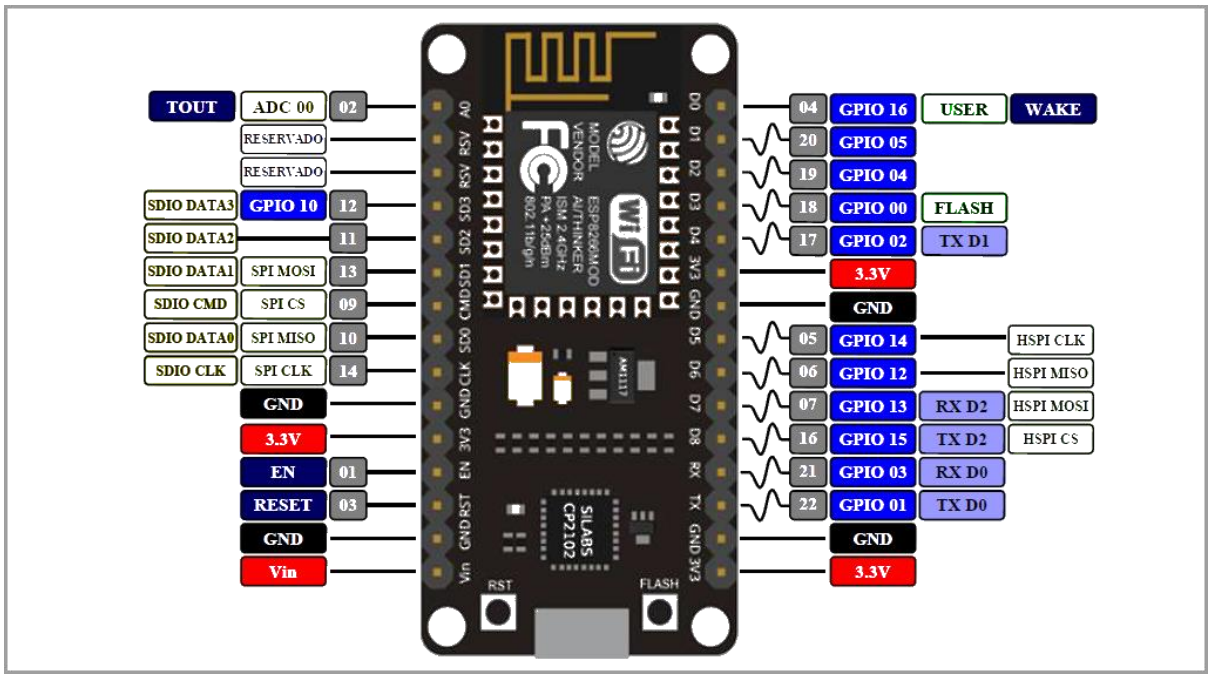



*Figure 8: ESP8266 Node MCU*
*Source: [Source link]*

Specification:

- Voltage: 3.3V.
- Wi-Fi Direct (P2P), soft AP.
- Current Consumption: 10uA~170mA.
- Integrated TCP/IP protocol stack.
- Flash Memory attachable: maximum 16MB, 512K normal.
- Processor: Ten silicaL106 32 bit.
- Processor speed: 80~`60MHz

- RAM: 32K + 80K
- GPIOs: 17
- Analog to Digital: 1 input with 1024 step resolution
- +19.5dBm output power in 802.11b module
- 802.11 support: b/g/n
- Maximum concurrent TCP connections: 5

### 4.1.2 A 5-220V Relay

Relay is an electromagnetic gadget that is utilized to segregate two circuits electrically and interface them attractively. They are valuable gadgets and enable one circuit to switch another while they are totally discrete. They are frequently used to interface an electronic circuit (working at a low voltage) to an electrical circuit that works at exceptionally high voltage. For instance, a relay can make a 5V DC battery circuit to switch a 220V AC mains circuit. In this manner, a little sensor circuit can drive, say, a fan or an electric bulb. A relay switch can be partitioned into two sections: input and output. The input section has a coil which produces a magnetic field when a little voltage from an electronic circuit is connected to it. This voltage is known as the working voltage. Generally utilized transfers are accessible in various designs of working voltages like 6V, 9V, 12V, 24V and so on. The output section comprises of contactors which interface or detach precisely. In a fundamental hand-off, there are three contactors: normally open (NO), normally closed (NC) and normal (COM). At no input state, the COM is associated with NC. At the point when the working voltage is connected the relay coil gets empowered and the COM changes contact to NO. Different relay arrangements are accessible like SPST, SPDT, DPDT and so forth, which have a distinctive number of changeover contacts.

