Design & Implementation of IoT Based Grid System

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DECLARATION OF AUTHENTICATION

We certify that the research/project based thesis titled, "**Design & Implementation of IoT Based Grid System**" is completely our group work. All sources and knowledge for this paper which were found by other researchers are acknowledged by reference. Materials of work such as images, figures, tables and citations in this paper are accepted by our Supervisor. We hereby declare that this thesis has not been previously submitted either in whole or in part, for any other degree or publication.

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Certification

This is to certify that this project entitled "**Design & Implementation of IoT Based Grid System**" is done by the following students under my direct supervision. This project work has been carried out by them in the laboratories of the Department of Electrical and Electronic Engineering under the Faculty of Engineering, Sonargaon University (SU) in partial fulfillment of the requirements for the degree of Bachelor of Science in Electrical and Electronic Engineering.

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List of Abbreviations

IoT	Internet of Thigh
SGS	Smart Grid System
LED	Light Emitting Diodes
ISP	In System Programming
EEPROM	Electrically Erasable Programmable Read-Only Memory
PWM	Pulse Width Modulation
USB	Universal Serial Bus
ICSP	In-Circuit Serial Programming
AC	Alternating Current
DC	Direct Current
IDE	Integrated Development Environment
SRAM	Static Random Access Memory
UART	Universal Asynchronous Receiver/Transmitter
SPP	Serial Port Protocol
AFH	Adaptive Frequency Hopping Feature

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ABSTRACT

The transmission lines plays an important role for transmitting power from generation end to consumer end. In traditional electrical grid network energy is generated in centralized power plants and it is not possible to communicate bidirectional. Smart grid system is the advancement of convectional electric grid system. Whenever one grid system that transfer power to consumer but due to some fault issue the power supply can be cut off. To overcome this difficulty we can connect all loads connected to grid station with some other station with the help of IOT. The IOT performs the function and maintenance by using different types of sensors. So we can give uninterrupted power supply to the consumer.

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CHAPTER 1

Introduction

1.1 Introduction

The Internet-of-Things (IoT) is a vision for an internetwork of intelligent, communicating objects such as home appliances, vehicles, factory machines, wearable devices and various types of sensors. The convergence of technologies like ubiquitous wireless communications, machine learning, real-time analytics and embedded systems has made novel IoT applications possible in a multitude of domains. A combination of commercial interests and government initiatives have made smart homes, smart healthcare, smart cities, and smart transport primary areas of focus for IoT application development. Internet-of-things-enabled personal healthcare applications will require sensors to collect data in smart spaces, such as smart homes or healthcare environments, and from wearable or implanted RFID tags. Data from RFID devices will provide insights into people's diurnal activities, help detect abnormal events, and possibly alert caregivers to problems. The idea of using an IoT to create smart cities may have originated with a 1990's era nationwide coalition, Smart Growth America (SGA). SGA sought to address issues related to urban environments, including resource management, transportation, and public administration. Recent government support for information and communication technology systems may finally allow the SGA's vision to be realized. Potential applications of IoT include the monitoring of building health, energy consumption, noise, and air quality; improved waste and traffic management; and smart lighting. The Internet-of-Vehicles (IoV) is a subfield of IoT that uses wireless technology to enable vehicles to communicate with their environment. IoV creates opportunities for developing novel applications in intelligent traffic control and management, road safety and vehicular safety such as online diagnosis, anti-theft systems and tracking. IoV enables vehicles to communicate utilizing multiple modes of communications including vehicle-to-vehicle, vehicle-to-network-to-vehicle, and vehicle-to-infrastructure communications. Smart home is a section of the IoT paradigm that aims to integrate home automation and security. Enabling objects in a typical household to

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be connected to the Internet allows home-owners to remotely monitor and control them. From lamps that are set on timers to turn off at a specific time of the day, to smart thermostats that will regulate the temperatures in a house and generate detailed reports about energy usage, smart homes have found its niche in the consumer market. The availability of affordable smartphones, micro-controllers and other open-source hardware along with the increasing use of cloud services, has made it possible to develop low-cost smart home security systems. With families having busier lives than ever, smart home automation and security systems can also cater to household members with limited mobility such as the handicapped and the old. The purpose of this paper is to present a low-cost architecture using RF based communication in a household to create an IoT-enabled smart home security system. Smart home devices that typically consume low power such as smart bulbs and door or window sensors use RF transceivers to communicate with each other. In this.

1.2 Defining Smart Grid Concept

It would be quite difficult to draw a clear distinction between a "smart grid" and a regular grid. Therefore, it is much more practical to consider "smart grid" as a term that enables the opportunities for improving power system operation. In general, the 'Smart Grid' can be defined as 'a system of systems'. It is a platform that enables functioning of different technologies and systems. It can be viewed as a better electricity delivery infrastructure. A Smart Grid is an electricity network that can intelligently integrate the actions of all users connected to it - generators, consumers and those that do both – in order to efficiently deliver sustainable, economic and secure electricity supplies [3]. See Figure 1 for a visual representation of the Smart Grid concept.

Here are some other definitions of the Smart Grid:

- A power system that contains multiple automated transmission and distribution (T&D) systems, all operating in a coordinated, efficient, and reliable manner. International Journal of Electrical and Electronics Engineering Research (IJEEER) ISSN 2250-155X Vol. 3, Issue 1, Mar 2013, 259-264 © TJPRC Pvt. Ltd.

