UNIVERSITI TEKNIKAL MALAYSIA MELAKA

"DEVELOPMENT OF HOME ELECTRIC USAGE NOTIFICATION & MONITORING SYSTEM USING NODEMCU

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electronics Engineering Technology (Telecommunications) with Honours.

by

DHEVANNATH A/L TANGARAJAN

FACULTY OF ELECTRICAL AND ELECTRONIC ENGINEERING TECHNOLOGY

2021

DECLARATION

I hereby, declared this report entitled “Development of Home Electric Usage Notification & Monitoring System Using Nodemcu is the results of my own research except as cited in references.

Signature: ……Dhevan……

Author : DHEVANNATH A/L TANGARAJAN

Date: 15/1/2021

APPROVAL

This report is submitted to the Faculty of Electrical and Electronic Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Electronics Engineering Technology (Telecommunications) with Honours. The member of the supervisory is as follow:

Signature: .....

Supervisor: TS. FAKHRULLAH BIN IDRIS

ABSTRAK

Penggunaan elektrik di Malaysia meningkat secara mendadak setiap tahun kerana penggunaan elektrik dalam peralatan rumah lebih tinggi. Tujuan kertas ini adalah untuk membangunkan prototaip sistem pemberitahuan & pemantauan penggunaan elektrik rumah menggunakan Nodemcu. Sistem yang dicadangkan boleh memaklumkan dan memantau pemakaian penggunaan tenaga elektrik pengguna dari segi arus, kuasa, kilowatt jam dan penukaran Riggit Malaysia mengikut Tarif TNB. Bill elektrik yang sedia ada dengan semua maklumat akan dipaparkan melalui LCD pada peranti prototaip itu sendiri dan juga ciri pemantauan dalam talian melalui telefon pintar. Sistem ini terdiri daripada Arduino Mega yang dipasangkan dengan sensor di mana sensor akan mengesan arus beban yang melalui kabel hayat. Bahagian pengatucaraan dicipta untuk penukaran maklumat dari sensor kepada ampere. Tarif TNB akan digunakan sebagai rujukan untuk menghasilkan bil elektrik dan kuasa yang akan ditambah dalam struktur pengaturcaraan. Untuk memudahkan pengguna memantau penggunaan tenaga, modul Nodemcu akan digunakan untuk membuat peranti IoT. Di samping itu, Relay akan ditambah ke sistem di mana pengguna dapat mengawal peralatan apabila penggunaan kuasa tinggi untuk peralatan rumah. Sistem ini membantu pengguna menyedarkan jumlah peralatan rumah tertentu dan menguruskan penggunaannya untuk menjimatkan elektrik. Selain itu, ia dapat membantu pengguna untuk merancang belanjawan mereka pada bulan yang akan datang kerana tanpa mengetahui jumlah tenaga elektrik yang digunakan, sukar bagi pengguna tertentu merancang belanjawan mereka.

ABSTRACT

The consumption of electricity in Malaysia rapidly rises every year because of higher utilization of electricity in home appliances. The aim of this paper is to develop a prototype of a home electric usage notification & monitoring system using Nodemcu. The proposed system can notify and remotely monitor the energy usage consumption of the consumer in current, power, kilowatt hour and conversion of RM according to TNB Tariff. The existing electricity bill with all the information will be display through LCD on a prototype device itself and online monitoring features through smartphone. The system consists of Arduino Mega which interface with the current sensor where the sensor will detect the load current that went through the life cable. A programming part is created for the conversion from the sensor to the ampere. TNB tariff will be used as a reference to produce an electric bill and power which will be added in programming structure. The efficient way for the consumer to monitor their energy consumption, Nodemcu module will be used to make IoT device. Additionally, a relay will be added to the system where consumer able to control the appliances whenever the power usage is high for home appliances. This system helps the user to realize the amount of certain household appliances and manage the usage of it to save electricity. Furthermore, it would able to help users to plan their budget on coming month because without knowing the amount of electricity been used it will be hard for certain users to plan their budget.

DEDICATION

I dedicate this project report to my beloved parents and friends. A special thanks to my mother Mrs. Kogilam A/P Muniandy and father Mr. Tangarajan A/L Venoo who both always being support my ideas and give encourage to do this project. I also being grateful to thanks my supervisor TS. Fakhrullah bin Idris who give lot of ideas and share her knowledge on doing report. I will always appreciate the help and knowledge shared especially by Mr Kishen, Mr Sureian and Mr Loga.

ACKNOWLEDGEMENTS

I would like to express my sincere acknowledgement to my supervisor TS. Fakhrullah Bin Idris from the Department of Electronic and Computer Engineering Technology from Faculty of Engineering Technology, University Technical Malaysia Melaka (UTeM) for their guidance, advices and suggestion during the whole period of this project. I would like to thank everyone who is involved in this project either directly or indirectly for their helps and cooperation, and to my family. Without their support I would not have been able to finish my final year project.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1
INTRODUCTION

1.0 Background

The power consumption and savings become the big issues nowadays. The uses of the electricity in Malaysia are increasing day by day. The domestic user such as residential customers is not aware about the total power used in daily life. This happen for the user that use air conditioner in their house. As all know the uses of air conditioner may increase the tariff.

Generally, bills are often prepared by assuming and if it is a digital energy meter user are unlikely to know the amount of usage because the lack in tariff calculation. Therefore, to overcome this problem a home electric usage notification & monitoring system is designed to monitor and notify the energy usage consumption in household's appliances most probably to air conditioner. The home electric usage notification & monitoring system which has an ability to notify and alert the consumer regarding usage energy consumption and at the simultaneously the consumer keeps track of the electric bill via app.

The main reason beyond developing this system is to empower the customer on the most proficient method, which effectively reduce energy utilization. Expanding and squandering of power utilization had given bad impact on the world. Arduino is use as an interface with current sensor where the sensor will detect the current charge that went pass to life wire. A programming part was developed into a transformation from a sensor into ampere unit. Moreover, an equation to pick up the energy and sum of all for obtain a power invoice with the recommendation by TNB tariff would be added in a programming construction.

The consumption of power and current charge can be detected by used of ACS712 Current sensor, which have the capability to show up electricity invoice with each and every information can be lay out via LCD on a prototype device itself and online monitoring features through smartphone. NodeMCU module will be utilized to make IoT device to make a good method for user to look up their energy expenditure. The main controller will apply these modules to forward all information into cloud storage server. The architecture of system will give access to the consumer to monitor their energy meter online through smartphone application. Additionally, when the consumer exceeds the limit of their energy usage and it operates in offline mode too the Blynk application send notification to the consumer. Meanwhile, a buzzer sound heard when the limit is reach and the consumer need to off the home appliances for temporary action.

The monitoring and control process of the appliances whenever the power usage is high for home appliances, a relay will be added to the system. It helps the user

to realize the amount of certain household appliances and manage the usage of it to save electricity. This system will be able to help users to plan their budget on coming month because without knowing the amount of electricity been used it will be hard for certain users to plan their budget.

1.1 Problem Statement

When the consumption energy become wide these energy meter has been introduced for residential and industrial section. The main function of energy meter is to detect energy and display it in kw/h. Energy meter is widely used in the world, when it is widely used proportionally along the growth of energy a lot of problems occur (Clenitiaa and Ilakya, 2017). Hence, this project implements in Malaysia, Tenaga Nasional Berhad (TNB) print out the bill which we can never figure out the amount of usage. When it comes to the festive season or during MCO during covid-19 the electricity usage will rise, and high electricity bill will be the big burden for customers itself.

There is no proper alerting system to the consumer and monitoring device that help the consumer to track the energy consumption in daily life. These contribute to the key problems of the current world that is the excessive energy consumption. Daily production of vast amounts of energy underwrites to the pollution that primes to the ozone hole, which has a great deal with the greenhouse effect, that prompts the liquefying of ice. Therefore, user should not quit utilizing energy sources that make our live more comfortable or facilitate the replacement of older appliances with new. This action may contribute to reduce energy consumption.

Additionally, this will help the user to concern about advantages of decrease the amount of energy were utilized system able to display and notify the total energy used. Hence, user also can trace out the total monthly electricity consumption to get a simple view on how often electricity they were used. By using the Home Electric Usage Notification and Monitoring system a user can record and view the power and current charge consumption in kilowatt-hour and RM value according to TNB tariff in the LCD and cloud server. The consumer will able to get a notification regarding the energy consumption through smart phone once the set limit was exceeded.

1.2 Objective

- To develop the Home Electric Usage Notification & Monitoring system mechanism via NODEMCU.
- To alert and notify consumer the utilized electric bill once set limit of ringgit Malaysia (RM) has reached.
- To measure and calculate the electric current usage based on tariff set by TNB.

1.3 Scope

The scope for this project is mainly introducing smart advance technology to residential houses for notify and monitor their usage. Arduino Uno shall be used in this project for monitoring, notify and calculating the usage of energy.

This model project was restricted to the charge test current that is not more than 30A because of utilization of the 30A current load sensor. The Blynk Application use in this project to alert consumer when the set limit by the user has reached. The limit for the RM can be set according to the user preference. Basically, this product can be beneficial for the low-income consumers especially B40 group.

1.4 Summary

This chapter has covered the background of the project, problem statement, objectives, and scope of the project. The background of this project is about home electric usage notification & monitoring system. This project is designed to improve recent energy meter which can help users to conserve and use electricity wisely in their daily life. The objectives had been explained briefly and the scope discuss the software and hardware that bean was utilized in these projects.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

Electricity is the main essential necessities for human being for their life. This is non- renewable energy source therefore we must use it judiciously for its sustainable utilization (Tan, Lee, & Mok, 2007). As the innovation develops day by day the Electric energy meter developed from the customary mechanical energy meter until the purpose that the innovation booked into GSM and GPRS. This part basically for the background, statistics and theory, previous research and relationship between techniques used by the journalist. The source of information related to the proposed system is obtained from journal, articles, research paper and Internet. The sources have been read, reviewed, analyses and compared in order the identify the technology been used, the working principle and methods that been applied to implement their projects. The related topics were collected and will be discussed on these chapter. All The pattern of source used can be clearly seen and explained.

2.1 The History of Electricity

In Malaysia, Electric at first seemed on the role of the 20th century, then most dependable record of energy age can be pursued back to a bit of mining town in Rawang, Selangor. The two tycoons had been important in Rawang's history Loke Yew and K. Thamboosamy Pillai who were stated to be the first to install electric powered generator pumps to perform their mines inside the town. At a similar time, modern deliver for avenue lighting expectancies related to Rawang city, and in 1895 the railroad stations in Kuala Lumpur were given its first power supply. In 1900, the Sampan Hydroelectric Power Station in Raub, laboured with the aid of the Rabu Australian Gold Mining Company transformed to the energy station in Malaysia. Electricity stand as an advancement industry today, despite political encroaching on the area, nation, and authorities' level.

On 1st September 1949, Central Electricity Board (CEB) was set up and start to perform. This board became re-established in April 1946 under National grid and heir to three essential initiatives consider with the aid of the Electricity Department. CEB on that time can generate potential of 39.88 MW and end up the owner of 34 energy station in Malaysia. This board most effective worked on until 22 June 1965, because Central Electricity Board became renamed to National Electricity Board (NEB). By the year 1980 this board can supply the electricity to the entire peninsular of Malaysia and after two years of operation this board had replaced Perak River Hydro Electric company. Then Malaysia Prime Minister Mahathir Mohamad have announced that new legislation was approved and replaced the Electricity Act and carry out the brand-new organization. To be succeed the National Electricity board (NEB), Tenaga

Nasional Berhad (TNB) turned into formed in 1990. TNB is the largest publicly listed strength business enterprise in the Southeast Asia and is the electric powered application organization in Peninsular Malaysia. TNB additionally become the non-public employer completely owned by the government.

2.2 Electricity Bill & Tariff

In standard, TNB tariff have been classified based on the customer interest at the basis and its voltage stage. There are 6 customer categories in TNB, that are Specific Agriculture, Domestic, Industrial, Commercial, Street lighting and Mining. Each category has its own tariff rating and pricing. The usage bill dependably advises the consumers the quantity to pay, when to pay, and where to pay. Usually electricity tariff differs from other country to country and should vary locality to locality in certain country. There are reasons why there is different in tariff pricing. Tariff may be a pricing structure of the quantity electricity usage. Calculation in tariff was inserted or have be code within the microcontroller language which can be displayed in energy meters. This essential standard of the structure is to administer a better fee for excessive pay clients with lowest cost versatility of energy request. If the facility used by a domestic device is observed individually, the cost is resonable. Appliances reception to be cost only multiple cents of feet to work, can clearly price numerous hundred ringgits yearly. So that it believed when the consumer will exactly see entire amount, they must buy devices during a while, they ready to realize what proportion they will save the device is works efficiently.

The tariff in power meter plays the crucial role in providing users total quantity they need was utilized for normal billing of electricity. That value had been estimated by multiplying the facility utilized by the time allotment it has been used. (Goss and Hansen, 2015). Considering this computation, the machines with high power rating that are utilized for quite while will cost the customer more since the kWh are going to be high (Thumann and Younger, 2003). Most all charge plans contain an electricity charge for every kWh for electricity utilization. The power charge relies upon on the general wide variety of gadgets recorded over the billing length, commonly approximately one month. Multiple utilities charge an equal price for all power utilized, at the same time as others price distinctive charges for numerous 'blocks' of energy. In Malaysia, TNB charges the primary 200 kWh for 21.80 cent/kWh. Subsequent kWh used are going to be charged differently as shown in Table 2.1. The rate is rising as the usage is increased. (Tenaga Nasional Berhad, 2019).

TARIFF CATEGORY	Current Rate
Tariff A - Domestic Tariff	
For the first 200 kWh (1 - 200 kWh) per month	21.8 sen/kWh
For the next 100 kWh (201 - 300 kWh) per month	33.4 sen/kWh
For the next 300 kWh (301 - 600 kWh) per month	51.6 sen/kWh
For the next 300 kWh (601 - 900 kWh) per month	54.6 sen/kWh
For the next kWh (901 kWh onwards) per month	57.1 sen/kWh
The minimum monthly charge is RM3.00	
TARIFF B - LOW VOLTAGE COMMERCIAL TARIFF	
For the first 200 kWh (1 -200 kWh) per month	43.5 sen/kWh
For the next kWh (201 kWh onwards) per month	50.9 sen/kWh
The minimum monthly charge is RM7.20	

Table 2.1: Tenaga Nasional Berhad Electricity Tariff (Tenaga Nasional Berhad, 2019)

2.3 Smart Meter

Pretty much every family in peninsular Malaysia will have the option to trace their capacity use and examples through the Development Metering Foundation or basically known as the smart meter. This will be made conceivable with Tenaga Nasional Bhd's (TNB) plans to introduce 9.1 million shrewd meters by 2026 to encourage full AMI benefits for its clients, under the Administrative Time frame 2 from 2018 to 2020, an aggregate of 1.5 million savvy meters are planned to be introduced at purchaser premises in Melaka and chose territories in Klang Valley. As of now, very nearly 300,000 brilliant meters have been effectively introduced in Melaka for Stage 1 of every 2018, while another 1.2 million will be introduced by 2020 in Selangor, Kuala Lumpur, and Putrajaya/Cyberjaya under Stage 2. (Tenaga Nasional Berhad, 2018)

2.3.1 "Design and Implementation of Smart Energy Meter" by Preethi and Harish.

According to (Preethi, V. and Harish, G., 2016) the aim for this project is to calculating usage of electricity and implementing the features of IOT. Besides, this study also introduces the new method and type of meter reading which is more effective and convenient compared to the old method. Furthermore, the new system also would eliminate the requirement by manually identifying the meter reading and instead threading efficiently.

The components were used in this paper were GSM module, ZigBee transmitter, smart card reader and LCD. In this case the process is divided into 2 systems which

are prepaid mode and post-paid mode. When the system during a prepaid mode, the system will identify weather there is a sim card or not. The LCD was used for displaying the consumption of energy which shown in watt. The system will power off the household appliances that uses relay once the limit reached and a buzzer will continuously alert the customer. For the post-paid mode, this technique will alert the customer by sending a SMS notification if there is any power theft case. Plus, the facility consumption is going to be monitored by the base station regularly. Finally, the system will alert the buyer once more by sending SMS to customer regarding the maturity bill and therefore the powered consumed by the customer. The block diagram in figure 2.1 below shows the flow process of the system. (Preethi, V. and Harish, G., 2016)

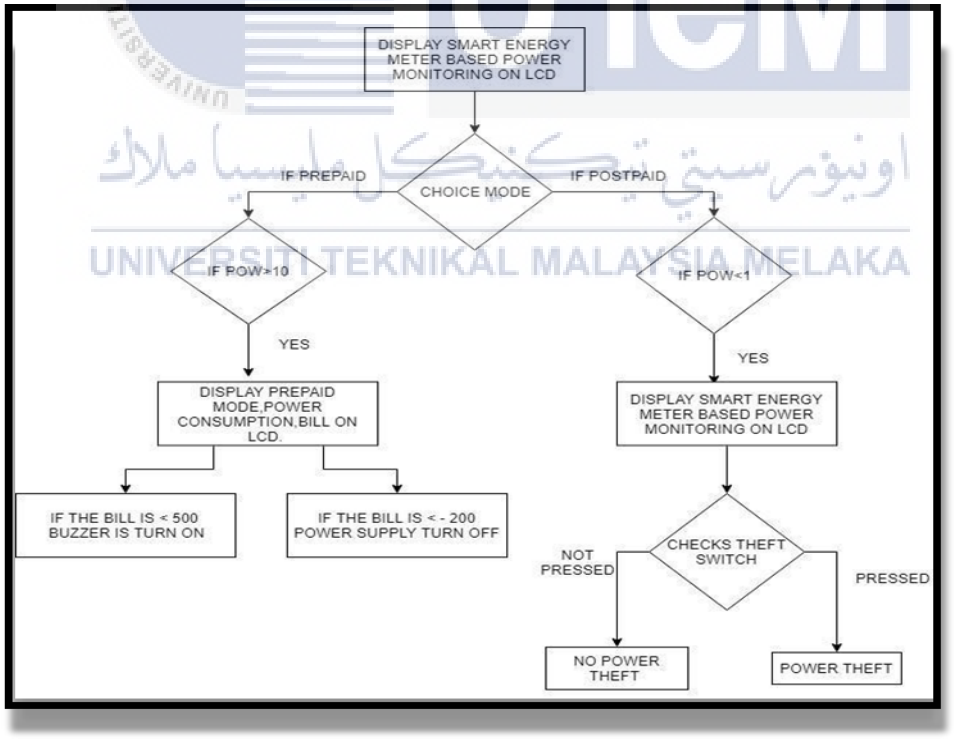

Figure 2.1: Process flow of the SEM system (Preethi, V. and Harish, G., 2016)

2.3.2 "Arduino and GSM Based Smart Energy Meter for Advanced Metering and Billing System" by Rahman, M.M., Islam, M.O. and Salakin, M.S

Researcher (Rahman, M.M et al., 2015) point out that smart power meter can implement billing and metering maintenance. As an example, the system will estimate the consumed energy. Then it will transfer the bill through SMS over GSM network. Besides that, with an energy supplier, a sensible meter transmits direct wireless data protocol. Hence, we do not need to record the meter reading.