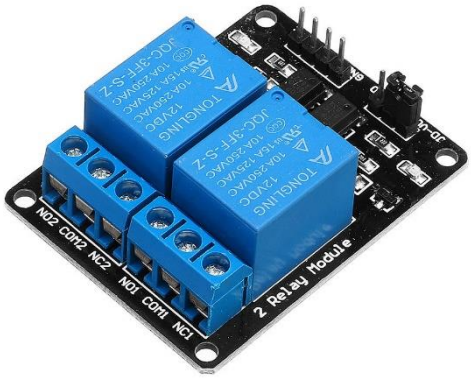



*Figure 9: Two Channel Relay*
*Source: Source Link*

Specifications:

- VCC: 5v DC
- COM: 5v DC

- IN1: high/low output
- IN2: high/low output
- GND: Ground

## 4.2 Software

### 4.2.1 Arduino IDE for Controller and ESP Programming

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a content manager for composing code, a message region, a content comfort, a toolbar with buttons for normal capacities and a progression of menus. It associates with the Arduino and Genuine equipment to transfer programs and speak with them. Projects composed utilizing Arduino Software (IDE) is called outlines. These representations are written in the word processor and are spared with the record augmentation. The editorial manager has highlights for cutting/gluing and for looking/supplanting content. The message territory gives criticism while sparing and sending out and furthermore shows mistakes. The comfort shows content yield by the Arduino Software (IDE), including total mistake messages and other data. The base right-hand corner of the window shows the designed board and sequential port. The toolbar catches enable you to confirm and transfer programs, make, open, and spare portrays, and open the sequential screen.

### 4.2.2 Textmaker

Textmaker is a modern cross platform LaTeX editor used free for linux, macOS and windows systems. It integrates many tools in one application to develop documents with LaTeX. Texmaker includes Unicode support, code fielding, spell check, auto completion and a built-in pdf viewer. This app uses wizard for tasks like- generate new documents, create tables, tabular, and figure environments and export LaTeX document via TeX4ht. It automatically locates errors and warnings detecting in log file after compilation. This editor is very easy to use and configure.

In this project-based research, we used this “Textmaker” app to write the logarithm. Textmaker automatically took all the code and transfer it to output in its original structure of coding we needed. It’s very easy for this work as this app didn’t create problem to format the coding in its mathematical shape.

### 4.2.3 PlanetB

**PlanetB** is a very simple online tool to snippet code in Microsoft Word Document. This tool can be used easily. The website link of this tool: http://www.planetb.ca/syntax-highlight-word

We have used this tool to snippet our program to MS word with highlighting syntax.

# Chapter 5

# Algorithms and Control Flow

## Introduction

The system has a central controller acting as central processing unit which is connected with a portable PCB unit consists of web servers and sensors. The central processing unit (CPU); here controller is also connected with the electrical home appliances through electrical relays and some other different loads like motors and distant on-site sensors. The central controller follows different algorithms to collect information, compare and make decisions, show results and control appliances. To create a web server esp-8266 module has been used which has a central processing unit as well, storage for data and Wi-Fi module in a single chip. The central processing unit of the esp-8266 module takes the name of the Wi-Fi network and the password of that network as input from the user and then establishes a connection with the network. According to the load list, a web page is written and designed and already stored in the memory of the esp-8266 module. Once esp-8266 is connected to a network then it is ready to show the states of electrical loads and different results and also take command from the client to control the appliances through the web page. To execute our desired applications used algorithms are as follows.

## 5.1 Node MCU Pin Configuration

To control the switch of Fan and Light we need to define pin of Node MCU which will be connected with relay channel.