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- A power system that serves millions of customers and has an intelligent communications infrastructure, enabling the timely, secure, and adaptable information flow, needed to provide power to the evolving digital economy.

The smart grid is a broad collection of technologies that delivers an electricity network that is flexible, accessible, reliable and economic. Smart grid facilitates the desired actions of its users and these may include distributed generation, the deployment of demand management and energy storage systems or the optimal expansion and management of grid assets

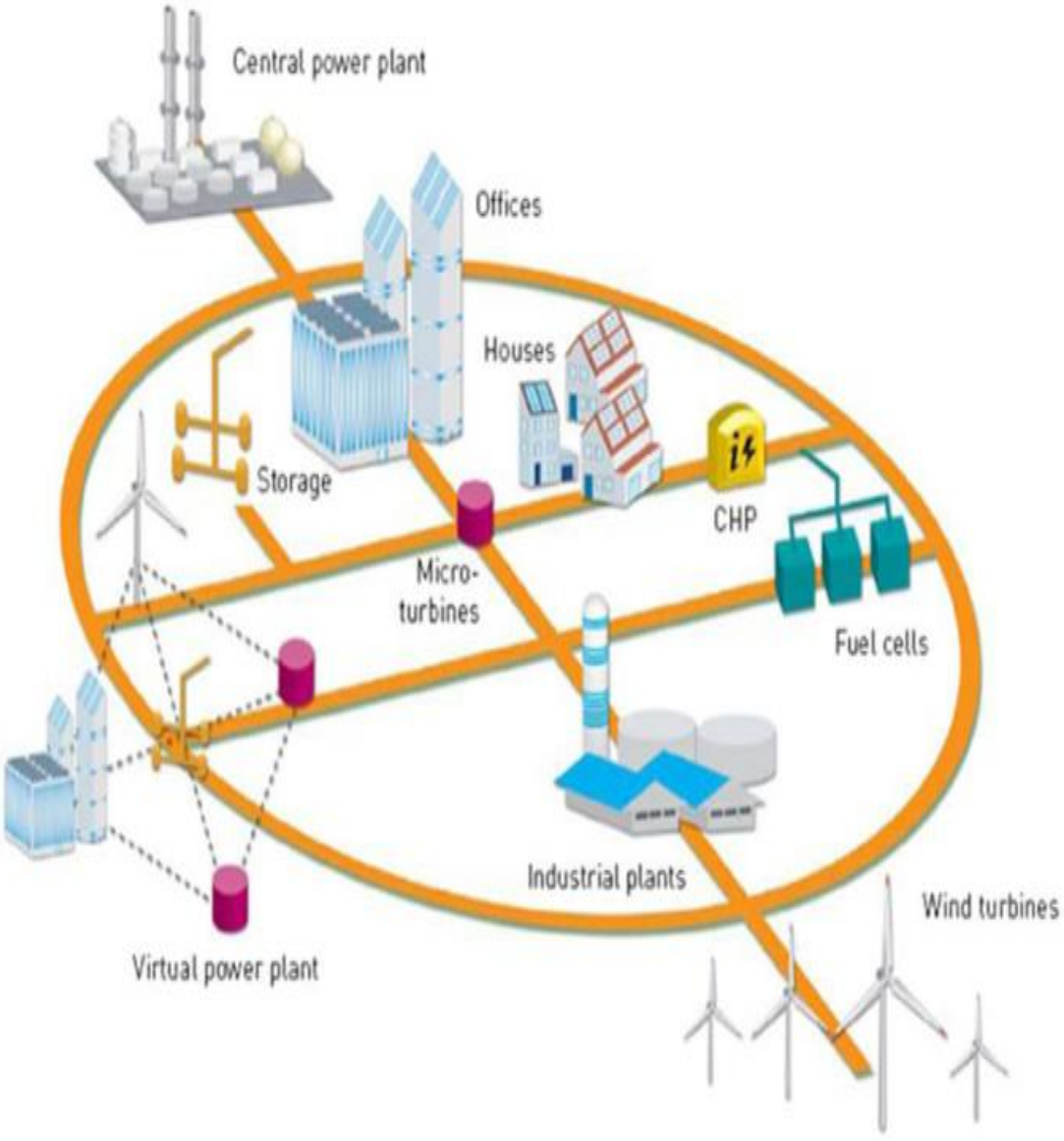

Figure 1.1: Smart Grid Concept

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1.3 Project Outline

Chapter 2 shows a study of the literature review of related work which was used to develop the project.

Chapter 3 describes the block diagram, working procedure, connection diagram and explanation.

Chapter 4 describes all the hardware devices and power supply to the project.

Chapter 5 reviews the results found through the project and provides a discussion on the findings.

Chapter 6 specified the limitations of the project, provides the future works that may be approached and conclusion.

1.4 Summary

Firstly, we discuss about smart grid, home automation. We also discuss about Benefits of Smart Cards and Advantages, Disadvantages of the security system. Then we discuss about problem statement, methodology and objective of this project. Lastly, we discuss about project outline in this chapter.

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CHAPTER 2

LITERATURE REVIEWS

2.1 Introduction

As an essential part of researching the three main questions posed by this thesis, it was necessary to examine and review available literature material for suitability for inclusion into this thesis. There are three sections to the literature review
Corresponding to each of the questions posed.

2.2 Smart grid System

The term smart grid may refer to any of a range of measures used to home appliance, Ram-raiding and lock picking, and prevent crimes such as burglary and home invasions. Smart grid is used in commercial and government buildings, as well as in residential settings.