There are variety of benefits of smart energy meter which displays the quantity of energy employed by consumers. From this, we will identify the energy spend which can help to settle on the ways to use them. Then, the smart meters also transfer exact information on the utilized energy. Below shown figure is that the diagram of the proposed smart energy metering system. This technique subsists of digital energy meter, an Arduino of microcontroller and GSM modem. When Arduino and GSM modem is turned on, the relay are going to be switched on and connect the energy meter to load. Figure 2.2 shows the block diagram of the proposed smart energy metering system.

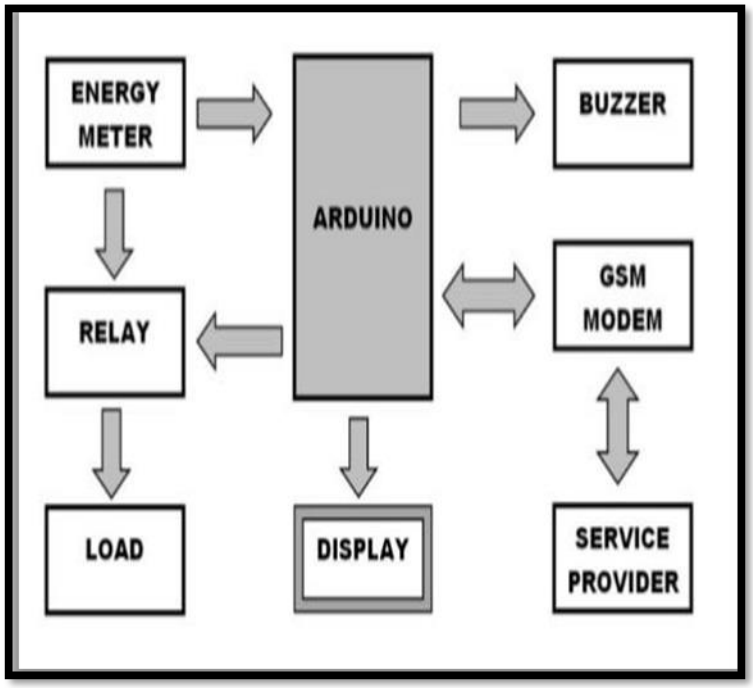

Figure 2.2: Block diagram of the proposed smart energy metering system. (Rahman, M.M et al., 2015)

The billing and metering system is a standard and it has been slowed, faulty and depraved. There variety of flaws and errors in current billing. As an example, it consumes longer, high chances of human blunder while recording the meter perusing, more manpower is required, the usage of consumer isn't updated, chances of theft and corruption and there's not a verification procedure to see the balance. During a nutshell, the project that the researcher implemented is very deserved for national. (Rahman, M.M et al., 2015)

2.3.3 "Design and Implementation of remotely located Energy Meter monitoring with load control & mobile billing system through GSM" by Sajedul Islam and Sadequr Rahman Bhuiyan.

The authors (Islam, M.S. and Bhuiyan, M.S.R., 2017) The aim for this project is to monitor the energy meter with a digital billing system using GSM 900. In addition, this system will introduce for sending billing information to the customer through telephone number which stored within the data base. Moreover, it also will terminate the buyer billing information if they did not pay the bill within the due time. This system will help to monitor the billing information regularly rather than taking the detain home or premises. The Figure 2.3 below shows the overview of complete system in the community.

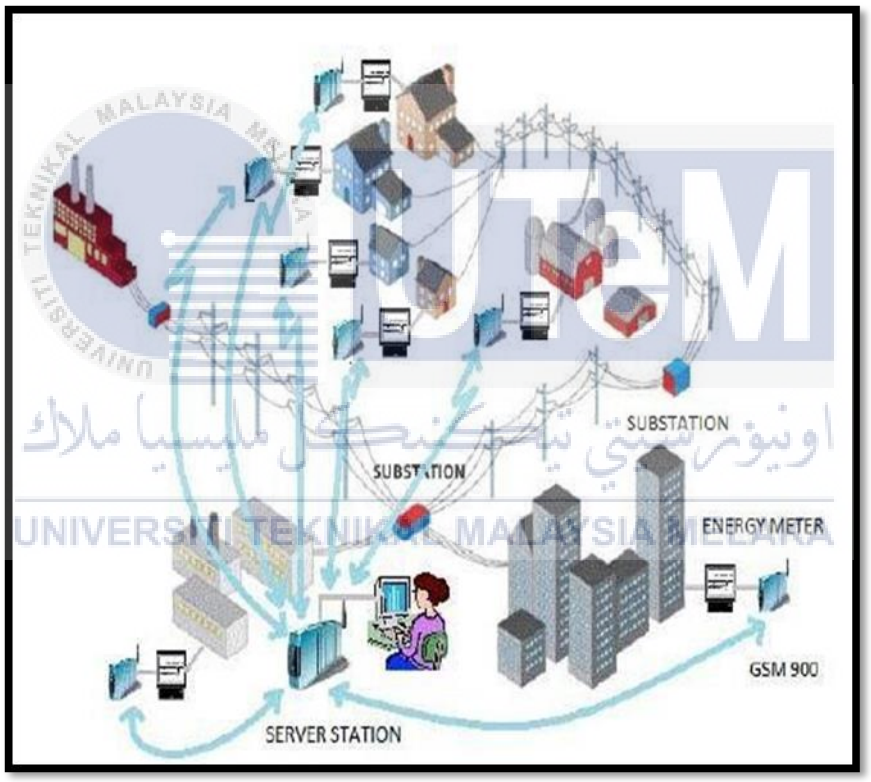

Figure 2.3: Complete system in Community (Islam, M.S. and Bhuiyan, M.S.R., 2017)

In this research, the system was implemented with GSM 900, Arduino Mega 2560, energy meter, LCD display, interrupting relay. There would be two parts which

is consumer unit and server unit for the 2-way communications. the user unit are going to be the brain of this system where server unit will receive the total information of energy usage through the GSM module. The server unit used for monitoring the information of consumer like billing status, energy usage and detail about the user. The power meter will ship the records to the GSM module whereby the info then is going to be uploaded to server on server computer. After the information received by the server, the system will forward a SMS notification to consumer concerning the invoice got to pay within the maturity. If the buyer unable to pay the bill, the energy meter bill is going to be terminated immediately but if the buyer pays the bill properly it will function normally with no interruption. Below shown in figure 2.4 overall idea and implementation how the system will operate. (Islam and Bhuiyan, 2017).

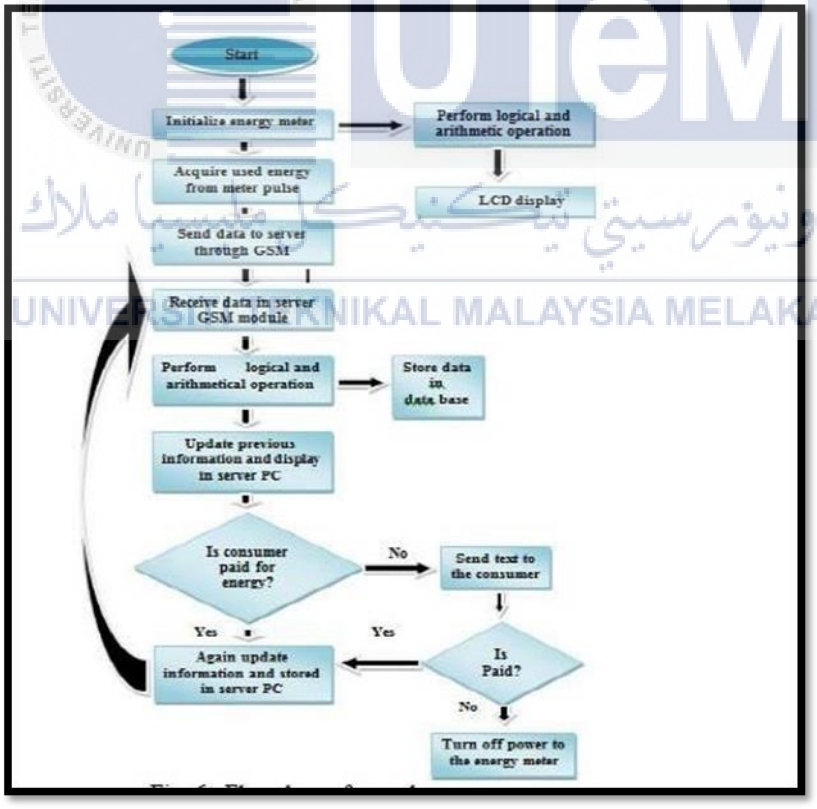

Figure 2.4: The system Operation (Islam, M.S. and Bhuiyan, M.S.R., 2017)

2.3.4 "Smart Energy Meter with Instant billing and payment" by R. Dhananjayan and E. Shanthi.

According to (Ravi, D., Shibu, J. and Shanthi, E., 2015) stated that paper explains and emphases the total of power used and provide the statistics for invoice to the households. Moreover, there is a ZigBee communication technology were used to create an easy prototype of Automatic Energy Meter with payment facility. This technology will help to communicate faster with other interference and will having high safety in in ongoing communication. The system will calculate the energy consumption in unit where the info will send to a server computer. Then, the energy bill consumption is going to be generated and therefore the data will remit again to the user. Thus, the user pays the bill at their home by using keypad system. The illustration of the overview for the system can be seen in the figure 2.5 below which the researchers shows the communication way and flow of the system (Ravi, D., Shibu, J. and Shanthi, E., 2015)

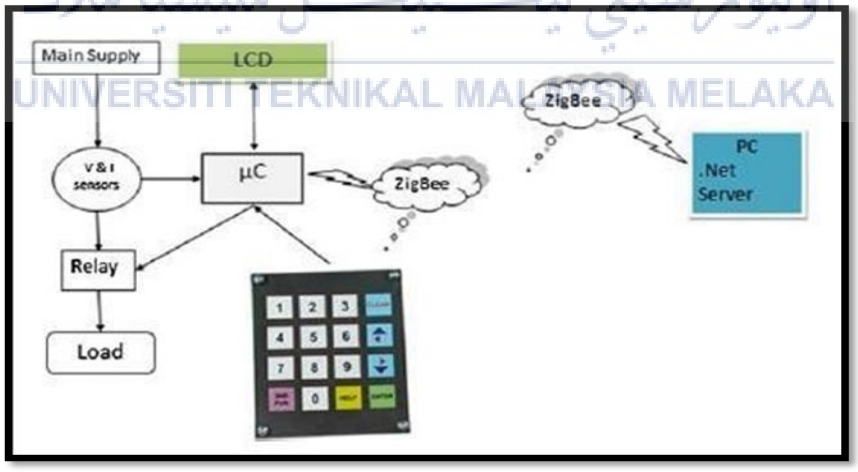

Figure 2.5: Illustration of overview of the system (Ravi, D., Shibu, J. and Shanthi, E., 2015)

In this research paper, the system comprises of Automatic meter reading facility with the presence of cutting-edge sensor and voltage sensor, the price is maintained to controller to compute using electricity. Then, ZigBee will receive an info from the remote terminal server. The bill energy usage from the user are going to be generated through a software developed using net within the server. The customer information and consumption of energy is sustained within the database. Furthermore, the quantity of usage of energy will remit to the Energy meter reading in home whereby it uses an equivalent ZigBee network. The system will introduce an EB card which is same as the top up cards for mobile. The user can purchase the EB card consistent with the energy utilization. For further process the user set a confidential number in the card by using the keypad and the data will send to server by using ZigBee network. The server will identify the quantity of the usage and it will credit the total amount if there is a balance pending amount. During this matter, the user ready to pay the bill form the house itself. Generally, the system is implemented by the journalist to measure the total power used, transfer data and reading the information in display and keypad for payment. (Ravi, D., Shibu, J. and Shanthi, E., 2015)

2.3.5 "A Smart Home Energy Management System Using IOT and Big Data Analytics Approach "by Al-Ali, A.R, Zualkernan, Mohammed Rashid, Ragini Gupta, MAzin Ali Karar.

The author (Al-Ali, A.R et al., 2015) stated that maintain and control the saving energy by find the better ways for monitoring is the main aim for this study. This paper is mainly about Energy Management System (EMS) uses in the smart home. A unique IP Address were created, and all home device interfaced with data IOT module which can be resulting in mesh wireless network.

For further process and analyse, the (SOC) which known as system on chip module will collect the total energy consumption data from all device and transmit the information to the main server. The data from all the residential area will be taken and send to the utility's server as A Big Data. For the consumer demand the (EMS) utilized the Business Intelligence (BI) and Big Data for the energy consumption in the better software. However, the (SOC) will collect all the Strength consumption facts and the ambient statistics periodically and switch it to the main server. This server will send all data then will transfer this reading in the database. The transferred data will be utilized by the analytic engine to generate charts, graphs, and report. Now the user can view all the graphs via the mobile application. The user application connects with the server with the WEBAPI to make communication using the web server. The application also will provide different service to the user such as control the device, bill payment, and view the report or graphs. (Al-Ali, A.R et al., 2015)

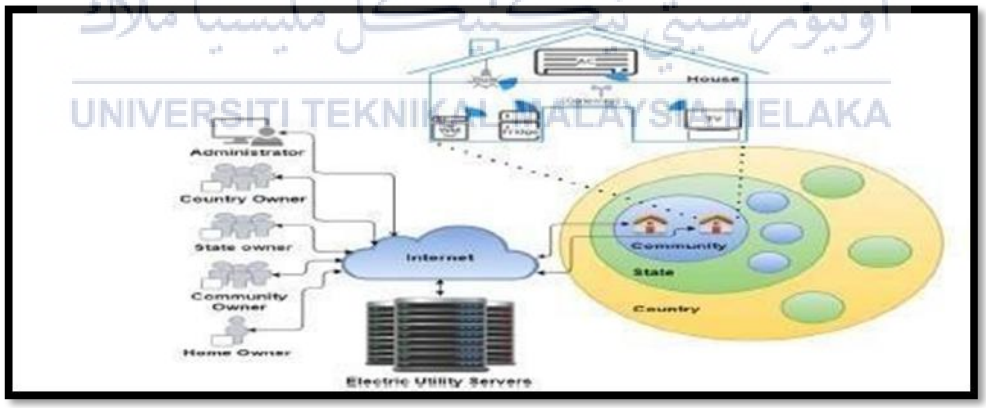

Figure 2.6: Block diagram of system architecture (Al-Ali, A.R et al., 2015)

In addition, the relay will be control by the microcontroller to switch on and off the device. To calculate the Ac current and to calculate the total energy used the current

sensor was used in this study. The application is developed and can access by all and get a different view according to the user privileges. The user may to see the service will run with the user privileges once they log in. (Al-Ali, A.R et al., 2015)

)

2.3.6 "GPRS enabled smart meter with in-home display and applications of time use pricing" by L.C. Saikia, Himsheker, N. B Dev Choudhury and T. Malakar.

According to (Saikia, L.C et al., 2016) mention that the motive of this paper is to introduces a (GPRS) based on a smart power meter in the home display with the sooner phase of using smart energy meter in India. The major objectives of this project are to deliver a two-manner communique among the purchaser and consequently the utility. This smart energy meter can take the power factor reading and real time voltage and current value.

GPRS were used to store the data of calculated energy consumed in the cloud server LabVIEW were used to perform the In-Home Display (IDP). However, IHD function is to display the level of energy used, schedule of the load and energy demand characteristics. (TOU) or well known as Time of Use pricing will produced and survey the outcomes. Block diagram in Figure 2.7 below shows the working rule and flow of the project (Saikia, L.C et al., 2016)

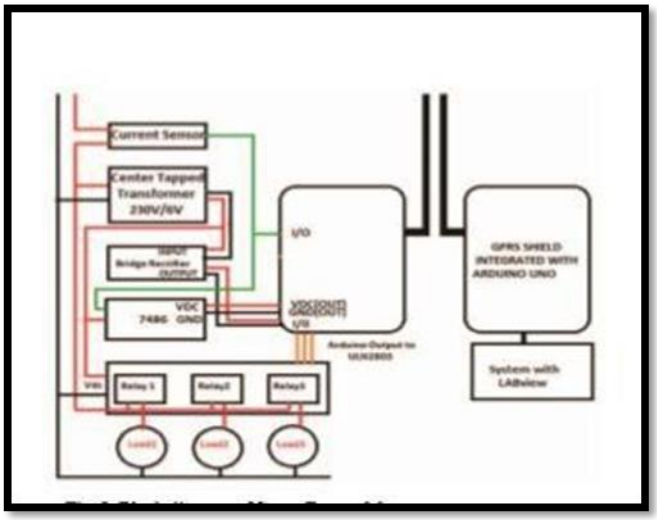

Figure 2.7: Flowchart of complete system (Saikia, L.C et al., 2016)

This project consists of Arduino Uno for the brain of the Energy Meter whereby it read the generated value of pulse wave along with the voltage and current value by X-OR circuit of voltage and current waveform. Then, it will evaluate the total energy usage using the RF transceiver and the info is going to be sent to the LabVIEW system that attach with the Arduino Uno. In Home Display (IHD) is used when this project to display the indication of automatic tripping of load applications, magnitude spectrum of voltage waveform, sensed frequency fundamental, actual power, direct voltage, and direct current. When the system limit reached the amount of bill Channel Relay Board Module with ULN2803 will cuts off the load. The interfacing of Arduino Uno and Relay Module can be seen in figure 2.8 below.