*Program 1: Pin Mode Configuration*

```
/* Here 12 & 13 are two pin
 * which is used to control
 * Fan & Light with Relay
 */

const int op1 = 13;
const int op2 = 12;

void setup() {
 pinMode(op1, OUTPUT);
 pinMode(op2, OUTPUT);

 digitalWrite(op1, LOW);
 digitalWrite(op2, LOW);
}

```

## 5.2 Wi-Fi Connection with Node MCU

In The Node MCU program we need to define the Wi-Fi Router SSID name & Password. In setup() function we can use the below program to connect Node MCU with router. After successfully connected, this program will display a message in the serial monitor.

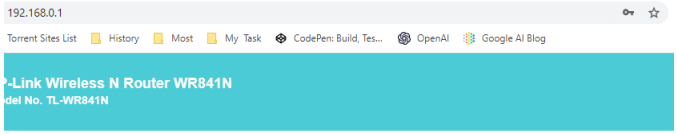
*Program 2: Node MCU connection with Router*

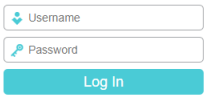
```
/*
 * This code program will connect
 * Node MCU to Router
 * and assigned an IP
 */
#include <ESP8266WiFi.h>

// needs to be changed according to router
char ssid[] = "Wi-Fi network name";
char pass[] = "password";

const int op1 = 13;
const int op2 = 12;

void setup() {
  Serial.begin(115200);

  WiFi.begin(ssid, pass);
  while(WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }

  Serial.println("");
  Serial.println("WiFi successfully Connected.");
  Serial.print("IP Address: ");
  Serial.println(WiFi.localIP());

}

```

## 5.3 Router Configuration

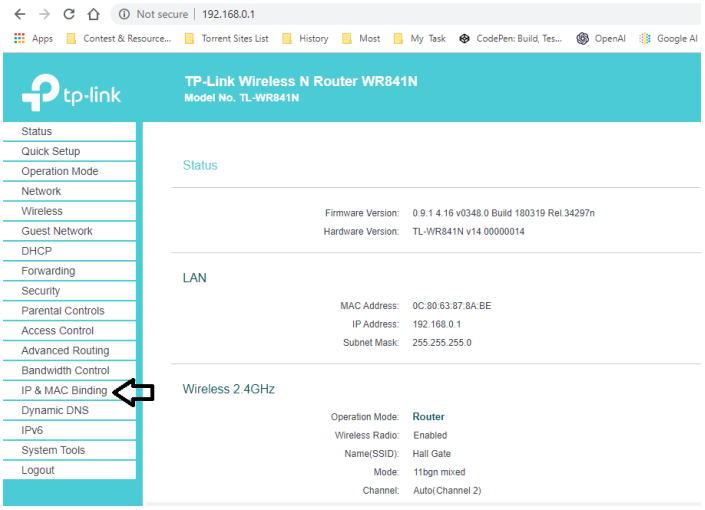
In The Router configuration, we need to set up a static IP Address for the user smartphone. To set up a static IP we need the MAC Address of the smartphone. In the given following way we can set a static IP to the router:

1. Open a web browser and type the router webpage. By default, some router supports **192.168.0.1** or **192.168.1.1**. We can get it from network details.
2. Enter the '**Log in'** by giving an **username** & **password**.