2.3 Mechanism of Security Access System

Security access system runs on automated doors likewise on systems, which makes do with a smartcard device. When the smart card is inserted into it, it prompts the host for identification of card, if confirmed access will be granted, if not access will be denied. Before it denies access completely to that smartcard and pin code, the alarm gets activated when access is generated. The smartcard sends a voltage signal of 5volts which triggers the relay causing it to activate the home appliance.

2.4 Types of Security Access System

There are different types of electric security devices, they are; switch activated smart grid system, sound activated system, shadow access home appliance system, light detector security system, pressure pad, sensitive security system and smart grid security access system etc. these systems are designed to serve different purpose as their names implies, their operation are related because some of them give access while some deny access.

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2.5 History of Smart Grid

1) USAIn 2009, the Department of Energy established the „Grid 2030 Plan‟ to invest 386.2 billion Wonin an M2M-based smart grid project and other projects. Since 2012, they have been operating the Domain Awareness System (DAS) that connects the private and public CCTVs and sensors in New York City in order to prevent terrorism. The National Intelligence Council (NIC) selected the IoT as one of the disruptive civil technologies that will affect the national competitiveness and provide national support until 2025.

(2) ChinaThe Chinese State Council announced that they would invest 6 trillion Won in the IoT areas, including smart grid, in the mid-term to long-term science and technology development plan (2006~2020), and build an IoT industrial complex and research center near Shanghai in 2010. As a strategy to promote national projects and support policy, the Ministry of Industry and Information announced the IoT 12-5 Development Plan, which covers the national core technology development, industrialization, standard research,and establishment. The detailed goals of the IoT 12-5 Development Plan include over 500 major research achievements in the sensor, transmission, processing, application, and other technology areas, the establishment of more than 200 standards, and the cultivation of 10 industrial special districts and over 100 core enterprises.

(3) EUIn 2009, the EU announced the IoT Action Plan to invest 76.9 billion Won in the IoT research and development, and the construction of clusters. They selected a „future network basis‟ as one of the top seven R&D projects for the seventh term since 2009. They are now promoting R&D and pilot services according to the action plan with the goal of infrastructure construction to prepare for the connection of several billion population and several trillion things. Since 2005, they have obligated the installation of the vessel monitoring system (VMS) in all ships in Europe.

(4) JapanThey included a plan to develop M2M technologies and services based on the sensor network in the „i-Japan 2015 Strategy‟ in 2009. In 2011, they funded

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3.8 trillion Won for the development of the neighborhood-level technologies for things and devices. In order to create new industries based on the recent ICT convergence, they set the direction of the Internet of Computer (IoC) to Internet of Things (IoT) through digitalization and networking, and released policies and action plans for the cultivation of the top six strategic areas and infrastructure development projects.

2.6 The History of Home Security

Recently, many local governments have been aiming to implement an IoT-based smart city through the construction of a test bed for IoT verification and an integrated infrastructure. This movement also corresponds to the creative economy that is emphasized by the Korean government. In this chapter, smart city implementation models based on IoT that can be implemented by local governments are described through examples.

2.7 Summary

Firstly we discuss about smart grid system, Mechanism of security access system. We also discuss about Types of security access system, phone apps access systems, history of smart grid. Lastly we discuss about the history of home appliance.

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CHAPTER 3

THEORETICAL MODEL

3.1 Introduction

NodeMCU Libraries is the most important for NodeMCU based project. So that we briefly discuss about NodeMCU libraries, algorithm and working procedure of Smart grid system. We present our whole procedure in this project by the algorithm.

3.2 NodeMCU Libraries Used

3.2.1 Software Serial

The NodeMCU hardware has built-in support for serial communication on pins 0 and 1 (which also goes to the computer via the USB connection). The native serial support happens via a piece of hardware (built into the chip) called a UART. This hardware allows the NodeMCU chip to receive serial communication even while working on other tasks, as long as there room in the 32 byte serial buffer.

3.2.2 Functions Used

Software Serial (rx Pin, txPin)

Software Serial is used to create an instance of a Software Serial object, whose name you need to provide as in the example below. The inverse logic argument is optional and defaults to false. See below for more details about what it does. Multiple Software Serial objects may be created, however only one can be active at a given moment.

Rx Pin: The pin on which to receive serial data Tx Pin: the pin on which to transmit serial data.

Begin (speed)

Sets the speed (baud rate) for the serial communication.

Read ()

Return a character that was received on the RX pin of the software serial port. Note that only one Software Serial instance can receive incoming data at a time.

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3.3 Connection Diagram of Smart Grid System