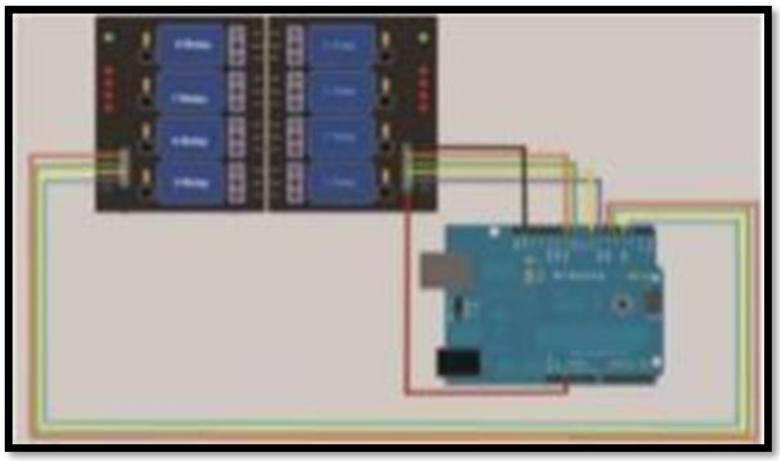

Figure 2.8: Interfacing of Arduino UNO with Relay Module (Saikia, L.C et al., 2016)

GSM SIM900A is used during this project for communicate with the customer and therefore the household appliances. This GSM SIM900A will alert the customer by sending a SMS when the energy usage exceeds the limit within the smart energy meter. It also sends energy consumption information to the smart energy meter from the Arduino Uno to a special Arduino Uno connected with a computer which using the In-Home Display (IHD). IHD may be a system which helps the customer to see or monitor the energy usage through installed LabVIEW in computer and another parameter also. The Time-based pricing is applied to the system by the researchers to look at the peak hours of energy consumption. The aim of time pricing is to make sure the user cut off the unnecessary loads of application and sending electricity to user with different. (Saikia, L.C et al., 2016)

2.3.7 "GSM Based Automatic Energy Meter Reading System with Instant Billing" by Ashna.k and Sudhish N George.

The author (Ashna, K. and George, S.N., 2013) stated that the paper mainly specialises in designing an inexpensive cost of GSM energy meter in wireless which connected with web server that can be interfaced to handle the collected data universally and automatic billing system. Moreover, the suggest system changes a normal meter analysis technique and allows a controlled of current meter energy from the energy supplier. Additionally, the energy provider not got to check or monitor the bill for every house regularly. This technique produces a replacement method where it senses the used energy automatically, records the bill rapidly and sent back to billing point over the network that controlled by GSM. Once the bill data received which is generated by the online based software, the SMS will send to the customer regarding the payment. Additionally, the registered user and authority can monitor the bill payment anytime and anywhere when the info is update through the online. The below figure 2.9 explains the overview of the proposed system. (Ashna, K. and George, S.N., 2013)

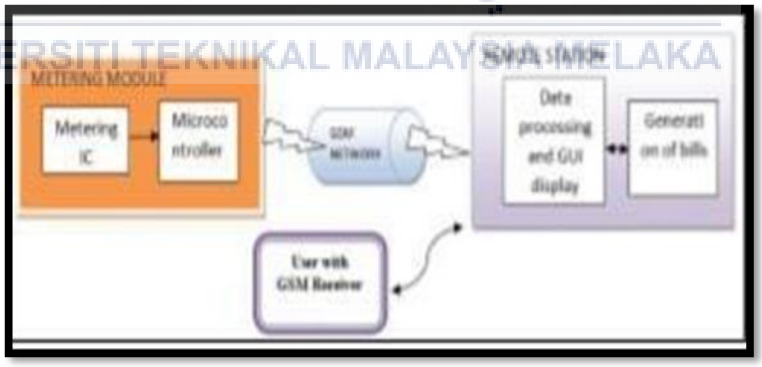

Figure 2.9: Overview of proposed system (Ashna, K. and George, S.N., 2013)

This paper was including with three main part which is GSM digital power meter which was fix all together the household consumer unit, 2-way transmission ability which is SMS, and a server to monitor the billing payment from the energy provider.

Figure 2.10 below shows the whole diagram of this project. This is system does not need human work to read the meter thus it automatically generates energy billing. The user pays the bill via online or directly when the amount reached the limit. GSM unit will receive the info from the consumer and therefore the software will calculate the total of bill from the energy consumption that the user utilized.

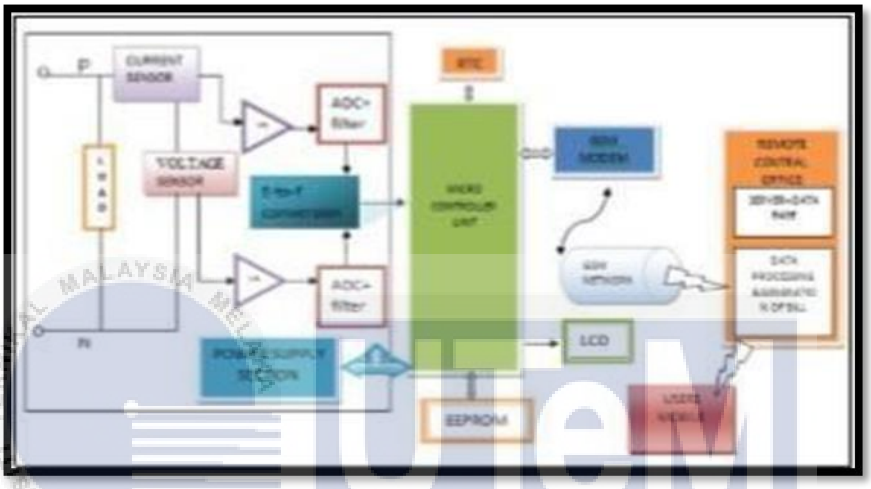

Figure 2.10: Block diagram of the design project (Ashna, K. and George, S.N., 2013)

Design for this project uses 2 major elements which is software design and the hardware detailed. For hardware design, GSM modem was used to construct a single microchip (IC MCP3905A). Additionally, a microcontroller PIC 16F877A, EEPROM memory and the (RTC) is additionally used. The function of GSM modem is to transfer the power usage value SMS to user via wireless. Whenever the info is sends to the user, it will store the info to the EEPROM memory. The RTC module was used integrate with the meter to capture the present time for the energy consumption. For the software part, a web- or i ented GUI was used for billing management. (Ashna, K. and George, S.N., 2013)

2.3.8 "Implementation of Wifi- Based Single Phase Smart Meter for Internet of Things (IoT)" by Win Hlaing, Somchai Thepphaeng, Varunyou Nontaboot, Natthanan Tangsunantham, Tanayoot Sangsuwan, Chaiyod Pira.

The researchers (Hlaing, W et al., 2017) stated that this project is mainly about the low-cost implementation were apply in Wi-Fi-based energy meter for internet of things (IOT). The challenges of manageability and energy efficiency can be overcome in this proposed system.

In this system the parameter of the power meter can take accurately and efficiently like the total energy consumption, load profile and demand value. In terms of technical details, this project mainly uses an LCD screen as a display unit reading and the other notification to the user. Besides, ESP8266 WI-FI module were used on this system. Implementation of TCP/IP for communication for the web application and meter process will happen once the module is embedded into the meter. By using this low-cost module, this system can perform a digital communication for web server and power meter. By this energy management system can monitor it. By utilized this technique, the billing process for user is supported and can be estimated the power consumption. Figure 2.11 below shows the architecture of Wi-Fi module with digital meter.

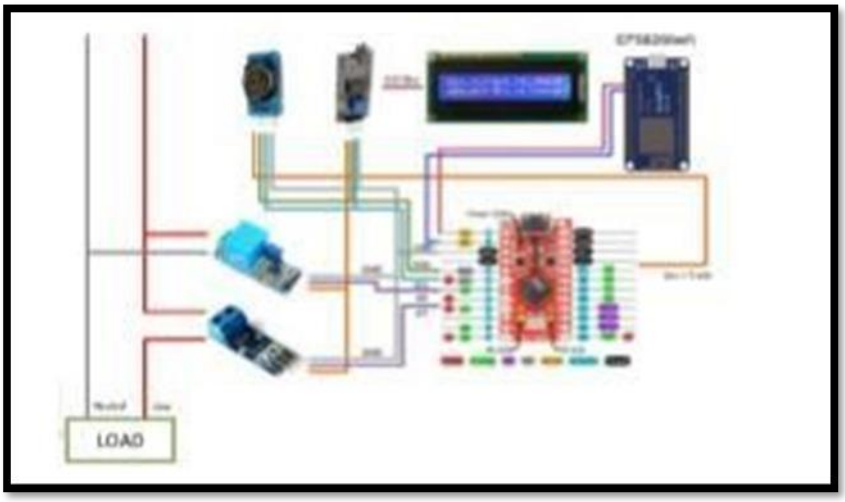

Figure 2.11: The architecture of Wi-Fi module with digital meter (Hlaing, W et al., 2017)

In term of hardware part, this digital energy meter is containing with of Arduino Leonardo Pro Micro - 5V/16MHz which will be role as the measure the meter parameter. This device accepts the implementation of application in switching mode power supplies and over current fault protection. This sensor voltage module has a maximum signal from the analog signal module. This device is consisting of a battery input to maintain accurate timekeeping when the main power was interrupted. It is easily programmable with no limit of displaying. Figure 2.12 below shows the digital meter's components on PCB board. (Hlaing, W et al., 2017)

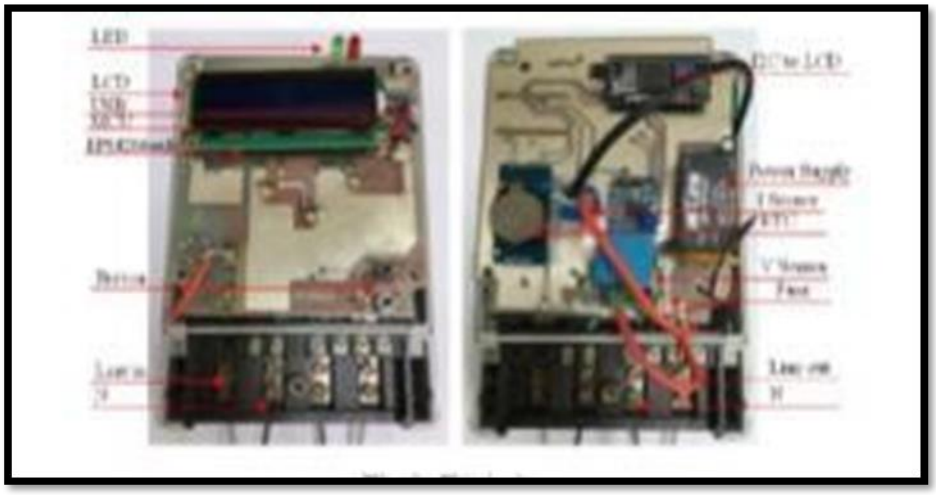

Figure 2.12: The digital meter's components on PCB board. (Hlaing, W et al., 2017)

2.3.9 "Internet of Things based Smart Energy Management for Smart Home" by Mehmet TASTAN.

According to (TAŞTAN, M., 2019) mention that this research is mainly talk about the development of a project or a prototype that is called as the IOT based on Management of meter in Smart Home. Based on research done by author of this journal, this research is aimed mainly for device of energy meter that able to monitor and decrease the amount of power used for the household's appliances. This system is powered with android and the consumer can the data and information about their electric device that used in this application. The user can take control about the device consumption. By apply this method the way to measure and calculate will be easy and at the same time have ability to ensure energy saving. Hence with android application the user can control the electric device in the house by using remote access. Then this android application has advantages to send the data or message through SMS or email.

In term of hardware part and software part for the system, the research added different functional hardware in the system such as NRFL01which function as wireless communication modules for RF. Arduino Pro Mini microcontrollers and Nodemcu also were used which is widely used “Lua” language .The sensor like ACS712-30A current and ZMPT101B voltage sensors for measuring the energy consumption were used. Figure 2.13 below shows the NodeMCU pin structure. (TAŞTAN, M., 2019)

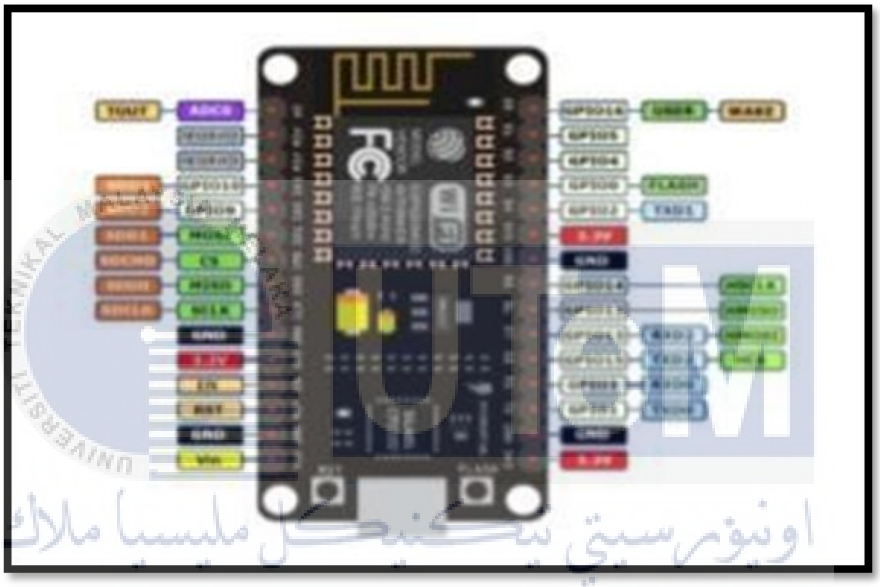

Figure 2.13: The NodeMCU pin structure. (TAŞTAN, M., 2019)

The structure of SEM system can be seen in Figure 2.14 Fundamentally, the framework involves a NodeMCU controller with the capacity to comunicate with Blynk server with the presence of Wi-Fi. Arduino were used to power estimation, controlling activities, Blynk SEM interface and Blynk server.

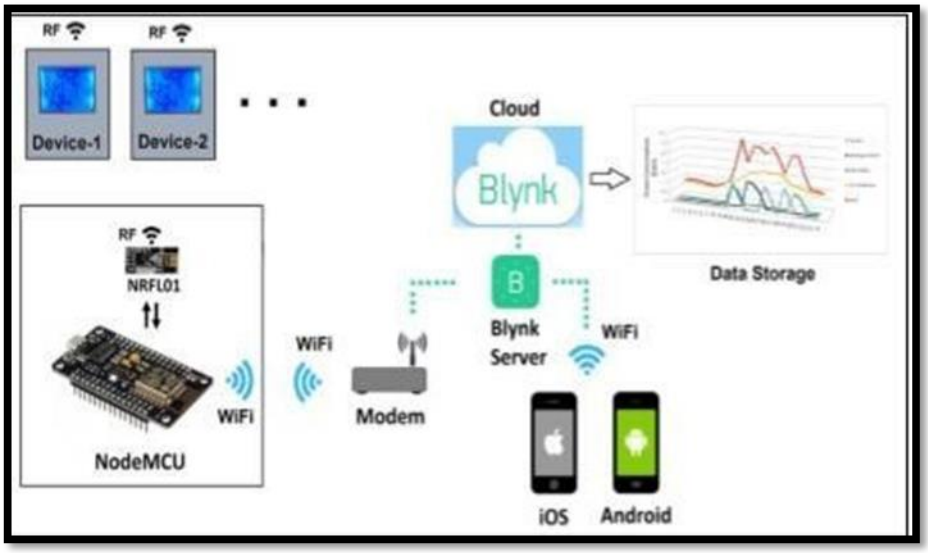

Figure 2.14: The Structure of SEM system. (TAŞTAN, M., 2019)

The NodeMCU, which have been interfaced with Wi-Fi module, will forward all the current charge and voltage value from the energy measurement to the Blynk server.The data that were send and transmit to Blynk server is through local Wi-Fi network. In the application like Blynk the number of bits can send through the pins. This system can measure and calculate the number energy that will cost. This system is updated with protected against voltage fluctuation and overload current. The protection carried out by cutting-off of the device power via the relay over the module. (TAŞTAN, M., 2019)

2.3.10 "IOT Based Home Electrical Appliances Control Using Node MCU" by M. Saikrishna, G. Vijaykiran.

The authors (Saikrishna, M. and Vijaykiran, G., 2017) stated that this paper mainly about the process of IOT in Wireless automation system that will use gadgets to control and regulate the basic devices through the internet. This process can do form

anywhere around the world. This process called as sensible home access. When it uses wireless sure this system will save a lot of electric power and the human energy that were carried. This system is difference with other because at the same time the consumer can operate the system and control form any place as long the user got the strong internet connection. In terms of the technical aspects that this project has been designed and it mainly uses GSM that embedded with ZigBee. This project mainly on home automations system. This system overall depends on microcontroller which well known as PIC. This research is mainly about prototype and design for basic home automation system which supported with SMS technology. The main component in home automation system is GSM module that can interface the communication the user and the automation system. The technology like SMS were used in the GSM modem to replace info and signal between home user and automative system itself. Another module that were used is microcontroller, which act as main supply of the home automation system. The actuators and sensor are directly attached to hardware microcontroller through the interface as shown in Figure 2.15. System security supported with the user access of every SMS. (Saikrishna, M. and Vijaykiran, G., 2017)

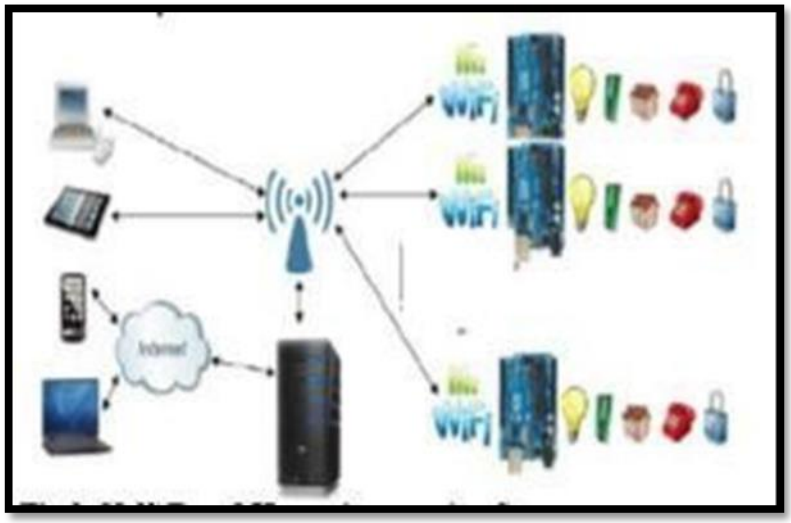

Figure 2.15:SMS Based Home Automation System. (Saikrishna, M. and Vijaykiran, G., 2017)

2.3.11 "IOT Based Real-Time Residential Energy Meter Monitoring System" by Karthikeyan, Bhuvaneswari P.T.V

According to (Karthikeyan, S. and Bhuvaneswari, P.T.V., 2017) mention that this research paper mainly focuses on how to reduce the cost by upgrading the energy meter. In the experiment it has been found that he energy consumption can be reduced than existing consumption. This system is divided into three parts, which are user interface, customer premises and server control. In the customer premises there are energy meter which included of nodemcu, optical sensor and energy meter. This part is under user control and the optical sensor was used to detect blinking of LED which embedded with the energy meter. The wireless router is used for configures with present of internet. When the hardware process is completed now data will send to the cloud. In the server there are the brain of this system which consist of 3 different part. It known as communication purpose control and server for storage.