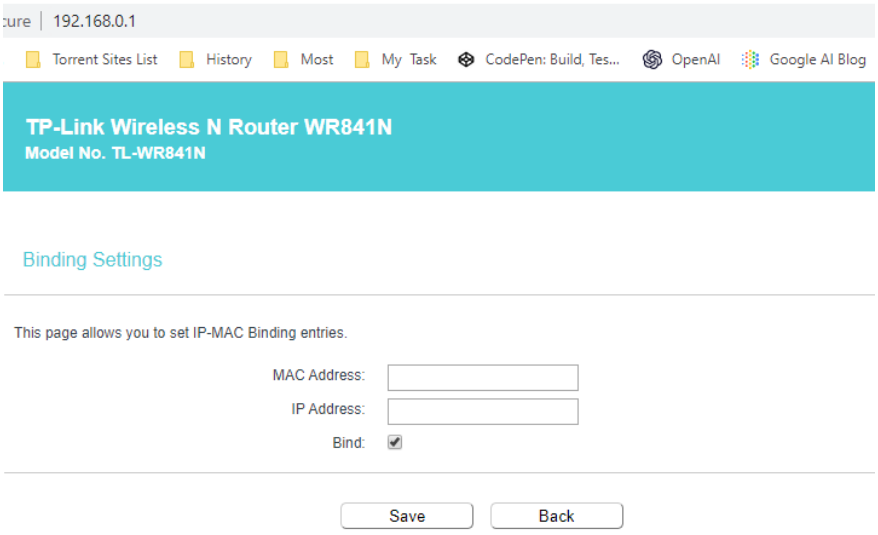


3. Go to IP & MAC Binding:




4. In MAC Address field give the MAC of the user smartphone & in IP Address field give this "**192.168.0.155**" IP Address.




5. After then click on '**Save**'. Done. Next time the smartphone will be connected with this given IP Address.

So, in the following way router configuration is done.

## 5.4 The Pinger Method to Detect Device

**The Pinger** method is used to get an error message of The Internet Control Message Protocol. This method has two functions. One is onReceive() which is used to check that the ICMP echo request is received by the targeted device or request time is out. The '**onReceive()**' function

returns a Boolean “true” if the request is received by the user smartphone or returns “false” if the request is not received by the targeted device.

Another One is ‘**onEnd()**’ function which is used to measure total response rate in percentage. The following code is given below:

To ping the static IP Address:

*Program 3: To ping an IP Address*

```
if(pinger.Ping(IPAddress(192, 168, 0, 155)  )) {
    Serial.println("Device found");
  } else {
    Serial.println("Device not found");
  }
```

*Program 4: OnReceive() Function*

```
pinger.OnReceive([](const PingerResponse& response)
  {
    if (response.ReceivedResponse)
    {
      Serial.printf(
        "Reply from %s: bytes=%d time=%lums TTL=%d\n",
        response.DestIPAddress.toString().c_str(),
        response.EchoMessageSize - sizeof(struct icmp_echo_hdr),
        response.ResponseTime,
        response.TimeToLive);
    }
    else
    {
      Serial.printf("Request timed out.\n");
    }

    // Return true to continue the ping sequence.
    // If current event returns false, the ping sequence is interrupted.
    return true;
  });

```

*Program 5: OnEnd() Function*

```
pinger.OnEnd([](const PingerResponse& response)
  {
    // Evaluate lost packet percentage
    float loss = 100;
    if(response.TotalReceivedResponses > 0)
    {
      loss = (response.TotalSentRequests - response.TotalReceivedResponses) * 100 / response.TotalSentRequests;
    }

    // Print packet trip data
    Serial.printf(
      "Ping statistics for %s:\n",
      response.DestIPAddress.toString().c_str());
    Serial.printf(
      "    Packets: Sent = %lu, Received = %lu, Lost = %lu (%.2f%% loss),\n",
      response.TotalSentRequests,
      response.TotalReceivedResponses,
      response.TotalSentRequests - response.TotalReceivedResponses,
      loss);

    // Print time information
    if(response.TotalReceivedResponses > 0)
    {
      Serial.printf("Approximate round trip times in milli-seconds:\n");
      Serial.printf(
        "    Minimum = %lums, Maximum = %lums, Average = %.2fms\n",
        response.MinResponseTime,
        response.MaxResponseTime,
        response.AvgResponseTime);
    }
    else {
      Serial.println("No Data recieved.");
      Serial.println("Device is out of bound");
    }
   // Print host data
    Serial.printf("Destination host data:\n");
    Serial.printf(
      "    IP address: %s\n",
      response.DestIPAddress.toString().c_str());
    if(response.DestMacAddress != nullptr)
    {
      Serial.printf(
        "    MAC address: " MACSTR "\n",
        MAC2STR(response.DestMacAddress->addr));
    }
    if(response.DestHostname != "")
    {
      Serial.printf(
        "    DNS name: %s\n",
        response.DestHostname.c_str());
    }

    return true;
  });
```

## 5.5 Node MCU Main Program

The Node MCU is programmed as the following program which is given below.
To operate this program on any other Node MCU, we need to change just an IP Address which is assigned at the router.