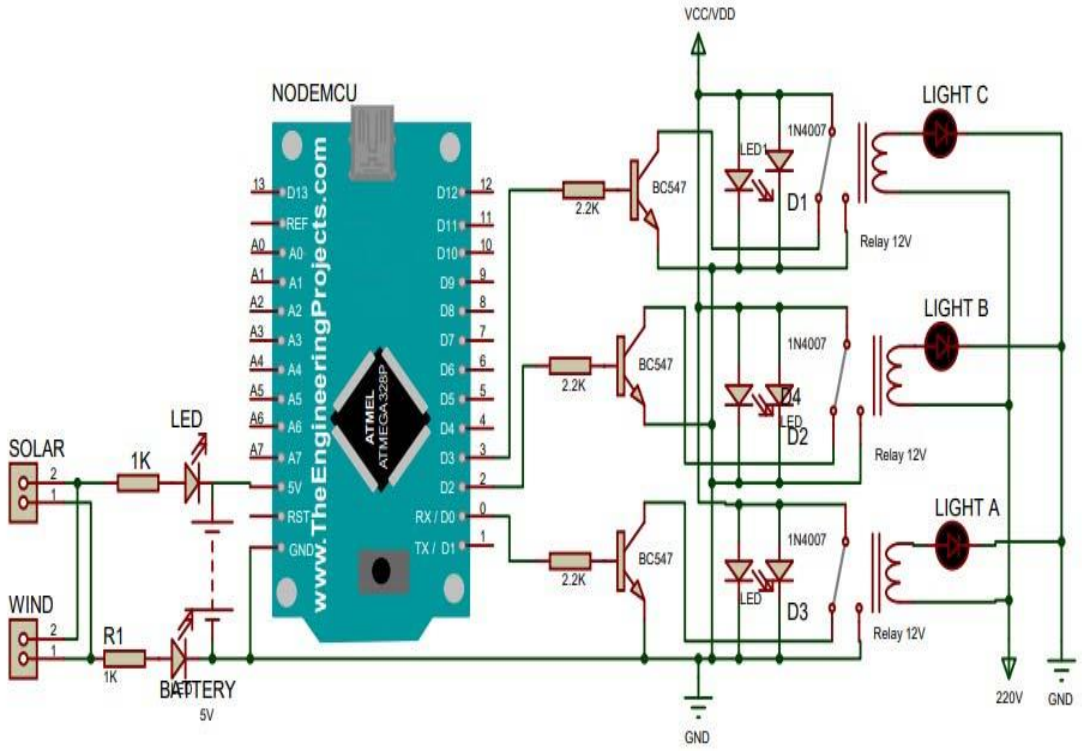

Figure 3.1: Connection Diagram of Smart grid System

3.4 Block diagram of Smart grid System

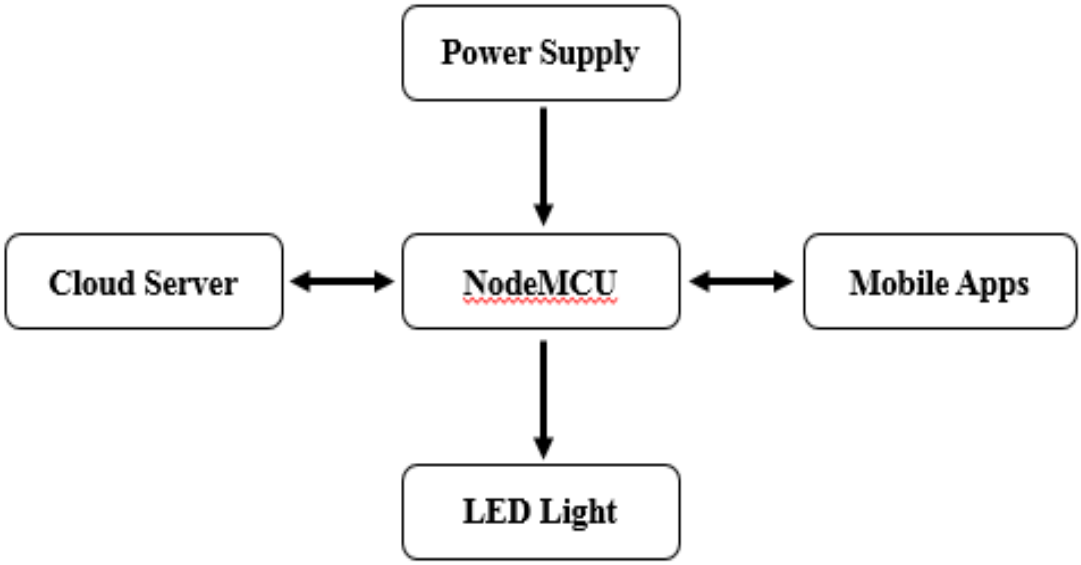

Figure 3.2: Block diagram of grid Security System

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Table No 3.1: The function of this project

System Block	Function
NodeMCU Microcontroller	As data processing center
Adaptor (5V)	As the power supply
LED	As indicator
LED Light	Mechanical working

The system required a program that must be implemented to the microcontroller. Programming language for the Arduino microcontroller is C language. To run the program and incorporate the program to the microcontroller needed software i.e. NodeMCU. Microcontroller NodeMCU has been equipped with an internal EEPROM, Flash memory, etc. This section will examine the input, and give orders to the LED, to fill out his program with the principle of ISP (In System Programming) so that the program can be done without removing control.

Power supply circuit is used to supply power throughout the series; the power needed for the whole series is equal to 5 Volts DC.

LED circuit serves as indicator for electric current. LED will turn on when current is 5V DC in LED Lamp condition, so the LED will be off when the passed from system current is not passed in the locked state.

3.5 Working Procedure

Firstly I give 5v dc power supply to the NodeMCU by using adapter. I used smart phone and Apps to control home appliance system. Here, I also used a WiFi. When I put the cloud inside the signal, sensor will sense our ID and instruct to motor to rotate 90 degree. That means door is open and LED light is ON. After 10sec door is automatically closed and LED also closed.

3.6 Summary

Firstly, we showed the connection diagram. Then we discuss about the block diagram and explanation. And lastly we briefly discuss about working procedure in this project.