These servers are function as to make sure the proper function in the system. The cloud will used to store the data and info from the meters. Then the server will process all the data and will produce the bill and generates the alert to consumers. The application server is function as the communication standard he server and the user. The Energy Meter architecture of the system is shown in Figure2.16.

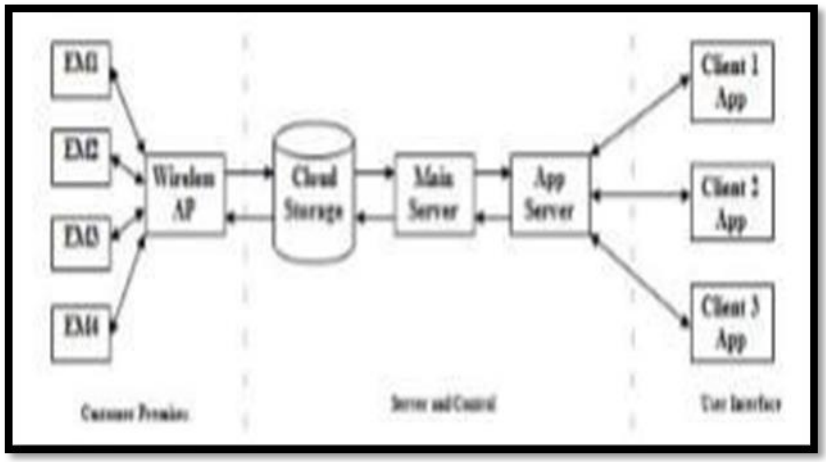

Figure 2.16: The Energy Meter architecture of the system (Karthikeyan, S. and Bhuvaneswari, P.T.V., 2017)

The user will interface application like Telegram were as the platform to send data to main server. The request by the user will be forward to the main server and the bot responds to the customer with the corresponding results. The system is installed within the user house to trace out the real time energy power used. The customized module that connected to 3 phase energy meter is shown on Figure 2.17. In one week, the data will be recorded and will be carried out for the data analysis. For each 10 minutes the consumption unit will execute every minute and forward to the cloud continuesly. Every 5 minutes the last computed value (units) is shipped to the cloud for storage. (Karthikeyan, S. and Bhuvaneswari, P.T.V., 2017)

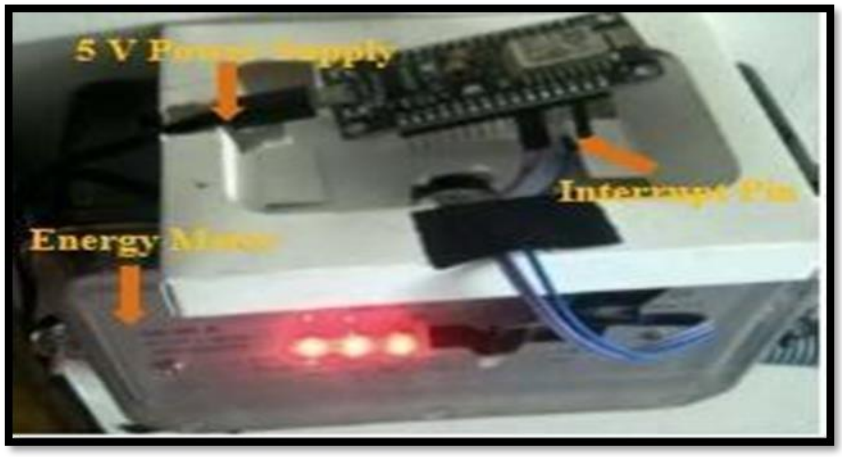

Figure 2.17:3 phase energy meter (Karthikeyan, S. and Bhuvaneswari, P.T.V., 2017)

2.3.12 "Low Cost GSM based Smart Energy Meter Design" by Rana Asad Ali, Mudassir Hussain and Tahir Mahmood

The author (Ali, R.A et al., 2018) stated that the planned system centers on designing and fabrication process for the domestic electricity user with the low cost smart energy meter. The design for the system has been implemented with the software then only the prototype model has been structured. The implemented design can have a communication with the consumed energy data through the GSM network. (Ali, R.A et al., 2018)

Then, time of use which well known as (TOU) metering and data Logging technique has been used in this system which can help utility companies to form electric meter system more essential and efficient. Another detection feature that have been implanted in the system is meter tampering detection to handle the theft problem.

In terms of the technical part for the system, the researcher uses the Arduino Mega 2560, GSM Module 900A, Non-Invasive Split Core Current Transformer, LCD (20×4), Real Time Clock (RTC, DS3231). The figure 2.18 below shows the construction of schematic diagram for the entire system. Each hardware of the system has its own function to run and process the system. (Ali, R.A et al., 2018)

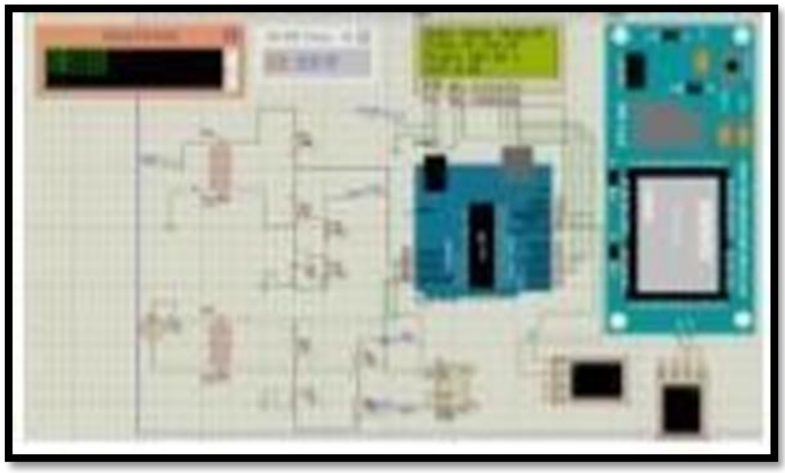

Figure 2.18: The construction of schematic diagram (Ali, R.A et al., 2018)

This system can measure the peak and off-peak energy separately with the present of Real Time Clock. The main advantage of this system is it can save all the data regarding the energy meter in the EEPROM. Almost the power of the Arduino is gets cut off the measurement are still stored safely in the EEPROM. The proposed SEM displays ToU as shown in Figure 2.19 and this feature encourages consumer to shift from peak to off peak- hours. (Ali, R.A et al., 2018)

Figure 2.19: The proposed SEM displays ToU (Ali, R.A et al., 2018)

2.3.13 "Smart Electricity Billing Using Node-MCU" by D.V.N Ananth, G. Joga Rao Ch. Satish, J. Shyam, K. Santosh, U.V.V.S.S.V. Prasad, and K. Ramya.

The researcher (Ananth, D.V.N et al., 2019) stated that the paper explains and emphases from the function of smart meter to get and record the accurate reading that has been consumed. In the electricity department the system will receive all the data and reading and make a process on it and will generate a bill that must be paid by the users. This system was implemented with the process that can send the message to the own user mobile phone about the bill. The bill contains information like the current bill, total bill for every month and the due of bill. This system can automatically power cut off if the user had made a delay in settling the bills.

With the presence of GSM modem in this system the user will get information about the energy reading and the total amount. The user will get a text as the notification through the GSM. With the help of WIFI modem the user can trace out the energy reading through the webpage. This system is benefit for the electric department because the system can read it with own without the individual visiting each house. This system will be the great achieved when the system is using the Arduino unit which can help to monitor and records the energy level reading permanently. This process allows the system to record the reading in the live meter reading and displayed on webpages to user on request. The hardware setup for power measurement is shown in figure 2.20 below. (Ananth, D.V.N et al., 2019)

Figure 2.20: The hardware setup for power measurement (Ananth, D.V.N et al., 2019)

The Node MCU is used in this system to monitor hardware system with the internet access. The amount of energy used by the load will be displayed in the cloud. It will show the time for the power were utilized for load that related to the system. As an innovation application the Energy Monitoring using IOT was developed to control all the home appliances using the remote over the cloud from anyplace. The current sensor was utilized to sense the present and display in IOT. The system has ability to update the information in every 1 to 2 second in the cloud. In the present system the energy load consumption can be access with help of Wi-Fi which can help the user to eliminate and avoid the unwanted uses of electric. With this IoT system the user can monitor the energy consumption and pay directly through online transaction. (Ananth, D.V.N et al., 2019)

2.4 Blynk Application

2.4.1 "Smart Automated Home Application using IoT with Blynk App" by Homera Durani, Mitul Sheth, Madhuri Vaghasia and Shyam Kotech

According to (Durani, H et al., 2018) the purpose of this project is how to handle the basic home appliances with device from any place. The user can turn on and turn off the electric appliances with this system. This system is implemented with the android application, NodeMCU ESP8266 and the internet connection. The system has its own features, whereby NodeMCU can implemented with the all the home appliances with the presence of coding with the web server. The application that can control in this system is can get from the android application.

Blynk is one of the IOT platform which can control all the electric device with remote. The user can create a graphic interface in the dashboard using the different gadgets. This Blynk app can display and store the sensor data from the system. Blynk app will provide the library only for the popular hardware platform like Raspberry pi and Arduino. In the Blynk app the three main part of components are Libraries, Server, and App. The libraries will enable the communication between the hardware and server using the commands. The server will liable the communication between app and the hardwires. Lastly, the app will help to make interface. assistance of web. The Node MCU is the main components in this system where it will connect the cable with the external power source. Another component is Relay, in this project they applied 5V DC relay as the switch. By use this Relay, The DC power can convert to the. In

Blynk app some new button was added to function as on and off the switch. The Blynk app working diagram is shown in figure 2.21 below.

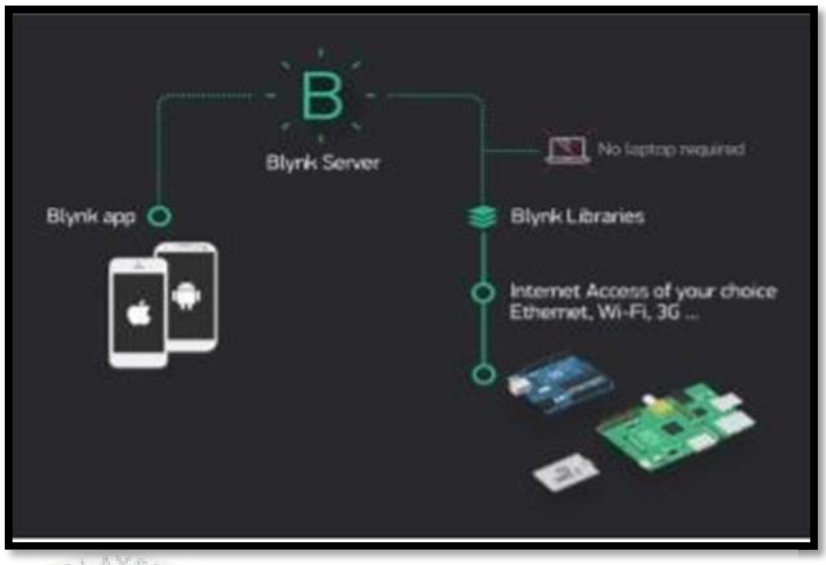

Figure 2.21: Blynk App working diagram (Durani, H et al., 2018)

In the system there are three sub system, first subsystem is containing of the Blynk app module which used to send the status of the equipment. The second sub system consists of multiple sensor DHT11 temperature sensor. This sensor is functioning to measure temperature the PIR sensor to detect the motion. The third sub system has a microcontroller which will function as the centre coordinator that communicates with other subsystem through Wi-Fi connection. The microcontroller in third subsystem interfaced with the relay to monitor the appliances in the location. The main advantages of the system are the system can work in automatic mode and manual mode. The automatic mode work as per the encompassing environmental conditions senses by the sensor. The manual mode the user can remotely trace and monitor each of the home appliances through the smart phone. (Durani, H et al., 2018)

2.4.2 "Smart Home Meter Reading using IoT with Blynk App" by Mohamad Shaiful Osman

According to (Osman, M.S., 2019) the main purpose of this project is to enhance a smart house facility that can handle from any place. This system is integrated with NodeMCU ESP8266, internet connection and Android Application. The NodeMCU are connect with the electric appliances and the meter reading with the help of coding in the web server. All the function is control by the Mobile App that created under the android application. This application is being control with the help of internet connection.

This paper also mentioned that monitor the electric device by using the NodeMCU through the Blynk app. There two main part in this project that are software and hardware. The hardware configuration is containing of microcontroller, sensors, actuators, and microprocessor arranging. The software was programmed and uploaded to the microcontroller and microprocessor. The main aim of this smart home is to supply better energy utilization and give a better security. In this system they created a WLAN network that supported with NodeMCU to present a small IOT system. The system can be operated as monitor through mobile with the internet connection. The real time wiring system is shown in figure 2.22 below. (Osman, M.S., 2019)

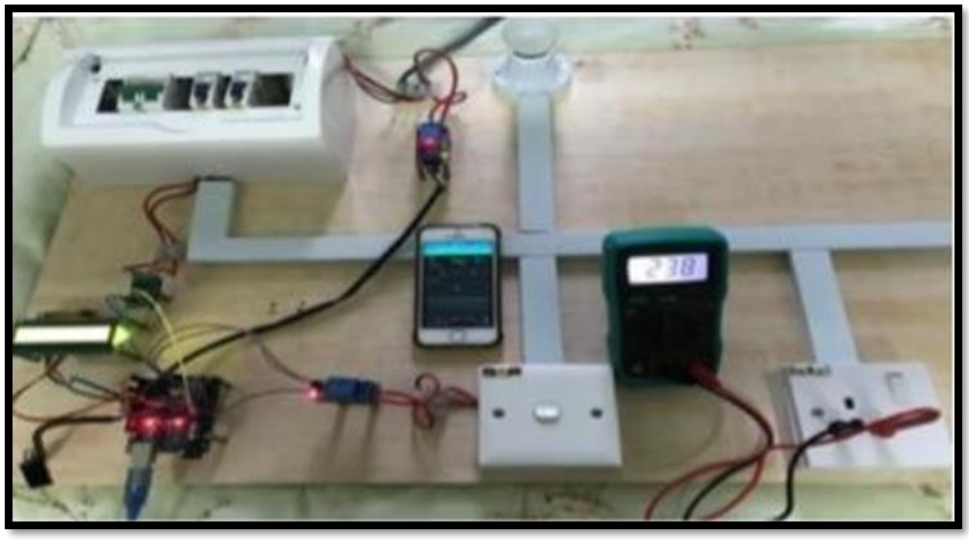

Figure 2.22: Real-time wiring the system (Osman, M.S., 2019)

There are three main part in the Blynk that are Libraries, App and Server. The libraries will enable the communication process between hardware and server using the commands. The app will help to create the interface. Lastly, the server is responsible for type of communication between the hardwires and the app. (Osman, M.S., 2019)

2.5 NodeMCU Transmitter

2.5.1 "NodeMCU-based Low-cost Smart Home Node Design" by TongQiang, Gao Guangling, Liu Hai, Lina and Wang Han.

According to (Qiang, T et al., 2015) the purpose of this project is to enhance a wifi wireless sensor network with low cost solution. The main aim of the system is to solve the problem of high costs of smart home consumption. The system based on the

NodeMCU and Android Application. It is integrated with ESP8266 module that consist of CP2102 USB-to-serial modules. The system works as follow, The NodeMCU was used to collect all the sensor data directly. This technique will save it in the main control chip and will reduce the costs. The NodeMCU chip is a hardware platform and supported with nodemcu filmware to a gateway control through a cloud server. The cloud gateway relates to smart home with the help of TCP protocol. The system can monitor and control the network system remotely. All Wi-Fi module will connect to the cloud through the router. The overall functional design of the smart house is shown in figure 2.23 below.