*Program 6: Node MCU main program*

```
/***
 *
 * Project Title: IoT based: Home Automation with Wi-Fi Router
 * Author @ imShakil
 * Dept. of ICT, IU
 * Bangladesh
 *
 */

// Imported libraries

#include <Pinger.h>
#include <ESP8266WiFi.h>

extern "C"{
  #include <lwip/icmp.h>  /// Needed for icmp packet definitions
}

// Defining global variables

Pinger pinger;
WiFiServer server(80);

// needs to be changed according to router
char ssid[] = "ICE_WiFi";
char pass[] = "ice43k21iu";

String header;
String ob1 = "OFF";
String ob2 = "OFF";

const int op1 = 13;
const int op2 = 12;
bool IsManual = false;
bool dcheck = false;

unsigned long CurrentTime = millis();
unsigned long PreviousTime = 0;
const long TimeOut = 10000;

// IPAddress ip = IPAddress(192, 168, 1, 126); /// needs to be changed according to user/client
// Added initial steps to setup() function

void setup() {

  Serial.begin(115200);

  pinMode(op1, OUTPUT);
  pinMode(op2, OUTPUT);

  digitalWrite(op1, LOW);
  digitalWrite(op2, LOW);

  Serial.println("Connecting to ");
```

```
  Serial.println(ssid);

  WiFi.begin(ssid, pass);
  while(WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }

  Serial.println("");
  Serial.println("WiFi successfully Connected.");
  Serial.print("IP Address: ");
  Serial.println(WiFi.localIP());

 /***
  * Pinger method to auto detect device is connected
  * or not
  */

  pinger.OnReceive([](const PingerResponse& response)
  {
    if (response.ReceivedResponse)
    {
      Serial.printf(
        "Reply from %s: bytes=%d time=%lums TTL=%d\n",
        response.DestIPAddress.toString().c_str(),
        response.EchoMessageSize - sizeof(struct icmp_echo_hdr),
        response.ResponseTime,
        response.TimeToLive);
    }
    else
    {
      Serial.printf("Request timed out.\n");
    }

    // Return true to continue the ping sequence.
    // If current event returns false, the ping sequence is interrupted.
    return true;
  });

  pinger.OnEnd([](const PingerResponse& response)
  {
    if(response.TotalReceivedResponses > 0)
    {
      Serial.println(WiFi.localIP());

            if(dcheck == false) {
              dcheck = true;
              IsManual = false;
              digitalWrite(op1, HIGH);
              digitalWrite(op2, HIGH);
            }

            ob1 = "ON";
            ob2 = "ON";

          }else {
            dcheck = false;
            IsManual = true;
            digitalWrite(op1, LOW);
            digitalWrite(op2, LOW);
            ob1 = ob2 = "OFF";
          }

          return true;
        });