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CHAPTER 4

Hardware Development

4.1 Introduction

Now-a-days the telecommunication technologies become wider and more new features exist to make human life better. This project will use a Bluetooth feature in mobile phone to automatically open the door so that Bluetooth technology syncs my phone directly with the lock.

4.2 Components Name and Quantity

Table No 4.1: Components Name and Quantity

SL	Component Name	Quantity
1	NodeMCU	1 Pcs
2	LED Light	3 Pcs
3	Relay	3 Pcs
4	LED	3 Pcs
5	Resistor	6 Pcs
6	Connecting Wire	As Require
7	Adapter	1 Pcs
8	Bread board	1 pcs

4.3 NodeMCU

The NodeMCU (Node MicroController Unit) is an open-source software and hardware development environment built around an inexpensive System-on-a-Chip (SoC) called the ESP8266. The ESP8266, designed and manufactured by Espressif Systems, contains the crucial elements of a computer: CPU, RAM, networking (WiFi), and even a modern operating system and SDK. That makes it an excellent choice for the Internet of Things (IoT) projects of all kinds.

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However, as a chip, the ESP8266 is also hard to access and use. You must solder wires, with the appropriate analog voltage, to its pins for the simplest tasks such as powering it on or sending a keystroke to the “computer” on the chip. You also have to program it in low-level machine instructions that can be interpreted by the chip hardware. This level of integration is not a problem using the ESP8266 as an embedded controller chip in mass-produced electronics. It is a huge burden for hobbyists, hackers, or students who want to experiment with it in their own IoT projects. But, what about Arduino? The Arduino project created an open-source hardware design and software SDK for their versatile IoT controller. Similar to NodeMCU, the Arduino hardware is a microcontroller board with a USB connector, LED lights, and standard data pins. It also defines standard interfaces to interact with sensors or other boards. But unlike NodeMCU, the Arduino board can have different types of CPU chips (typically an ARM or Intel x86 chip) with memory chips, and a variety of programming environments. There is an Arduino reference design for the ESP8266 chip as well. However, the flexibility of Arduino also means significant variations across different vendors. For example, most Arduino boards do not have WiFi capabilities, and some even have a serial data port instead of a USB port..

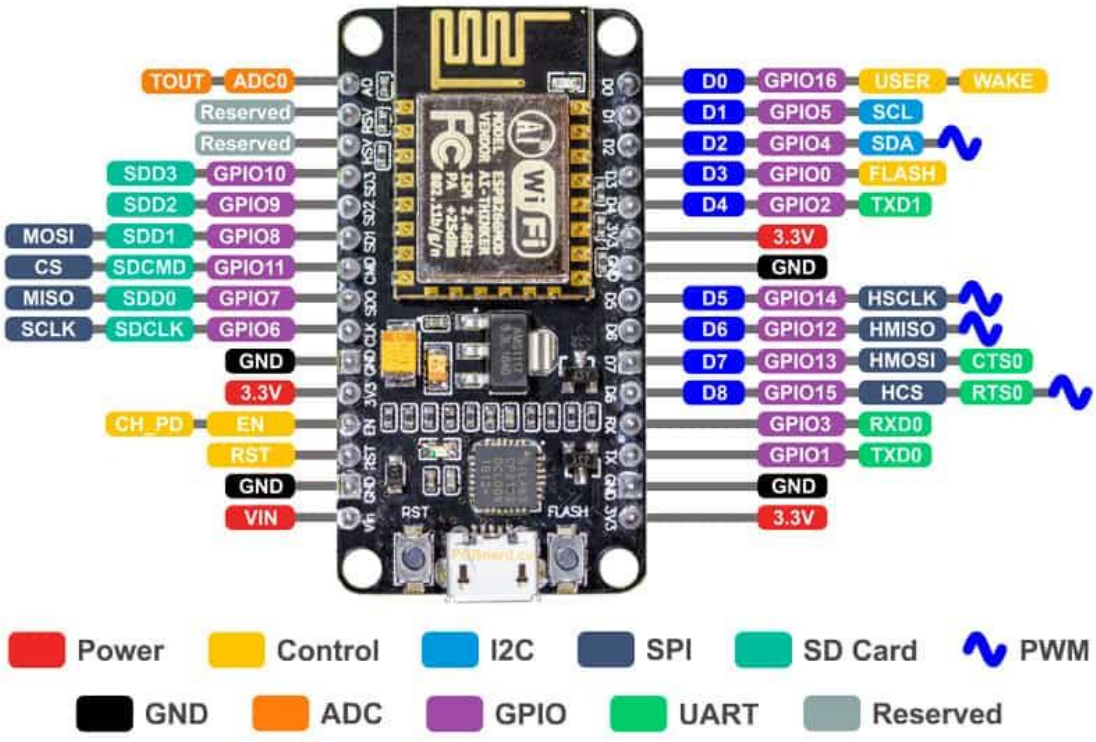

Figure 4.1: Identification NodeMCU

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4.3.1 Different Models of the NodeMCU

The NodeMCU is available in various package styles. Common to all the designs is the base ESP8266 core. Designs based on the architecture have maintained the standard 30-pin layout. Some designs use the more common narrow (0.9″) footprint, while others use a wide (1.1″) footprint – an important consideration to be aware of.

The most common models of the NodeMCU are the Amica (based on the standard narrow pin-spacing) and the LoLin which has the wider pin spacing and larger board. The open-source design of the base ESP8266 enables the market to design new varients of the NodeMCU continually.