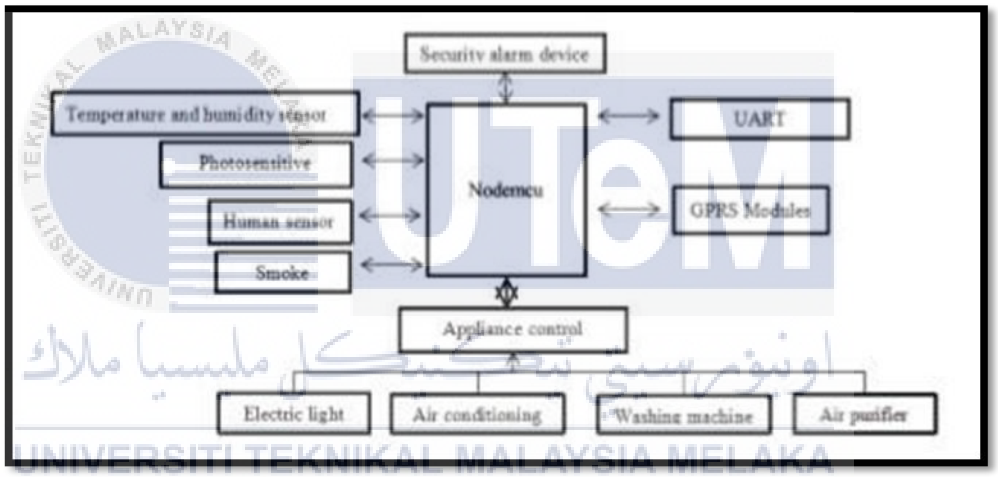

Figure 2.23: Overall function design of smart home (Qiang, T et al., 2015)

For the Software operation the user must log in to mobile phone with the app. This app is built up with the login command so it will begin with the login display interface. From the username and password that was entered to varication match, the security login can be done. After entering the system, the smart home device can be operated and monitor in the real time. The data observed by the user in real time through the mobile phone is shown in figure2.24 below. (Qiang, T et al., 2015)

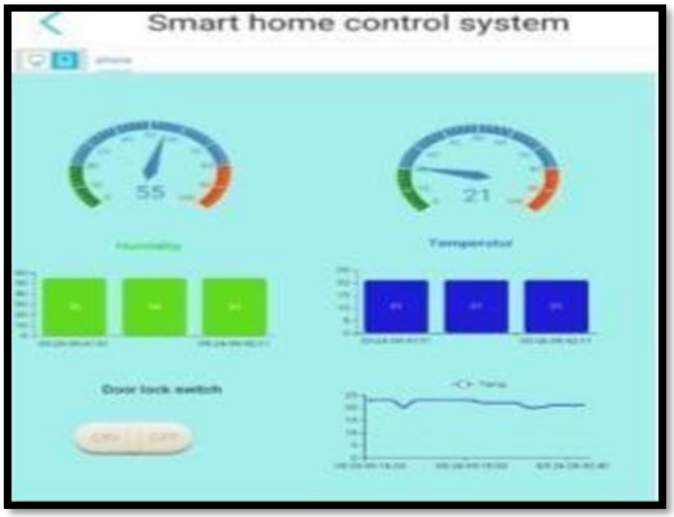

Figure 2.24: The relevant data in real time through mobile phones (Qiang, T et al., 2015)

2.5.2 "IoT Based Smart Energy Meter Using Arduino Avr and NodeMcu" by Lavanya Garg and Charul Sharma

The authors (Garg, L et al., 2018) stated that this machine included with NodeMCU ESP8266, CT sensor, transformer, and microcontroller. In this project AVR microcontroller light will be used. The Arduino programming can be view in Arduino advancement condition. The Wi-Fi module can remotely control the ESP8266 with the TCP protocol. In this system THINGSPEAK webpage have been used. Thingspeak was used to showing the information of the system. (Garg, L et al., 2018)

The human note down the perusing of their heap utilizing by the home meter. For this work he or she will go close to the meter and note down the perusing yet. Then the user cannot ascertain the perusing charging or ampere. They can just note down the perusing of meter that how much or long it functions. So the users composed a

process which name have "AVR based Real time current and load estimation of the gadgets" In this task the users have utilized the avr, hub mcu, power and current sensor, which measure the power and current of the gadgets. The perusing is transfer on cloud and the count of energy, charging and current ascertain by the avr and this esteem send to the cloud. Power ascertain in watts, current compute in ampere and charging figure in rupees. The data observed by the user in real time through the cloud is shown in figure 2.25 below.

Figure 2.25: The relevant data in real time through cloud (Garg, L et al., 2018)

No	Author	Title of project	Hardware component	Home appliances that were measured	Type of microcon troller	Type of trans mitter	Application to monitor the electric usage	Type
1.	(Preethi and Harish, 2016)	Design and Implementation of Smart Energy Meter	Relay, LCD, Buzzer, Smart card reader,	-	ARM 7 microcontr oller, GSM module	ZigBee technology	(SEM)-have energy meter chip to measure electric usage	Hardware
2.	(Rahma n et al 2015)	Arduino GSM Based smart Meter for advance metering and biling system	Relay, Energy Meter IC(BL6503), Buzzer, optocoupler, Relay and load.	Ordinary Bulb	Arduino (Uno R3), Arduino GSM Shield (SIM 900),	GSM	(SEM)-have energy meter chip to measure electric usage	Hardware & simulation
3.	(Islam and Bhuiyan, 2017)	Design and Implementation of remotely located Energy Meter & mobile billing system through GSM	LCD, Interruption Relay, Energy meter, Server Computer.	Ordinary Bulb	GSM 900 module, Arduino Mega 2560	Server end GSM 900	Human inspected energy meter	Hardware & simulation
4.	(Dhananjay a n and Shanthi, 2015)	Smart Energy Meter with Instant billing and payment	Current sensor Server computer, Relay, LCD, Keypad	-	Atmel's AT89S52 microcontroller	Zig Bee technology	Automatic Meter Reading (AMR) system	Simulatio n
5.	(Al-Ali *et al 2017*)	ASmart Home Energy Management System Using IoTandBigData Analytics Approach	RFID reader, relay bank, temperature sensor, heat sensor	Fan	-	Zig Bee techno logy	MQTT server	Hardware & simulation

6.	(Saikia et al., 2017)	GPRS enabled smart meter with Home Display and smart meter of time of use within pricing	Centre Tapped Transformer, Relay board, Current sensor, computer	-	Arduino Uno, GSM SIM900A	-, GPRS shield	LABVIEW and smart energy meter	Hardware & simulation
7.	(Ashna and George, 2013)	GSM Based Automatic Energy Meter Reading System with Instant Billing	current and voltage sensor, Real time Clock (RTC), EEPROM memory, LCD	Ordinary Bulb	PIC16F877A microcontroller ller, GSM Modem	GSM	Automatic Meter Reading (AMR) system, web- oriented GUI	Hardware & simulation
8.	(Win Hlaing et al.,2017)	Implementation of Wi-Fi-Based Single Phase Smart Meter for Internet of Things (IoT)	EEPROM, (WIFI ESP8266)	15W light bulb	(WIFI ESP8266)	IOT	digital energy meter consists of Arduino Leonardo Pro Micro	Hardware & simulation
9.	(Mehmet TAŞTAN 2019)	“Internet of Things based Smart Energy Management for Smart Home	NodeMCU, ACS712-30A current sensor, ZMPT101B voltage sensors	Ordinary Bulb	Arduino Pro Mini micro control lers,	IOT	BLYNK app	Hardware & simulation

10.	(M. SAIKRISHNA 2017)	"IOT Based Home Electrical Appliances Control Using Node MCU"	Node MCU, Arduino Pro Mini, ZMPT101B voltage sensor	-	NodeMCU	IOT	BLYNK app	Hardware & simulation
11.	(Karthikeyan, Bhuvaneswari P.T.V, 2017)	IoT Based Real-Time Residential Energy Meter Monitoring System	Meter (EM), optical sensor Arduino Mega 2560, GSM Module 900A, Non-Invasive Split Core Current Transformer, LCD	-	NodeMCU (ESP8266)	WI-FI	CLOUD, TELEGRAM	Hardware & simulation
			(20×4), Real Time Clock (RTC, DS3231).					
12.	(N.Anant etal.,2019)	Smart Electricity Billing Using Node-MCU	Energy Meter, Node- MCU, Current Sensor, Voltage Regulator	Ordinary Bulb	NodeMCU	IOT	BLYNK app	Hardware & simulation
13.	(Rana Asad Ali et al., 2018)	Low Cost GSM based Smart Energy Meter Design	Arduino Mega 2560 GSM Module 900A Non-Invasive Split Core Current Transformer LCD (20×4) Real Time	-	Arduino AT mega 2560	GSM	SEM meter	Hardware & simulation

			Clock (RTC, DS3231)					
14	(Homera Durani et al 2018)	Smart Automated Home Application using IoT with Blynk App	NodeMCU ESP8266, Raspberrypi, DHTT Temperature		NodeMCU ESP8266,	IOT	Blynk app	Hardware & simulation
15	(Moham mad Shaiful Osman 2019)	Smart Home Meter Reading using IoT with Blynk App	microcontroller, sensors and actuators	13 A switch	NodeMCU ESP8266,	IOT	Blynk app	Hardware & simulation
16	(Tong Qiang et al 2015)	Nodemcu-based Low-cost Smart Home Node Design	CP2102 USB, ESP8266 module		NodeMCU	IOT		Hardware & simulation
17	(Lavanya Gar g et al 2018)	Iot Based Smart Energy Meter Using Arduino Avr And Node Mcu	CT sensor, AVR microcontroller		NodeMCU ESP8266	IOT	Cloud	Hardware & simulation
18.	Preferred design of my project	Development of Home Electric Usage Notification & Monitoring System Using NodeMCU	Latest technology with NodeMCU, ACS712 20A Current Sensor and cloud server.	Specific for air-conditioner	NodeMCU	IOT	BLYNK app	Hardware & simulation

Table 2.2 The Previous Project Summary

CHAPTER 3`

METHODOLOGY

3.0 Introduction

The acts of chapter will emphasize at the sensitive strategies of the right steps to be undertaken one by one to materialize this project. It might be carried out concurrently with the procedure of know-how and fulfil the analysis for the sake of attaining the objectives that were favoured. The complete procedure of observe and perceiving the parts of the look at had been conducted appropriately on Home Electric Usage Notification and Monitoring system using NODEMCU.

3.1 Planning

A good and right plan need to complete and analysis this project within the period given by the supervisor and ensure that the project is function properly. Therefore, this part is the main for the project because it will show the process of project and the way to perform the outcomes of the project for Projek Sarjana Muda 1 and 2 with the similar function of working and terminate any failure during the project take process.

3.2 Work plan of the project

The average time taken that will take to complete this project is 2 semester which is same to 30 weeks according to UTeM calender. But the best preperation is the early preparation whereby the supervisor was assigned and consult on the previous semester

before the PSM 1 is started. When the supervisor was assigned the project work will start I the middle of February month. When the semester six is started where it is official of PSM 1 start and will end by the end of 2020 December. The total time span expected to be invested in the completion of this project is 2 semesters which is equivalent to approximately 30 weeks. In table down below the Gantt chart and the date of each progress regarding the project were shown. alongside the up to date progress of the project report were presented in Table as shown below. This Gantt chart will show very clearly the planning were taken to finish the project. This method always the good ways to eliminates and avoid the problem and obstacles that were faced for completing this project within the given time limit.

3.3 Flow chart of overall PSM

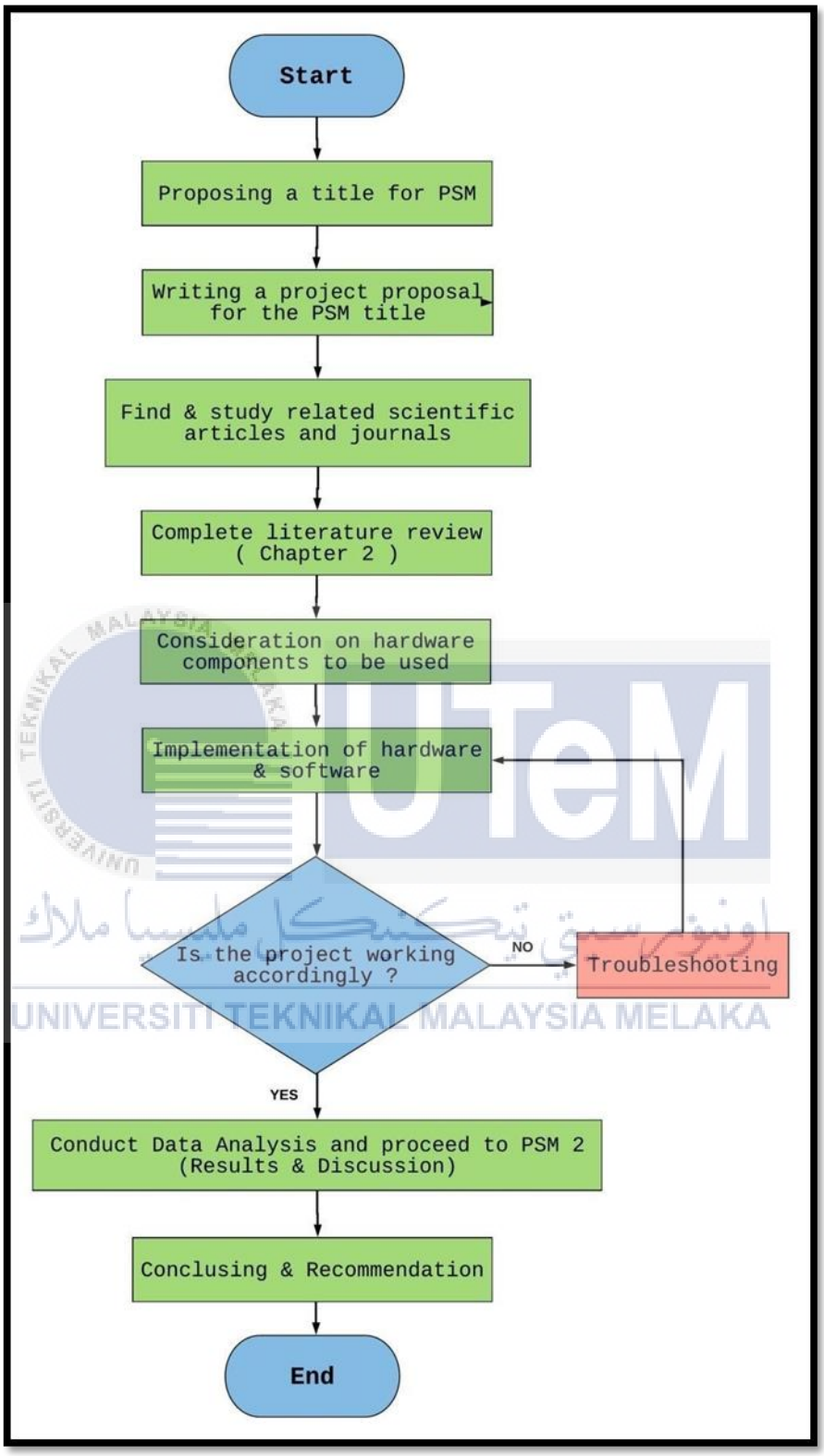

Figure 3.1: Flowchart of overall flow of PSM

3.4 Data collection

The collection of Data is very important for the project to be completed. The information that will collected will be like Home Electric Usage Notification and Monitoring system using NODEMCU integrated with the components and the software that needed to use for completing this project. Hence, the study of literature review on chapter 2 is refer as the guide for move on this project. Nodemcu will be interface and save all important data's such as ampere, power, kilowatt-hour, and conversion of tariff in Ringgit Malaysia. Besides that, data collected will be stores in created cloud server via smartphone application known as Internet of Things (IoT). In order on gather this required information, a circuit board have created using relay, current sensor, buzzer and all required components. This development of project utilized all the gathered information from various source.

3.5 Design

3.5.1 Development of Home Electric Notification & Monitoring System using NODEMCU

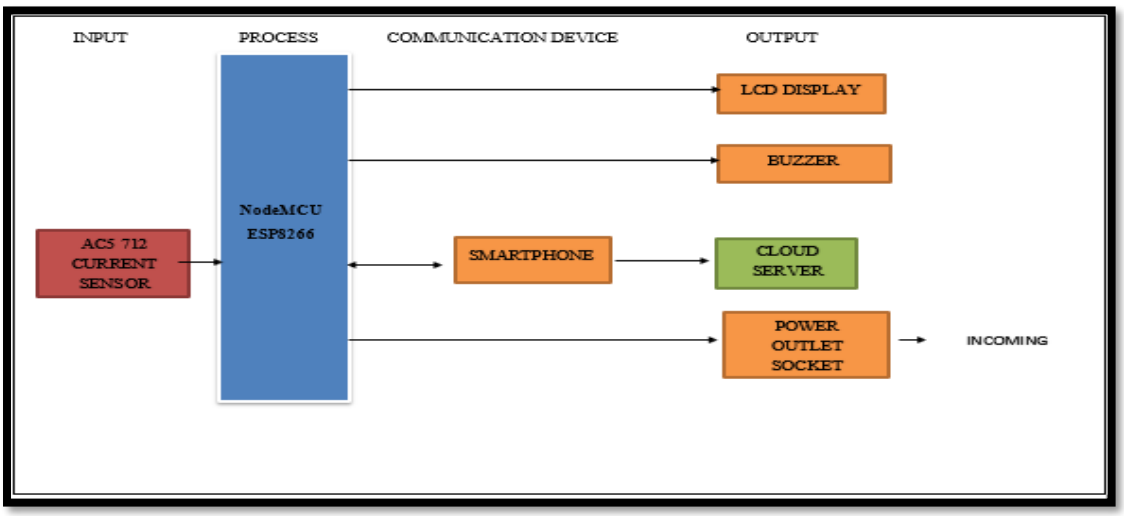

Figure 3.2: The Block Diagram for the project system

Figure 3.2 shows the block diagram for Home Electric Usage Notification & Monitoring system using NODEMCU project. This specific block diagram decides accurately on the way of system work and combined laterally with the software application and hardware tool. Furthermore, the main brain of the system is NodeMCU. It is will be interface with the input device such keypad and current sensor. Output from the Nodemcu will be LCD, Relay, power outlet socket and the consumer smartphone. Moreover, the cloud server will be created through the smartphone. Each of the component has its own function to make a major part in succeeding this project.