```

```
121.          server.begin();
122.
123.          Serial.println("HTTP server started");
124.
125.        }
126.
127.        // Added loop steps in loop() function to perform continuously
128.
129.        void loop() {
130.
131.            WiFiClient Client = server.available();    // Finding available Clients
132.
133.          if (Client && IsManual) {
134.            Serial.println("New Client: ");
135.            String CurrentLine = "";
136.            CurrentTime = millis();
137.            PreviousTime = CurrentTime;
138.
139.            while (Client.connected() && CurrentTime - PreviousTime <= TimeOut) {
140.              CurrentTime = millis();
141.
142.              if(Client.available()){
143.                char ch = Client.read();
144.                Serial.write(ch);
145.                header += ch;
146.
147.                if(ch == '\n')
148.                {
149.                  if (CurrentLine.length() == 0) {
150.                    Client.println("HTTP/1.1 200 OK");
151.                    Client.println("Content-type:text/html");
152.                    Client.println("Connection: close");
153.                    Client.println();
154.
155.                    // turns the GPIOs on and off
156.                    if (header.indexOf("GET /5/on") >= 0) {
157.                      Serial.println("GPIO 5 on");
158.                      ob1 = "ON";
159.                      digitalWrite(op1, HIGH);
160.                    } else if (header.indexOf("GET /5/off") >= 0) {
161.                      Serial.println("GPIO 5 off");
162.                      ob1 = "OFF";
163.                      digitalWrite(op1, LOW);
164.                    } else if (header.indexOf("GET /4/on") >= 0) {
165.                      Serial.println("GPIO 4 on");
166.                      ob2 = "ON";
167.                      digitalWrite(op2, HIGH);
168.                    } else if (header.indexOf("GET /4/off") >= 0) {
169.                      Serial.println("GPIO 4 off");
170.                      ob2 = "OFF";
171.                      digitalWrite(op2, LOW);
172.                    }
173.
174.                    // Display the HTML web page
175.                    Client.println("<!DOCTYPE html><html>");
176.                    Client.println("<head><meta name=\"viewport\" content=\"width=de
    vice-width, initial-scale=1\">");
177.                    Client.println("<link rel=\"icon\" href=\"data:,\">");
178.                    // CSS to style the on/off buttons
179.                    // Feel free to change the background-color and font-
    size attributes to fit your preferences
180.                    Client.println("<style>html { font-
    family: Helvetica; display: inline-block; margin: 0px auto; text-
    align: center;}");
```

```
                    Client.println(".button { background-
    color: #195B6A; border: none; color: white; padding: 16px 40px;");
                    Client.println("text-decoration: none; font-
    size: 30px; margin: 2px; cursor: pointer;}");
                    Client.println(".button2 {background-
    color: #77878A;}</style></head>");

                    // Web Page Heading
                    Client.println("<body><h1>ESP8266 Web Server</h1>");

                    // Display current state, and ON/OFF buttons for GPIO 5
                    Client.println("<p>GPIO 5 - State " + ob1 + "</p>");
                    // If the output5State is off, it displays the ON button

                    if (ob1=="OFF") {
                      Client.println("<p><a href=\"/5/on\"><button class=\"button\">
    ON</button></a></p>");
                    } else {
                      Client.println("<p><a href=\"/5/off\"><button class=\"button b
    utton2\">OFF</button></a></p>");
                    }

                    // Display current state, and ON/OFF buttons for GPIO 4
                    Client.println("<p>GPIO 4 - State " + ob2 + "</p>");
                    // If the output4State is off, it displays the ON button

                    if (ob2=="OFF") {
                      Client.println("<p><a href=\"/4/on\"><button class=\"button\">
    ON</button></a></p>");
                    } else {
                      Client.println("<p><a href=\"/4/off\"><button class=\"button b
    utton2\">OFF</button></a></p>");
                    }
                    Client.println("</body></html>");

                    // The HTTP response ends with another blank line
                    Client.println();
                    // Break out of the while loop
                    break;
                  } else{
                    CurrentLine = "";
                  }

                } else if (ch != '\r'){
                  CurrentLine += ch;
                }

              }
            }

            header = "";
            Serial.println("Client Disconnected.\n");
            Client.stop();

          }
          else {
            Serial.println("Piniging is here");
            IsConnected();
            delay(10000);
          }
        }

        /***
         *
         * In this part I've created some custom function
         * to hanlde webpage to display the switches status.
```

```
238.         *
239.         */
240.
241.         void IsConnected() {
242.
243.           if(pinger.Ping(IPAddress(192, 168, 118, 113)  )) {
244.            Serial.println("Device found");
245.          } else {
246.            Serial.println("Device not found");
247.          }
248.
249.         }
250.
```

# Chapter 6

# Goal and Uniqueness

## 6.1 Goal

The basic most vital goal of home automation is to ensure the amenity of user time and making life simpler even if it guided us to frugal of electricity. The importance here is on objectives; for each smart thing automation project, they are distinct. However, epiphany during the construction that home mechanization without sensationalizing it can stabilize our daily lives. There was a lengthy method of gradual reasoning, wherein hypothesis it was checked whether all that does something in house cloud or should be automated. Architecture is coming up the first step before jumping into intervention. During the real execution of any scheme, a lot of rework needed such as a home mechanization system. We inaugurated the system by keeping some questions in mind which are-

- Which type of appliance should I want to govern?
- Is this governance should have specific access use only or not?
- Is the cost of being a solicitude?
- Is vigilance important?
- Can it be possible for installing it for myself?