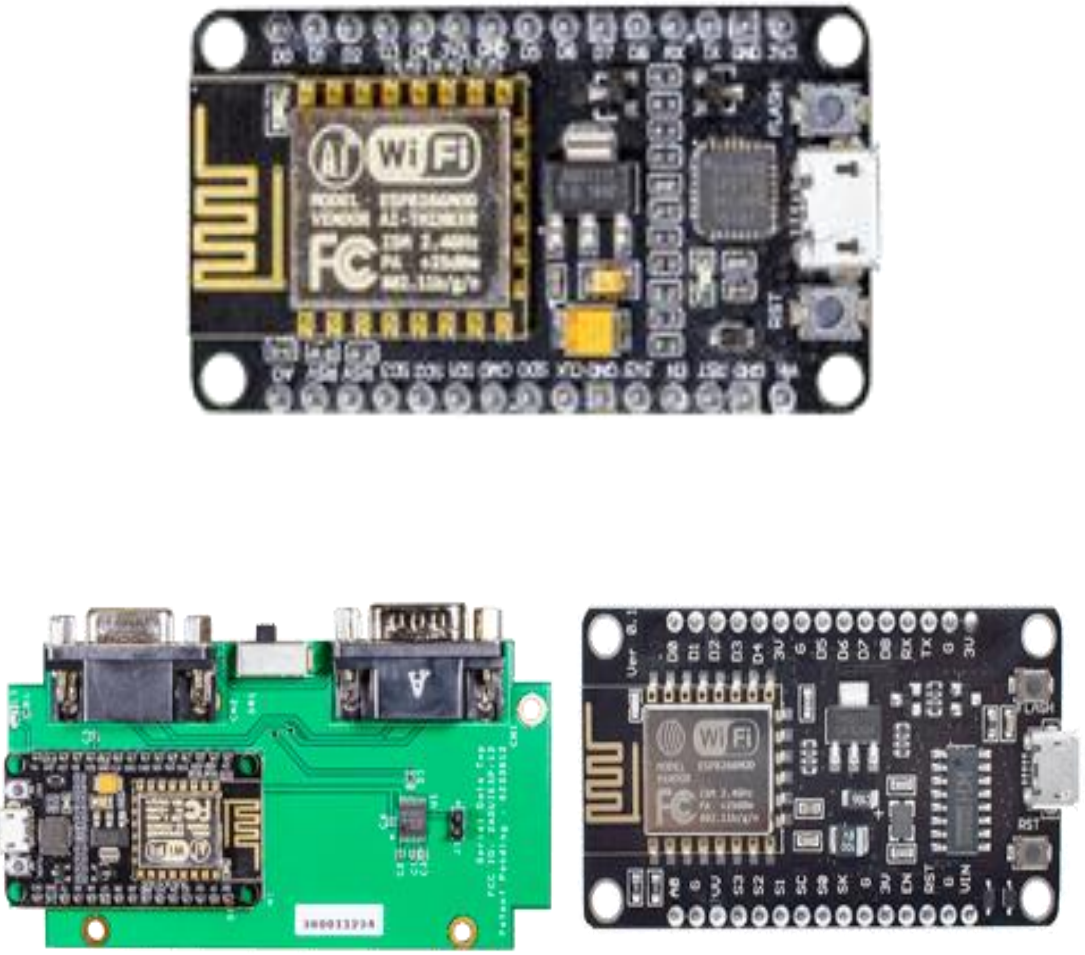

Figure 4.2: **NodeMCU**

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4.3.2 Power

The power pins are as follows:

• VIN: The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source).

• 5V: The regulated power supply used to power the microcontroller and other components on the board. This can come either from VIN via an on-board regulator, or be supplied by USB or another regulated 5V supply.

• GND: Ground pins.

4.3.3 Memory

The ESP-8266 32-bit has 4 MB / 64 KB of flash memory for storing code. It has also 2 KB of SRAM and 64 KB of EEPROM.

4.3.4 Inputs and Outputs

Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ESP-8266 USB-to-TTL Serial chip.

PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analog Write() function.

SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication, which, although provided by the underlying hardware, is not currently included in the Arduino language.

LED: 13, there is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

Reset. Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the on the board.

4.4 LED Light

Stands for "Light-Emitting Diode." An LED is an electronic device that emits light when an electrical current is passed through it. Early LEDs produced only red light, but modern LEDs can produce several different colors, including red, green, and blue

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(RGB) light. Recent advances in LED technology have made it possible for LEDs to produce white light as well.

LEDs are commonly used for indicator lights (such as power on/off lights) on electronic devices. They also have several other applications, including electronic signs, clock displays, and flashlights. Since LEDs are energy efficient and have a long lifespan (often more than 100,000 hours), they have begun to replace traditional light bulbs in several areas. Some examples include street lights, the red lights on cars, and various types of decorative lighting. You can typically identify LEDs by a series of small lights that make up a larger display. For example, if you look closely at a street light, you can tell it is an LED light if each circle is comprised of a series of dots.

The energy efficient nature of LEDs allows them to produce brighter light than other types of bulbs while using less energy. For this reason, traditional flat screen LCD displays have started to be replaced by LED displays, which use LEDs for the backlight. LED TVs and computer monitors are typically brighter and thinner than their LCD counterparts.