3.5.2 Project Overview

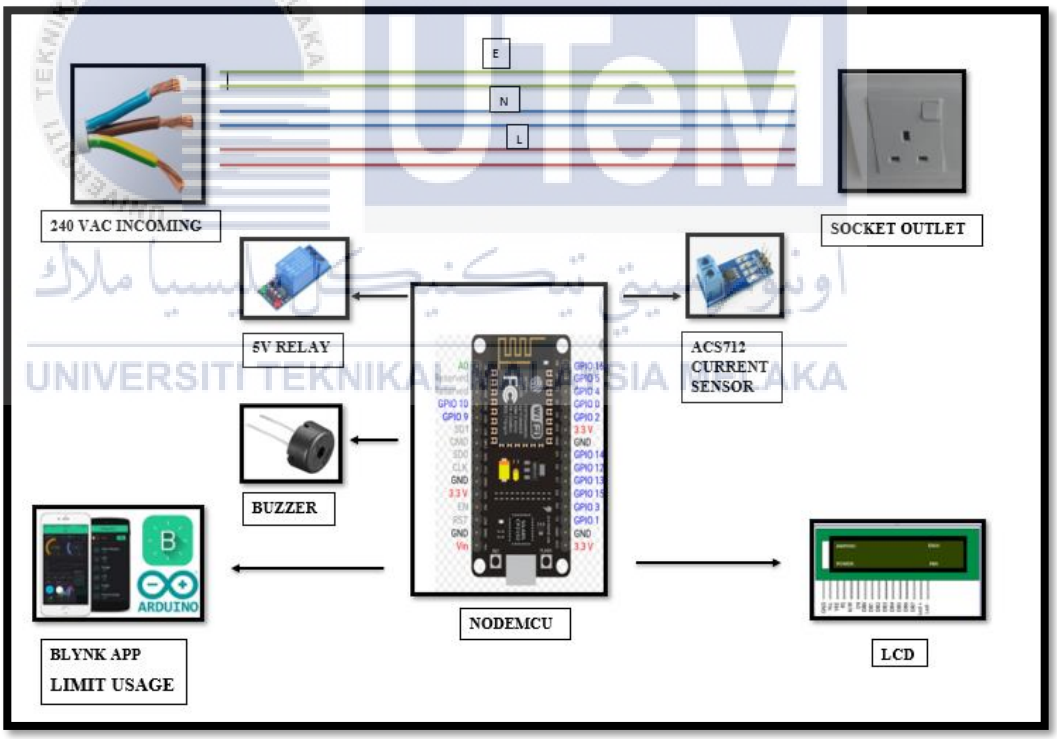

Figure 3.3: The overview for the project system

Figure 3.3 in above show that the overview for the operation of the Home Electric Notification and Monitoring System using NodeMCU. There are three incoming electric

wire of single-phase source with earth, neutral and life cable that was connect to the socket outlet. In this system ACS712A current sensor was used to trace out the usage of current from the socket outlet. This sensor is very compatible with all the home appliances. 30 A is the highest and maximum capacity current sensor that was used in this project. When there is a load in the socket outlet the flow of AC current will automatically sense the current sensor. The AC current waveform on the load can be saw when the changes of DC output is sensed by the current sensor. The ampere conversion result can be produced when the Nodemcu will calculate and trace the DC output from current sensor. The TNB tariff of power usage will be calculated and programmed in the Nodemcu.

After all the process is made up, the data will be sent to LCD and the user or client can monitor via a Blynk app frequently. The NodeMCU will be used as the IOT in this system. Besides, the user able to set the limit of electricity bill in Ringgit Malaysia. This step can be done by do it on smartphones that have a Blynk app after reached the limit. The use also able to monitor out the exceeding bill. The Relay was used to switch on and off the appliances in the house.

3.6 Hardware specification

In the project, there are several hardware components that were took part to complete the desired project. Some of the project that were used in this project are Nodemcu, current sensor, LCD, Relay, a smartphone, and other components as well.

3.6.1 NODEMCU

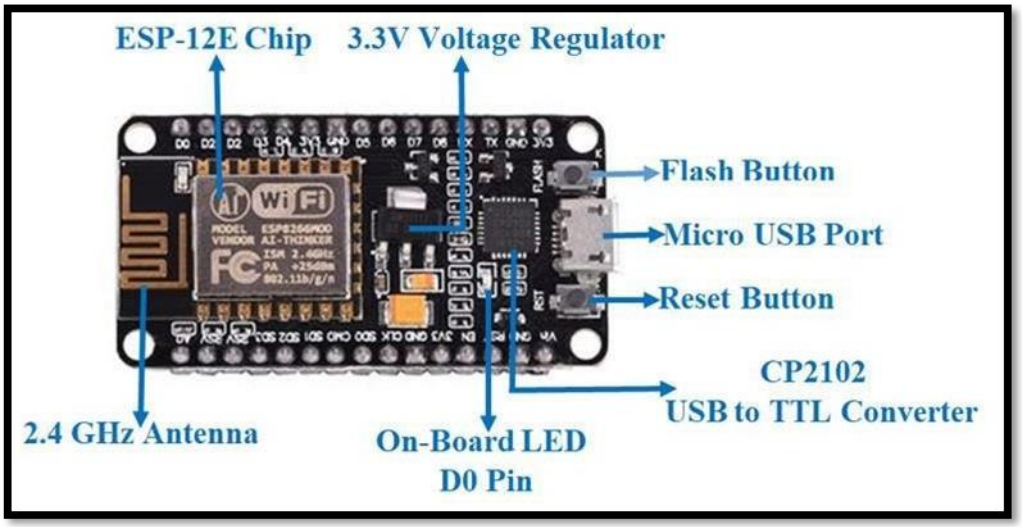

Figure 3.4: Front view of the NodeMCU

The Hub MCU is the open flexibly stage. Nodemcu consists of firmware which runs at ESP8266 Wi-Fi SoC from Es press if Frameworks, and equipment which depends absolutely on the ESP-12 module. The timeframe "NodeMCU" by utilizing default refer as to the firmware rather than the dev units. The firmware utilizes the Lua scripting language. It depends on the eLua crucial, built on the Espress if Non-operating system SDK for ESP8266. The ESP8266 is a Wi-Fi SoC integrated with a Tensilica Xtensa LX106 core, generally utilized in IoT applications. NodeMCU began on 13 October 2014, when Hong submitted the main record of nodemcu-firmware to GitHub. After two months, the task extended to incorporate an open-equipment stage when engineer Huang R submitted the Gerber record of an ESP8266 board, named devkit v0.9. Soon thereafter, Tuan PM ported MQTT customer library from Contiki to the ESP8266 SoC stage and focused on NodeMCU venture. The name Hub MCU alludes to two separate segments:

The Hub MCU firmware which gives a Lua improvement and execution condition which can run on anyESP8266 module with at least 512Kb Blaze Memory.

The Hub MCU Inc produced advancement packs. These are minimal effort breadboard-accommodating modules which are planned for giving an easy to design and set up, equipment stage for creating ESP8266-based LuaIoT applications S SDK

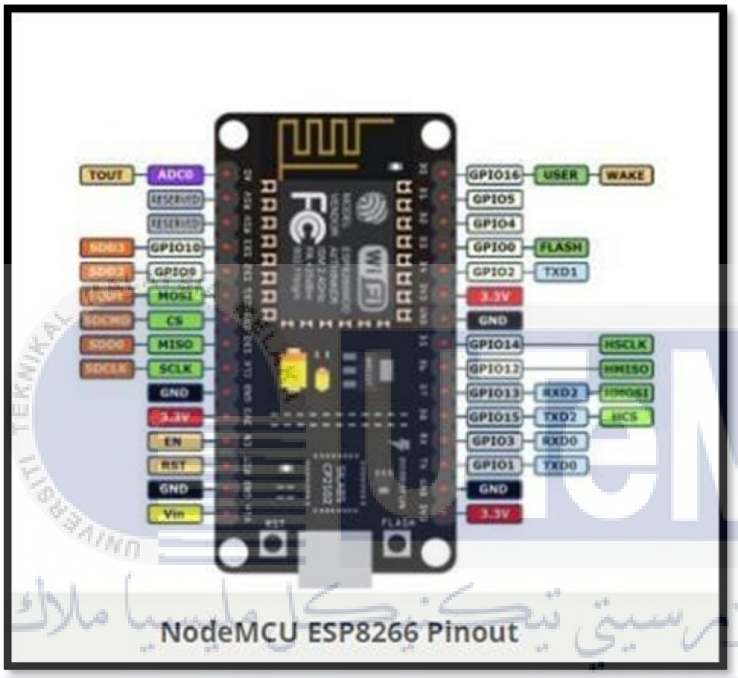

Figure 3.5: The NodeMCU board with part label

3.6.2 ACS 712 CURRENT Sensor (30A)

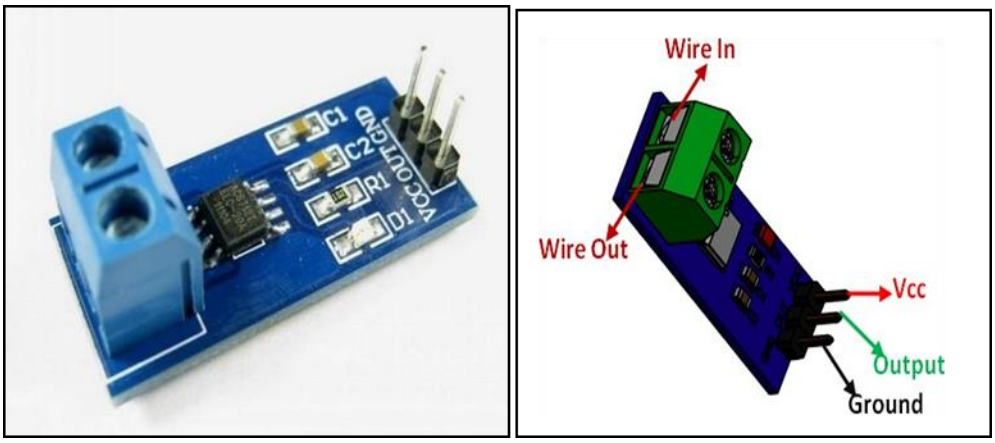

Figure 3.6: Rear view and labelled pin configuration

The ACS712 Current sensor in Figure 3.7 is used for calculating AC and DC current from the required load or terminals. It available in 3 modules which are 5A, 20A and 30A.For this project, the 30A current sensor will used. It requires 5V of supply to power up the sensor, but the output can be either AC or DC supply. Loads from high incoming voltage such as 240V AC also able to measure.

Figure 3.7: Internal view of current sensor

The ACS712 Current Sensor is also known as Hall Effect sensor because the internal part of the current sensor consists of magnetic-electric converting element whereby it will allow alternating current. Figure 3.8 above demonstrates the illustration of the internal view of current sensor and how it works on it. This sensor pin can be configured easily because it has 5 pins which are 3 input pin and the remaining are at the output. Figure below shows the pin number and the function of each pin.

Pin Number	Pin Name	Description
1	VCC	Input voltage is +5V for typical applications
2	Output	Outputs Analog voltage proportional to current.
3	Ground	Connected to ground of circuit
T1	Wire In	The wire through current has to be measured is connected here
T2	Wire Out	

Table 3.3: Pin configuration and function of ACS712 Current Sensor

3.6.3 Liquid Crystal Display (LCD)

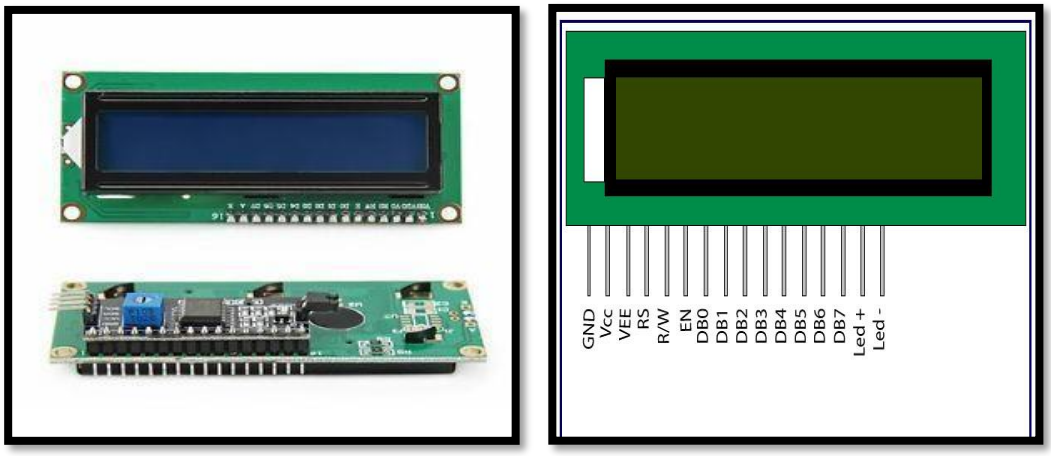

Figure 3.8: Overview of LCD display and pin configuration

LCD (Liquid Crystal Display) is a digital show module and discover an in-depth variety of utilizations. A 20x4 LCD as shown in figure 3.8 is tremendously fundamental module and is often utilize as a part of extraordinary devices and circuits. These modules are favoured greater than seven segments and different multi section LEDs. The motives being LCDs are sensible resultseasily programmable have not any impediment of displaying unique and even custom characters. A 16x2 LCD implies it could show sixteen characters for every line and there are 2 such strains. In this LCD each character is proven in 5x7 pixel matrix. This LCD has two registers, specially, Command and Data.

The command registers shop the order suggestions given to the LCD. A command is a course given to LCD to finish a predefined task like introducing it, clearing its screen, setting the cursor role, controlling show off and so on. The records sign up stores the information to be shown at the LCD. The statistics is the ASCII estimation of the character to be proven on the LCD. Table 3.4 describe each of the LCD pin.

Pin No	Function	Name
1	Ground (0V)	Ground
2	Supply voltage; 5V (4.7V – 5.3V)	VCC
3	Contrast adjustment; through a variable resistor	VEE
4	Selects command register when low; and data register when high	Register Select (RS)
5	Low to write to the register; High to read from the register	Read/write (R/W)
6	Sends data to data pins when a high to low pulse is given	Enable (EN)
7 – 14	8-bit data pins	DB1-DB7
15	Backlight VCC (5V)	Led+
16	Backlight Ground (0V)	Led-

Table 3.4: Pin configuration and function of LCD

3.6.4 Buzzer

3.7 Implementation

3.7.1 Project Implementation

After the hardware section were finalized, the flow of the implementation project was discovered and analysed. There are few aspects that effect and give problem in the process of implementation in evaluating the potential risks. The right and essential technologies need to ensure a good performance and maintain the function of system in long term. After well known about these factors the construction and implementation of project can be made as the requirement needed. the scale of technological solution needed, ensuring a solid desired performance. Sketching out the outlook of the project execution is critical basic development as it requires a lot of thought whereby any progress made once structures are concluded could be inconvenient in the demonstrates of materializing the project

In this part, the integration of the software and hardware to implemented simultaneously into the conduct of this project is the most challenging part. The project was developed to

notify and monitor electric home appliances usage purpose which is for consumer. The Nodemcu has the capability to detect consumption of current charge, the power in kw/h and the electricity bill withal the data that can be display through LCD on a prototype device itself and also online monitoring features through smartphone. Therefore, this is an efficient way for the user to trace out their energy consumption. To make the IOT device the Nodemcu module was used. The main controller will use this module to forward all information to the cloud storage server. The architecture of the system will give access to the consumer to monitor their energy meter online through smartphone application.

The result of this project is displaying the ampere, power, kilowatt per hour and the RM conversion approximately to the TNB bill. The calculation and data will be collected to make a comparison between the TNB tariff and the project to use this project prototype for the future.

3.7.2 The Operation Flowchart

The complete process flow of Home Electric Usage Notification & Monitoring system device is demonstrated through the flow chart shown in Figure 3.9.

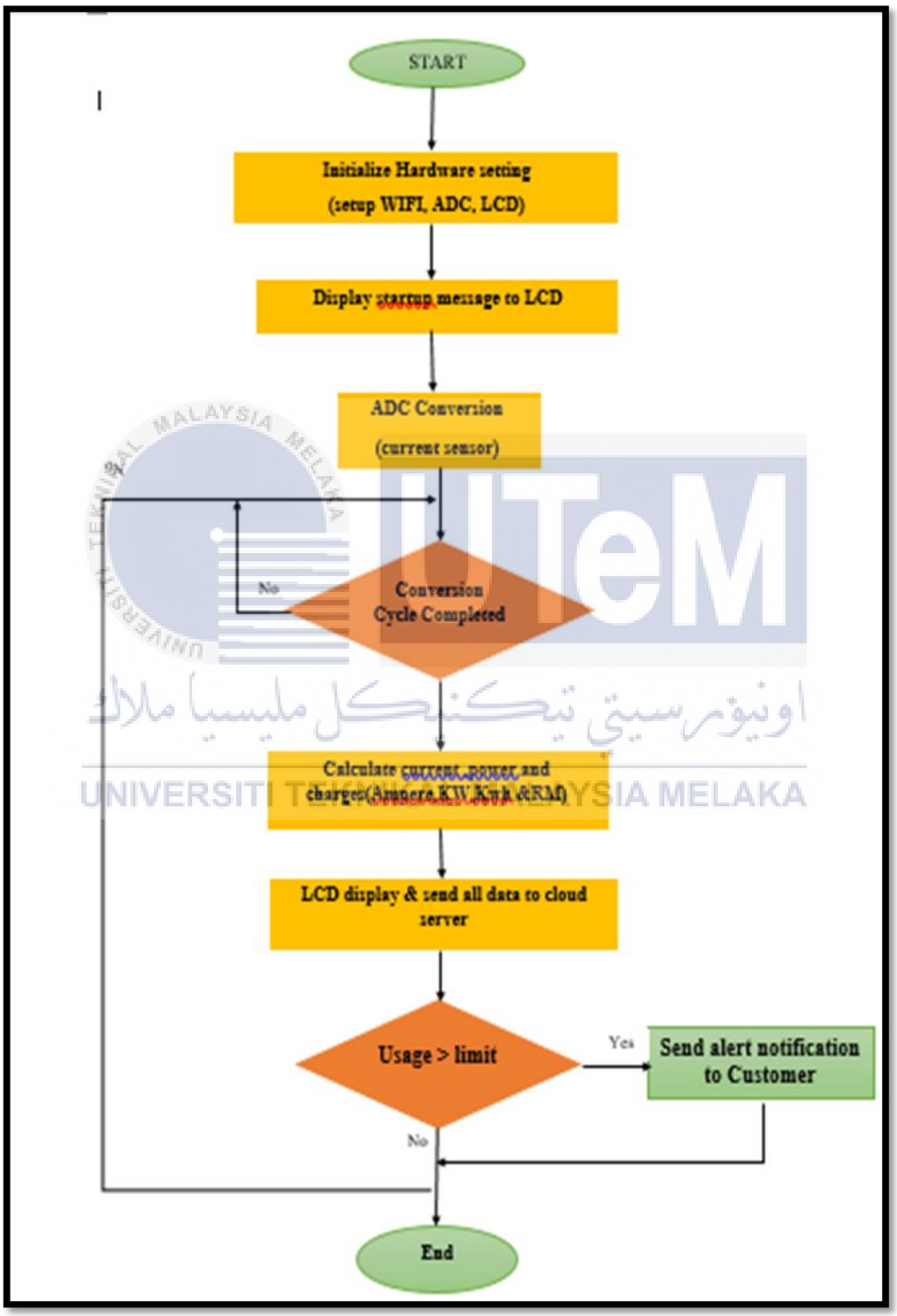

Figure 3.9: The process flow of project

3.8 Software Configuration

3.8.1 Cloud Server (Blynk)

Figure 3.10: Blynk application

Blynk APP is a Platform utilized with iOS and Android applications to control Arduino, Raspberry Pi, and another microcontroller over the Internet. It has an advanced dashboard where user can assemble a realistic interface dependent on the undertaking, we structured by basically relocating gadgets. The upside of Blynk is it is not fixing to some explicit board or shield rather; it is supporting equipment of our decision. Blynk will prepare on the web and for the Internet of Your Things. Figure 3.10 above shows the Blynk application used for controlling device wirelessly and using hotspot devices from the smartphones.