### 6.1.1 Established Goals

First, we assembled a system consisting of controlling-unit, web server and internet connection. Then, we will create a webpage and upload it to the webserver. Uploaded web page will be the user interface for the following goals.

1. Controlling all loads.
2. Monitoring all load's power consumption.
3. Calculating total power consumption.
4. Providing time-varying electricity prices and suggestions regarding the price.
5. Scheduling some loads when total power consumption exceeds the peak value.

## 6.2 Uniqueness

### 6.2.1 Simplicity and Ingenuousness

Simplicity is a significant consideration, although it is difficult to accomplish. However, it is enormously complex quite convoluted to be resolute interfaces. Automation is the main focus, along with generating green energy through PV sell this implies the automation system does what is desired or needed effectively and efficiently, only initiating human influence messages.

### 6.2.2 Usability

Anyone can use this system such as a nonprofessional individual can be capable to use it in a definite broaden and also arrange the system without a console screen. In addition, because of

having ingenuousness of the system can only see an indisputable form a functional prospect else from a structural prospect. Access to web pages and operating appliances for any task is suitable. There is no complex situation programmed to work the system functionally.

### 6.2.3 Affordability or Economical

If not hundreds of thousands of bucks, domestic home automation will cost huge. Household automation with only a very few appliances controlled, a single-family home management scheme will readily surpass 850,000 Tk. Nobody wants to spend such much cash on sensors, actuators or parts of home automation in particular. The home improvement path was completely viable based on electronics and engineering hence the path shortlisted.

### 6.2.4 Efficiency

Though energy consumption is a significant factor in the functioning of a home automation scheme, some preconditions are almost compulsory. As we are constructing a fresh home, by constructing the residence from the beginning, we have left no question unanswered to discover efficiency improvements. Most of our lighting is LED-based and energy-efficient after automation. Timer, incident, intensity, as well as transient triggers, will continue to use these lights. After automation, we are focusing on generating green energy to save energy consumption from the main grid and as well as nature. The generating green energy power will work on the basic components. In such a manner we save extra energy consumption cost and nature.

# Chapter 7

# Conclusion

## 7.1 Summary

This project depicts the home energy management by using systematic usages of home appliances in a smart home. It is a novel proposed model that we implemented at a minimum cost system to determine an authentic smart home by using its intelligent management of home appliances inefficient manner. The home mechanization framework includes a lot of systems and diverse technology. Home customization innovation looks to decrease your worry by guaranteeing your house is secure notwithstanding when you are far away. It is additionally intended to lessen the measure of exertion you put each day into running your family so you can concentrate more on yourself and the general within it. Envision if your home could naturally set aside save you cash, time and exertion. With a large number of these effectively settled and effectively improving frameworks, these aspirations are conceivable. We accomplished this project into two steps through the utilization of solar power beside the grid line in a skillful way and a user-friendly dedicated authentic webpage to monitor and operate the apparatus that will make busy life more pleasant and hassle-free. The leading goal of this project is to use home energy-inefficient form by abating unnecessary energy waste, money and improve a user-friendly home appliance management. The efficiency of the cost management system in this project inferior enough compared to any other automatic method available in market. Additionally, we also implement a different type of appliances in this circuit. It will help to operate the household smoothly. They need a framework that is strong and keeps running as one unit that issues directions that are astute and appropriate for the homeowner a way of life without them saying it. Regardless of whether through one-time programming or by figuring out how to examine movement and follow up on its own, these projects are worked in light of the client. Keen home frameworks will just proceed to develop and turn out to be further developed. Numerous devices and frameworks are intended to either mix in with the environment or even stand out as an announcement piece. So, while shrewd home frameworks may set aside some effort to comprehend and ace, they will, and as of now are, making life simpler.

## 7.2 Future Research

As the innovation for savvy homes keeps on advancing, the scope of capacities is just going to grow. Right now, home customization is proceeding to evolve. In future things have taken ordinary assets and transformed them into computerized gadgets, to catch data about your own utilization propensities and adjust to them. Homes of things to come might just accompany shrewd home highlights worked in, considering the rate at which these advances are being formed and incorporated into our regular day to day existence. However, a few people might need to establish and further redo home mechanization gadgets by themselves.

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