Figure 4.3: LED Light

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4.5 Lamp Holder

Figure 4.4: lamp holders

Lamps are usually inserted in lamp holder sockets which provide electrical connections to the lamp and support it in the lighting fixture. The use of sockets allows lamps to be safely and conveniently replaced at the end of life, or to change power, color, lighting technology or etc. There are many different standards for these lamp holders, created by de facto and by various standards bodies. A general coding system is a letter or abbreviation followed by a number. Some miniature lamps have wire leads suitable for direct connection to wires; some reflector lamps have screw terminals for wire connections.

4.6 LED

Light Emitting Diode is abbreviated as LED. They are used at different places such as street lighting; home LED lighting, commercial LED etc. LED lights are small light bulb which fits into the electrical circuit. Working mechanism of LED lights is

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depending upon the electrons in the semiconductor. LED lights have more lifespan then other ordinary lights.

Figure 4.5: LED

4.7 Resistor

A resistor is an electrical component that limits or regulates the flow of electrical current in an electronic circuit. Resistors can also be used to provide a specific voltage for an active device such as a transistor

Figure No 4.6: Resistor

4.8 5 Volts Adapter

An adapter or adaptor is a device that converts attributes of one electrical device or system to those of an otherwise incompatible device or system. Some modify power or signal attributes, while others merely adapt the physical form of one electrical connector to another.

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Figure 4.7: 5 Volt Adapter

4.9 Summary

Firstly we discuss about components name which are used in this project. Then we discuss about NodeMCU where we briefly discuss about why NodeMCU, technical specification, power, inputs outputs, memory, communication etc. Then we briefly discuss about LED Light, Relay, Light Holder, resistor and 5 volts adapter in this chapter.

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CHAPTER 5

RESULT AND DISCUSSIONS

5.1 Introduction

Result presents the success of a project. We find out the successful result of this project by different experiment.