3.9 Summary

This summary of the methodology highlights the importance of implementing the proper methods of analysis and regulatory planning in the process of materializing as efficiently as possible. The proposed framework of this chapter is emulated with several steps which will ensure the outcome of the project will be as close to as planned previously. This chapter also presents the platform and the means of obtaining the desired data and information which are important to the objective of executing this PSM title. As a conclusion, the Home Electric Usage Notification & Monitoring system can be implemented if all the hardware and software is connected correctly and matches its requirement as above. The data collection and analysis will be done and explained in chapter 4.

CHAPTER 4
RESULT AND DISCUSSION

4.0 Introduction

This chapter explains which was thoroughly conducted during implementation of hardware and software, the general result of the final year project and the analysis of the outcomes were clarified in detail. Furthermore, the schematic structure of the hardware and programming were explained in this segment. At the same time, the software configuration by using Nodemcu and Blynk application will be established as well. The analysis that related on the accuracy and the response time against limit in RINGGIT MALAYSIA (RM).

4.1 Software and Coding Development

Figure 4.1 below shows, the conversion of coding for the Ringgit Malaysia (RM) which was implemented in Arduino software. Once the coding was programmed to Nodemcu the raw value from the input to Ringgit Malaysia also will converted. Besides, to examine the accuracy of the output value the TNB tariff was used. To make the system work as energy meter, there are few calculations in this coding. In real time life, the user needs to set "multiplier" 1 in the programming part to make the system work as normal while for the demo purpose and to get a fastest result the "multiplier" has set by 1000 to make the system work. To interpret data and collect information at end of the experiment this coding part is more important.


```
void myTimerEvent() {
  double U = 230;
  double I = sensor.getCurrentAC();
  double P = U * I;
   if(I < 0.08){
    I = 0;
    P = 0;
  }
  else{
  kwh = kwh + (P * 0.00028 / 1000);
  currentP = currentP + (kwh * 5);
  }

  Serial.println(String(I) + "  " + String(P)+ "  " + String(kwh,6) + "  " + String(currentP,6));
  if ( setP < currentP) {
    digitalWrite(buzzer, HIGH);
    if(con == 0){
      Blynk.notify("exceed limit");
      con = 1;
    }
  }
```

Figure 4.1: The conversion coding for Ringgit Malaysia (RM)

4.2.1 Coding for ACS712 Current Sensor

To control current flow in the Home Electric Usage Notification & Monitoring Usage using Nodemcu the current sensor was used. Specifically, this sensor can detect the 30 Ampere, in the AC current. The Figure 4.2 below shows the coding for current sensor that have been programmed in the Nodemcu. The coding in below figure will explain every process that take place in changes in incoming current value that straightly come from socket. The current sensor can sense the presence of appliances utilized and send information to the system and the Blynk application. Moreover, consumer able to monitor the ampere through the system and the Blynk application.


```
BLYNK_WRITE(V1)
{
  setP = param.asDouble();
  Serial.print("V1 Slider value is: ");
  Serial.println(setP);
}

void myTimerEvent() {
  double U = 230;
  double I = sensor.getCurrentAC();
  double P = U * I;
   if(I < 0.08){
    I = 0;
    P = 0;
  }
```

Figure 4.2: The coding for ACS712 current sensor

4.2.2 Coding for Nodemcu

The important part of this project is the Nodemcu Module, which was used for communication purpose between the device and the smartphone. To communicate with the smartphone few coding were used to function. Furthermore, the coding that was used is more safe and secure to accessed by the users. By adding the char ssid= "Tanga@unifi"; and char pass = "56152809", the Wi-Fi module start to make connectivity with the Wi-Fi Router. Once the Wi-Fi detected the system will start to generate the output. Therefore, for the security purpose the user has the authority to change the ssid and password in the system. The serial monitor at the Arduino Ide software will show the connectivity either "PASS" or "FAIL". Additionally, the blue light will light up and blinks once the connectivity was detected. Figure 4.3 below shows the coding for Nodemcu module.


```
#define BLYNK_PRINT Serial
#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>
#include "ACS712.h"
#include <Wire.h>
#include <LiquidCrystal_I2C.h>

char auth[] = "XPayWD5PnG5V2UbYfNmRTXGbSY8jDVFW";
char ssid[] = "Tanga@unifi";
char pass[] = "56152809";
ACS712 sensor(ACS712_05B, A0);
LiquidCrystal_I2C lcd(0x3F, 16, 2);
BlynkTimer timer;
int buzzer = 14;
double kwh;
double currentP = 0;
double setP = 0;
int con = 0;
```

Figure 4.3: The coding for Nodemcu Module

4.2 Development of Blynk application

The main program of the Home Electric Usage Notification & Monitoring system using NODEMCU was developed with Blynk Application. The user can access the system through their phone. In the same time the user can monitor the blynk application. In this Blynk system the user can monitor the real time current price, power, and Kilowatt. Besides that, the user able to set their current price limit of Ringgit Malaysia in the Blynk system. In the Blynk application there are added button function as on and off. This button will function as relay. This system also supported with notification icon to notify the user the exceed limit. This Blynk application can be downloaded from play store for the android phone. Then this Blynk app need to register with google account. Then the google account will give a token to active this blynk application

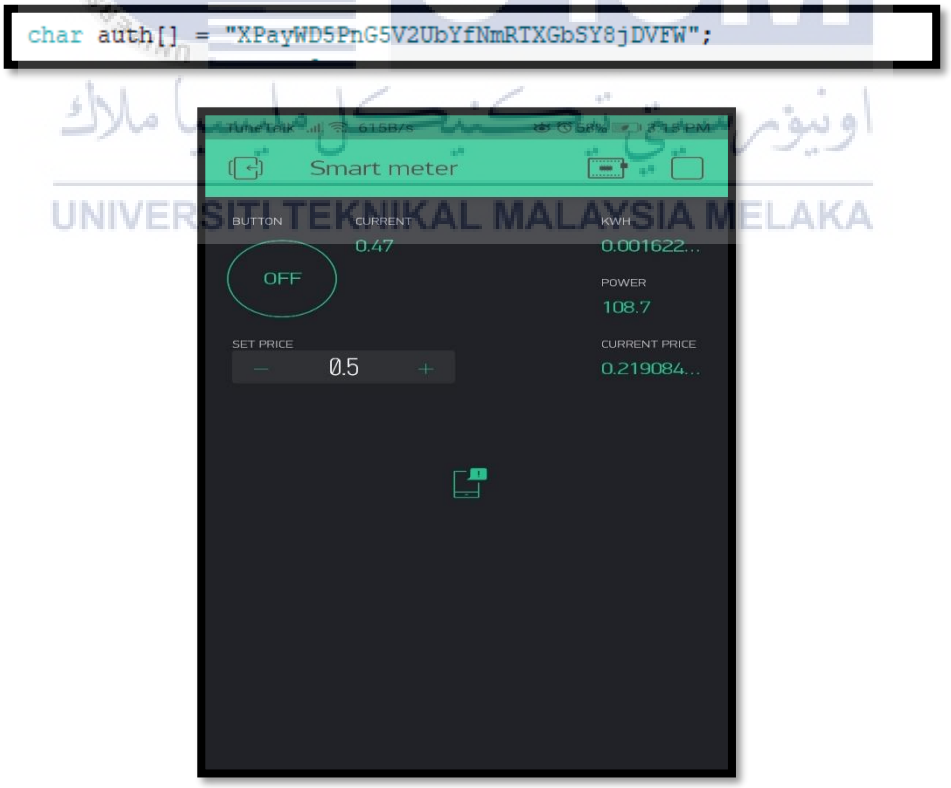

Figure 4.4: The Blynk application

4.3 HARDWARE DEVELOPMENT

In the development of hardware for this project is included of two part which is external and internal part. The Home Electric Usage Notification & Monitoring system was advanced developed in line with the targets and the capability, which has been proven earlier than the system implemented.

4.3.1 Internal and External Hardware Development

The internal part of the hardware development is the brain of the project because it consists of the Nodemcu which function as wifi module to communicate with other devices. Firstly, the ACS712 current sensor pin A0, 5V and 0V was connected to the Nodemcu. This current sensor required approximately 5V to active the Nodemcu. Meanwhile, the pin 18 and 19 from the Nodemcu changed into connection of Tx and Rx. Furthermore, LCD pins starting with pin 1 until 14 was linked to the Nodemcu according to the datasheet. Figure 4.6 shows the development of the LCD to the Nodemcu. Finally, buzzer positive and negative pins changed into linked to Nodemcu module with the sufficient needed voltage..

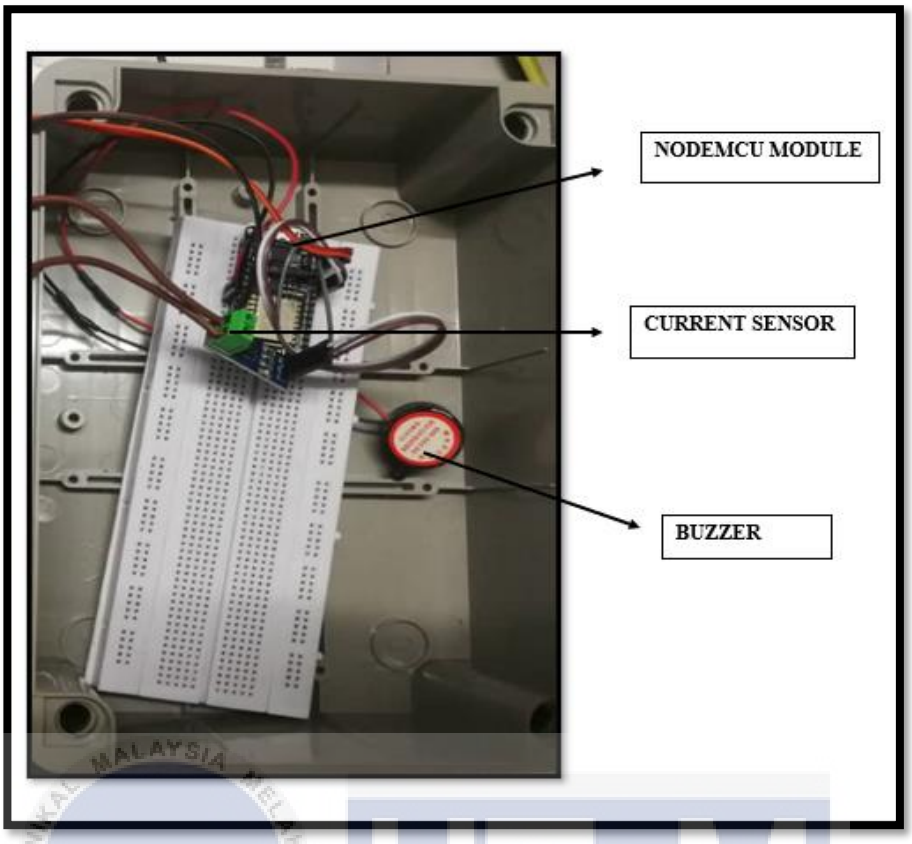

Figure 4.5: Internal Hardware development

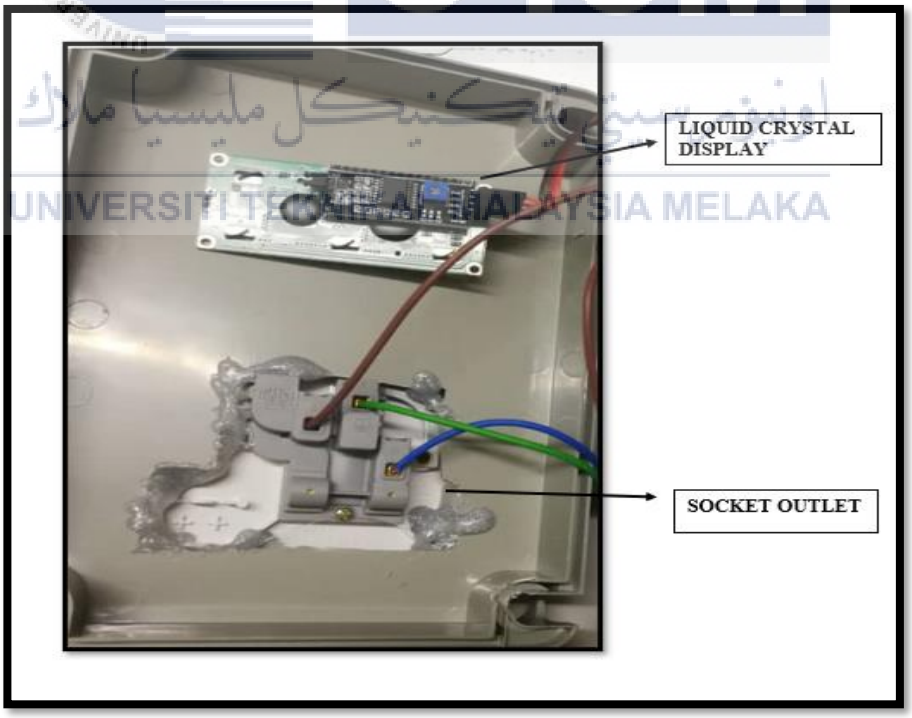

Figure 4.6: External Hardware development

4.4 PROTOTYPE DEVELOPMENT

A whole prototype changed into accomplished the usage of a number of the daily life matters to make this project greater creative and it changed into a good idea to visualise this system as a product final result. There were several things used to complete the prototype such as plastic casing box.

4.4.1 Notification Electric Usage Meter

Figure 4.7: Notification Electric Usage Meter

Figure 4.7 above shows the main system that was showed with the prototype, which was Notification Electric Usage Meter. Basically, all the

hardware devices were fitted together into one box to make the system more compact and portable. Therefore, all the electronic component was placed into the pvc board. Then, on the top of the casing box the LCD and socket outlet were installed. The Notification Electric Usage Meter was ready for analysis and collect the data.

4.4.2 Prototype of the system

Figure 4.8: Home Appliances Prototype

Figure 4.8 above shows a daily uses of home appliances model. This model was created using the electrical board and other electrical hardware. The bulbs that were used is 25 w, 4 w, 60 w, and 100w. For addition, air cooler was added as the main load. Additionally, a switch was added to the electrical board to control the light. This prototype been created for the analysis result part.

4.4.3 Interface of the system

The Home Electric Usage Notification and Monitoring System using Nodemcu only can usus for daily home usage only. This system is ready and can use for 24 hours per day. Furthermore, the system can alert the user once reached the limit.

The workflow of the system is shown below, First, the user needs to turn on the supply and need to wait for 5 to 20 second to active the system and make sure the correct WI-FI signal is connected.

Figure 4.9: Initial Display of the system

After the turned on the system is done, the user needs to set the limit of current price that need to set in the Blynk application through the smartphone and at the same time the user can monitor the power kilowatt and notification alert message.

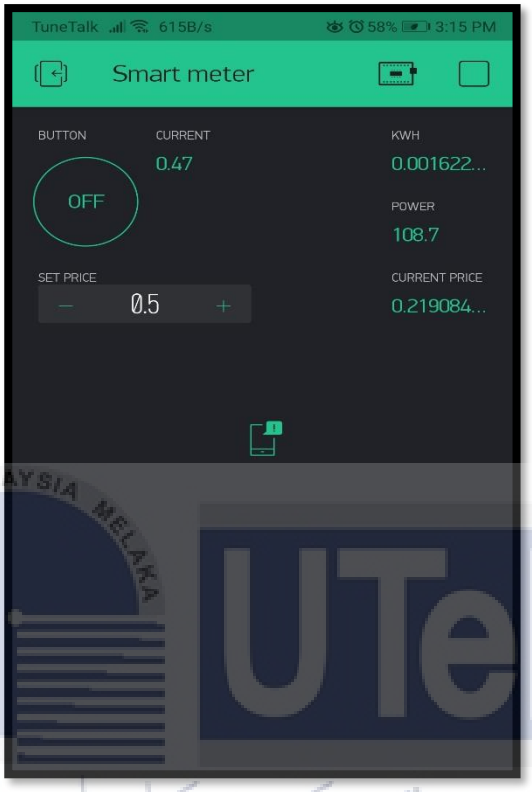

Figure 4.10: Blynk application at smartphone

The limit set in the system by the user is shown in Figure 4.11 below

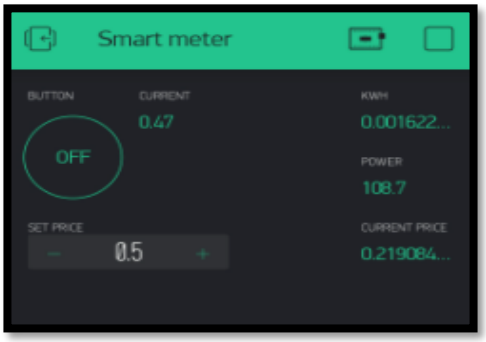

Figure 4.11: Limit display

The user turns on the bulb and the air cooler and the system started to display the output as shown in figure 4.12 below.