5.2 Apps control using home appliance

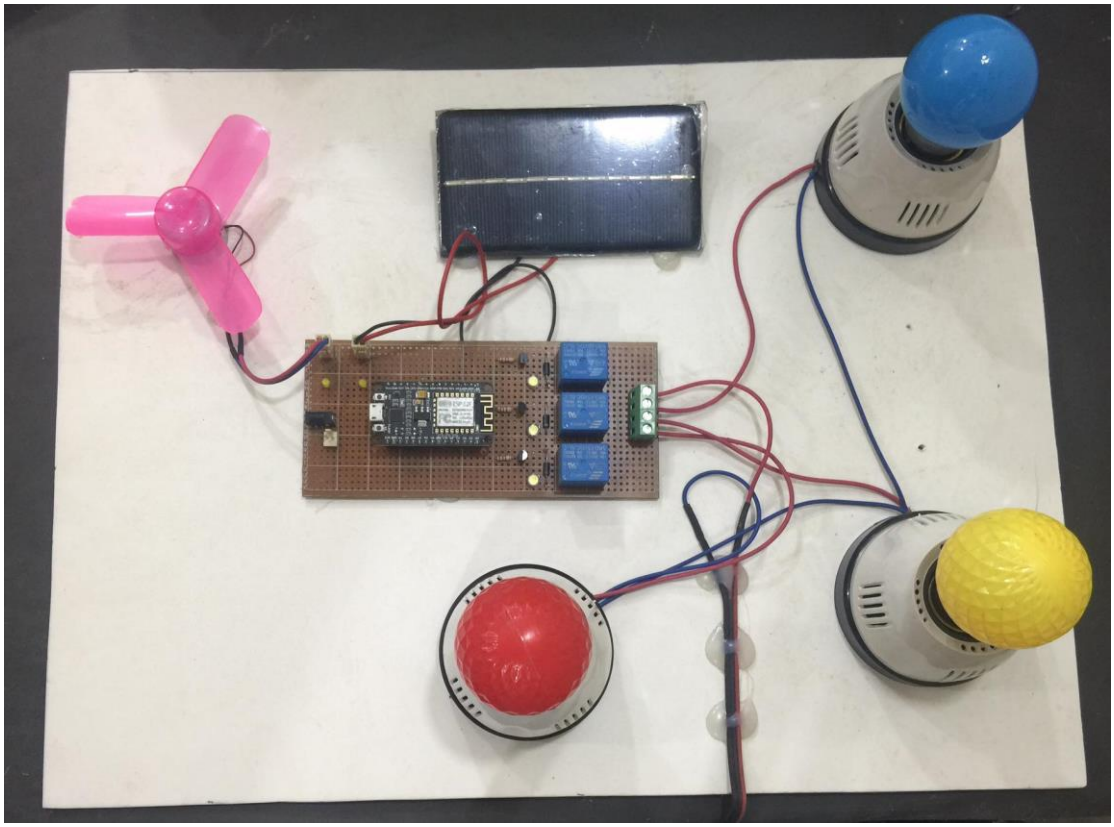

Figure 5.1: Project image

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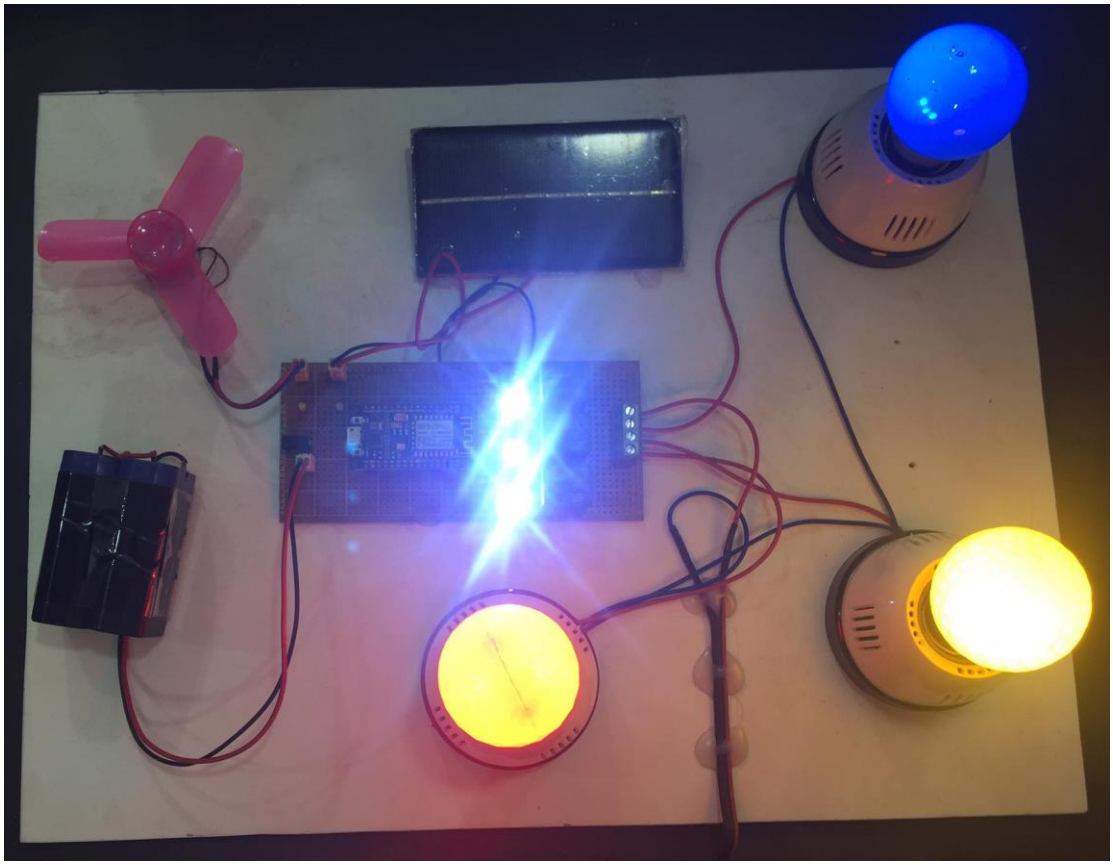

Figure 5.2: Smart grid system

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5.3 Total Project Cost, Quantity and Price

Table No 5.1: Equipment Cost

SL	Equipment Name	Quantity	Price(TK)
1	NodeMCU	1	600
2	Light	3	200
3	5V Adapter	1	200
4	Light Holder	3	200
5	Relay	3	200
6	Diode	3	30
7	White board	As necessity	800
8	LED	5	30
9	Glue	1	50
	Wire	As necessity	200
	Bread board	1	100
		Total Project Cost =	2,886Tk

5.4 Summary

Firstly we discuss about Control door security using Smart Grid, use Cloud and phone Apps use home appliance. Finally I discuss Total Project Cost, Quantity and Price.

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CHAPTER 6

CONCLUSIONS

6.1 Conclusions

This study is significant in outlining general information about IoT, such as definition, market size, and status of IoT, which has become a hot IT topic nowadays, and in presenting applicable IoT business models to help business entities and research institutes participating in related projects build a smart city as part of the future vision of local governments by reflecting the new information paradigm of IoT. A limitation of this study, however, is the lack of available data in Korea that hinders the required empirical analysis on the benefits of IoT technology. We hope that more research in this field will be conducted in the future.

6.2 Overview of Smart Grid System

The real-time two-way communications available in a Smart Grid will allow customers to be compensated for their efforts to save energy and to sell energy back into the grid through Advanced Metering technologies. After spreading distributed generation concepts such as residential solar panels and small wind turbines, the Smart Grid will improve the efficiency of energy industry by providing green energy recourses and reducing peak loads. It will allow small domestic customers and businesses to sell power to their neighbors or even back into the distribution grid. The same concept can beapplied to larger commercial organizations that have renewable power systems that can give the excess power back into the grid during peak demand hours. Implementation of Smart Grids promises to reduce grid operational expenses, enhance asset management, and improve distribution operations.

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6.3 Future Scopes

There are a lot of scopes to develop in this project like we can use GSM module instead of Bluetooth module. It can increase our control rage as well as it can notify us in case of insecure situation by sending us message or dialing call.

We can control our home security through internet. By this, we can always check last update of home security.

Not only it, we can also use biometric security system instead of smart card security system. It can protect our home from unexpected person entrance.

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Appendix

The code used in NodeMCU

```
#define LED1 16  //D0
#define LED2 5   //D1
#define LED3 4   //D2

void setup() {
  Serial.begin(9600);

  pinMode(LED1, OUTPUT);
  pinMode(LED2, OUTPUT);
  pinMode(LED3, OUTPUT);
  delay(1500);
}

void loop()
void onLight1Change()  {
  if (light1 == 1)
  {
    digitalWrite(LED1, HIGH);
  }
    if (light2 == 1)
    {
      digitalWrite(LED2, HIGH);
    }

    if (light3 == 1)
    {
      digitalWrite(LED3, HIGH);
    }
    else
    {
      digitalWrite(LED1, LOW);
      digitalWrite(LED2, LOW);
      digitalWrite(LED3, LOW);
    }
}
```


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