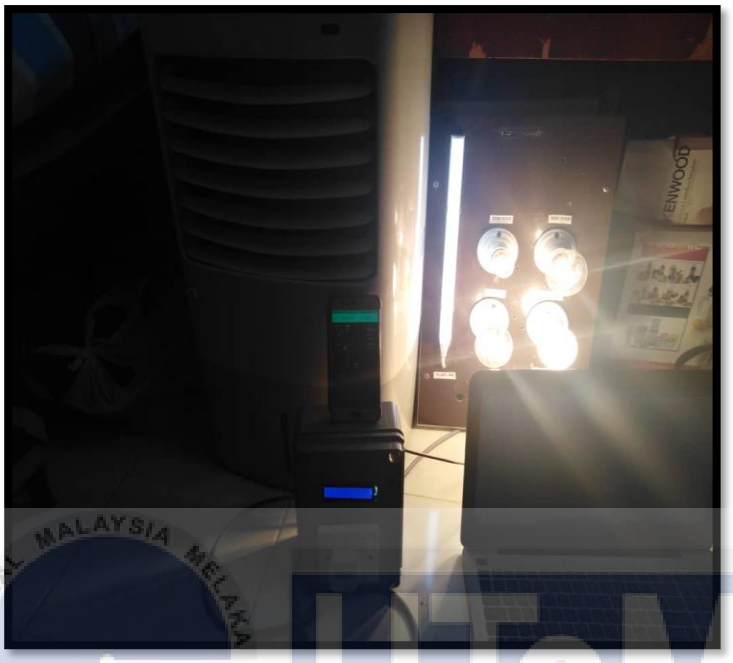

Figure 4.12: Home appliances turned on

The user will receive the notification alert through the smartphone once reached the limit as shown in figure 4.13 below. Once the limit is reached a buzzer sound also will be heard until the user turns off in the Blynk app.

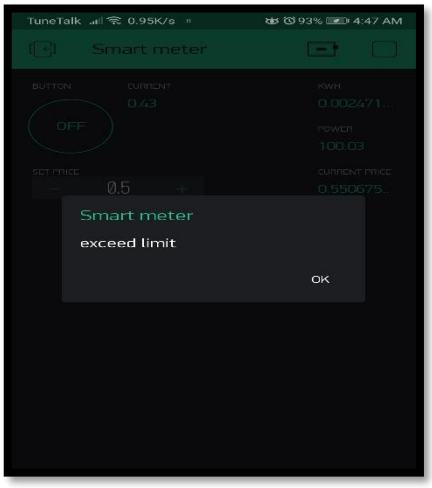

Figure 4.13: Blynk Notification

Then if the user still wants to use the system, the user needs to increase the limit until the buzzer sound heard again, the system will continue to work until it reached the limit again.

Figure 4.14: Adding different limit value

The development of the overall Home Electric Usage Notification & Monitoring system using IoT visualized in the Figure 4.15 below.

Figure 4.15: Overall prototype system

4.5 DATA ANALYSIS

In this project, there are three types of data analysis was taken to ensure the system is working properly with greater accuracy, able to be marketable and use by the consumer. All the experiment was carrying out in home environment the scope of this project was for home only. This analysis able to examine the output of the system in real time application. Thus, several data were collected and analyse it using graph.

Figure 4.16: Specification of Air cooler

Figure 4.17: Specification for Laptop Charger

Figure 4.16 and Figure 4.17 shows the specification for Air cooler and laptop charger.

4.5.1 Time taken to receive notification with different type of load

In this analysis, the data collected based on laptop charger, air cooler and few different watts of bulb. RM 0.50 limit were set in the system for each load. Hence, based on table 4.1 below, the data was recorded after conducting the load test at different watt of bulb and 2 electrical appliances. The purpose of this experiment is to examine the suitable bulb, which is suitable for user to use for longer time with less cost. Therefore, the less the time taken to receive the notification, the better the usage of bulb.

Type of Load	Limit set In system (RM)	Time taken to receive the limit Notification
4W LED	0.50	27.00
25W LED bulb	0.50	2.42
40 W LED bulb	0.50	2.08
Air Cooler	0.50	1.52
60 W LED bulb	0.50	1.50
Laptop Charger	0.50	1.29
100 W LED bulb	0.50	1.21

Table 4.1: Notification alert with different type of load

Based on the data analysis above, a bar graph in figure 4.16 below was derived and the graph shows the time taken to receive a notification on different type of load rapidly decreasing because the

type of load and rating is increasing. The high peak of data shows 27 minutes to receive a notification when connected with 4 watt Led bulb. Meanwhile for the lowest time taken to receive notification is 100-Watt bulb. Hence, the receiving time of notification need to be less because to ensure the bulb able to work longer time. Besides, instead of using 100W of bulb consumer need to use 4W because it is an energy saver and has higher efficiency in it.

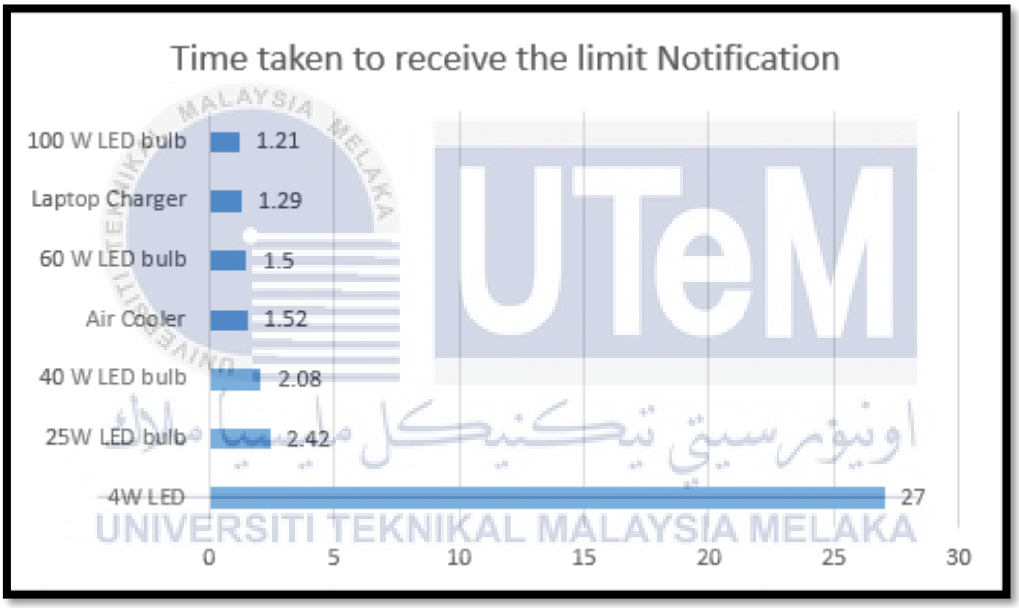

Figure 4.16: Time taken to receive notification on different load

4.5.2 Energy consumption usage with different type of load

Type of Load	Calculation based on ratings (Kwh)	Experiment result (Kwh)
4 Watt Led	0.004	0.0036
25 Watt Led	0.01	0.019
40 Watt Led	0.025	0.035
Air cooler	0.06	0.055
60 Watt Led	0.06	0.055
Laptop charger	0.097	0.1
100 Watt Led	0.1	0.19

Table 4.2: Energy consumption usage with different type of load

Energy consumption usage with different type of load and rating is the second analysis that have been carried out. To get the actual result all the load was consumed for 1-hour time to compare with energy consumption. The data for this experiment has been taken and recorded in table 4.3 below. The purpose of this experiment is to observe the actual and the experiment results of energy consumption usage either same or different from the project implemented. Additionally, to prove the actual results and experiment results of the project an example of calculation was clarified as well in table below.

Example Calculation base on ratings P = I x V = 0.0166A x 240V = 4W x 1 Hours / 1000 = 0.04 kWh	Example Experiment Calculation P = I x V = 0.015A x 240V = 3.6W x 1 Hours / 1000 = 0.0036kWh

Table 4.3: calculation base on ratings and experiment

Based on Figure 4.17 below, the graph shows the comparison between the actual and taken results of the energy consumption utilization. It also may be discovered as the ratings of the bulbs increase from 4W to 100W, the electricity consumption usage additionally hastily will increase. The experiment result for 100W bulb is expanded higher that is 0.19 kWh compare to the actual value, which become 0.1kWh whereby it is able to be see within the graph below. Moreover, for 10W and 25W bulb rating the experiment result became approximately high as the 100W, that's 0.019kWh and 0.035kWh by compare to the actual effects. The energy consumption usage increasing because there were sure errors within the ACS712 current sensor. In addition, the graph below shows 4W, 60W and air cooler consumed less usage of energy consumption In the experimental results compare to the actual results.

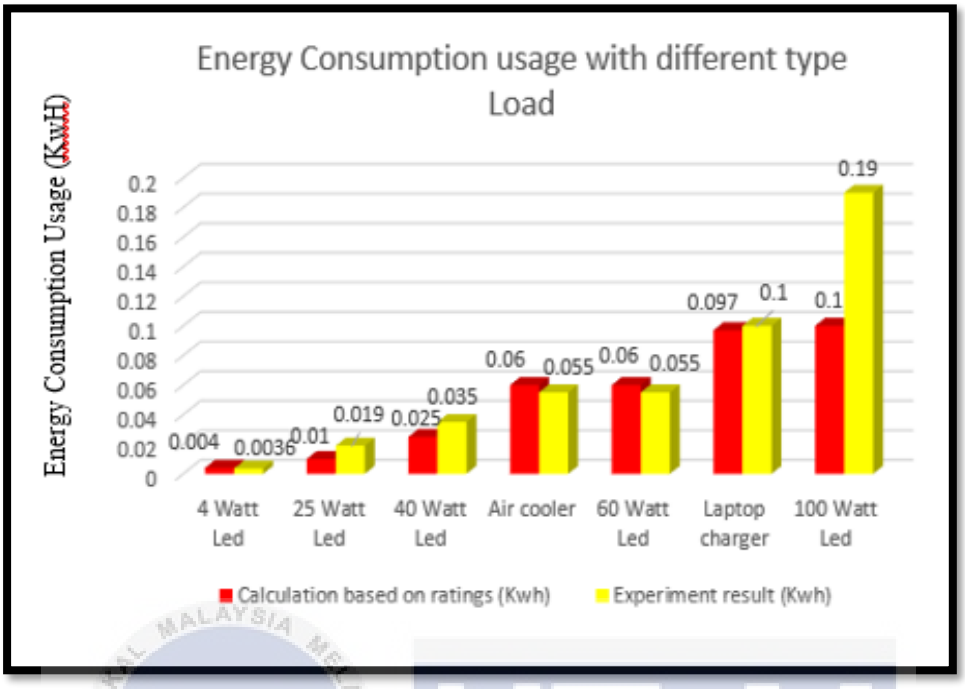

Figure 4.17: Energy consumption usage with different type of load

4.6 Discussion

In this project, the main purpose and aim of this project were done is to create a Notification Energy Meter which will help the user to monitor and budget their daily electric usage and electric bill. As I mentioned earlier in chapter 1 and chapter 2 the electricity savings and power consumption become the major problem and the need of power is increasing year by year with the population in Malaysia. The whole process of developing this project took around 6 months since the title was suggest and proposed. The research process was done to find the similar project and for comparison among the project with current one to obtain the component was used. After the complete concept this project was done successfully with few defects and with few components the prototype was made. Even though many projects are similar, this prototype was made with different specification and components, it is designed using Nodemcu module, ASC712 current sensor, LCD, socket outlet and buzzer. In completing the design there some problem and error that have faced such as difficult to find the proper coding and have faced many troubleshooting. Moreover, this system created after managed to get the entire component where all this were designed into one module.

According to the finding and analysis on both experiments, the user needs to choose the better electrical appliances. The longer the consuming time of load, the slower the notification received by the user. This system is very beneficially and help to reduce the amount of electric bill and at the same time the user can budget the limit usage.

CHAPTER 5

CONCLUSION & RECOMMENDATIONS

5.1 Introduction

This chapter will discuss on how the development of Home Electric Usage Notification & Monitoring system using NODEMCU helps to achieve the main objectives of the project. Besides that, in this chapter had discussed about the limitations that were faced during the research of this project. Furthermore, the recommendations for future work of this project will also be stated and elaborated here in this chapter. The recommendations of this project will also be added on the way to improve its efficiency based on the advantages and disadvantages.

5.2 Conclusion

Now at Malaysia the savings and efficiency of power consumption became a major issue recently and the need for power is increasing day by day. Besides, the user frequently uses electricity without knowing their limit, moreover when it comes to festive season or the MCO time the electricity usage will rise up and along with all expenses, high electricity bill would be a big burden for consumer. In addition, there was not any alert system to the user to monitoring and helps the user for track the daily

consumption.

Thus, in a good way to help the user to alert and realize the importance of energy consumption, a project which called as Development of Home Electric Usage Notification and Monitoring system using Nodemcu was designed and notify the user the energy usage in Ringgit Malaysia (RM).

This project was made up and design based on three main objectives to achieve the aim of this project which is to reduce the cost of monthly electric bill for the users. Firstly, the objectives of this project have been achieved successfully which is to develop Home Electric Usage Notification and Monitoring System via Nodemcu. Besides that, developing this project will also alert and notify consumer the utilized electric bill once set limit of ringgit Malaysia (RM) has reached. Finally, the implemented system will measure and calculate the electric current usage based on tariff set by TNB.

5.3 Future Recommendations

This Notification Energy meter is one of the effective systems to the consumers. The system able to notify, track and monitor the energy consumption. This system is widely developed in many countries using various technologies and component. In this project, there were few limitations that were found and that stopped more features to be added into this project.

The future recommendation for this project is to suggest using Raspberry Pi to be added in this project. This is because, if there is a Raspberry Pi in the system, the system able to work during offline by connecting through Bluetooth and the user still can receive the notification with absent of WI-FI. Additionally, the system needs to integrate with higher current sensor ampere value that able to track higher home appliances current.

REFERENCE

Al-Ali, A.R., Zualkernan, I.A., Rashid, M., Gupta, R. and AliKarar, M., 2017. A smart home energy management system using IoT and big data analytics approach. IEEE Transactions on Consumer Electronics, 63(4), pp.426-434.

Ali, R.A., Hussain, M. and Mahmood, T., Low Cost GSM based Smart Energy Meter Design: Capable of Demand Side Management and Data Logging.

Ananth, D.V.N., Satish, G.J.R.C., Shyam, J., Santosh, K., Prasad, U.V.V.S.S.V. and Ramya, K., 2019. Smart Electricity Billing Using Node-MCU. International Journal of Scientific Research in Science, Engineering and Technology (IJSRSET), Online ISSN, pp.2394-4099.

Ashna, K. and George, S.N., 2013, March. GSM based automatic energy meter reading system with instant billing. In 2013 International Mutli-Conference on Automation, Computing, Communication, Control and Compressed Sensing (iMac4s) (pp. 65-72). IEEE.

Durani, H., Sheth, M., Vaghasia, M. and Kotech, S., 2018, April. Smart automated home application using IoT with Blynk app. In 2018 Second International Conference on Inventive Communication and Computational Technologies (ICICCT) (pp. 393-397). IEEE.

Garg, L., Sharma, C. and Verma, R., 2018. IOT Based Smart Energy Meter Using Arduino AVR and NODE MCU.

Hlaing, W., Thepphaeng, S., Nontaboot, V., Tangsunantham, N., Sangsuwan, T. and Pira, C., 2017, March. Implementation of WiFi-based single phase smart meter for Internet of Things (IoT). In 2017 International Electrical Engineering Congress (iEECON) (pp. 1-4). IEEE.

Islam, M.S. and Bhuiyan, M.S.R., 2017, February. Design and implementation of remotely located energy meter monitoring with load control and mobile billing system through GSM. In 2017 International Conference on Electrical, Computer and Communication Engineering (ECCE) (pp. 158-163). IEEE.

Karthikeyan, S. and Bhuvaneswari, P.T.V., 2017, January. Iot based real-time residential energy meter monitoring system. In 2017 Trends in Industrial Measurement and Automation (TIMA) (pp. 1-5). IEEE.

Osman, M.S., 2019, July. Smart home meter reading using IoT with Blynk app. In AIP Conference Proceedings (Vol. 2129, No. 1, p. 020109). AIP Publishing LLC.

Preethi, V. and Harish, G., 2016, August. Design and implementation of smart energy meter. In 2016 International Conference on Inventive Computation Technologies (ICICT) (Vol. 1, pp. 1-5). IEEE.

Qiang, T., Guangling, G., Lina, C. and Han, W., 2018, October. Nodemcu-based Low-cost Smart Home Node Design. In IOP Conference Series: Materials Science and Engineering (Vol. 435, No. 1, p. 012013). IOP Publishing.

Rahman, M.M., Islam, M.O. and Salakin, M.S., 2015, May. Arduino and GSM based smart energy meter for advanced metering and billing system. In 2015 International Conference on Electrical Engineering and Information Communication Technology (ICEEICT) (pp. 1-6). IEEE.

Ravi, D., Shibu, J. and Shanthi, E., 2015. Smart Energy Meter with Instant Billing and Payment. In Artificial Intelligence and Evolutionary Algorithms in Engineering Systems (pp. 187-196). Springer, New Delhi.

Saikia, L.C., Das, H., Choudhury, N.D. and Malakar, T., 2016, December. GPRS enabled smart energy meter with in-home display and application of time of use pricing. In 2016 IEEE Annual India Conference (INDICON) (pp. 1-5). IEEE.

Saikrishna, M. and Vijaykiran, G., 2017. IOT Based Home Electrical Appliances Control Using Node MCU. International Journal of Scientific Engineering and Technology Research, 6(04), pp.0783-0788.

TAŞTAN, M., 2019. Internet of things based smart energy management for smart home. KSII Transactions on Internet & Information Systems, 13(6).

Wikipedia contributors. (2020, May 25). Tenaga Nasional. In Wikipedia, The Free Encyclopedia. Retrieved 18:22, June 10, 2020, from https://en.wikipedia.org/w/index.php?title=Tenaga_Nasional&oldid=95867166

Project Activity	(PSM 1) SEM 1 2020/2021														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Selection of title								Mid Term Break							
Online title registration															
Internet and Library research															
Proposal preparation															
Consultation															
Proposal Submission															
Chapter 1 Preperation															
Chapter 2 Preperation															
Chapter 3 Preperation															
Report Submission															