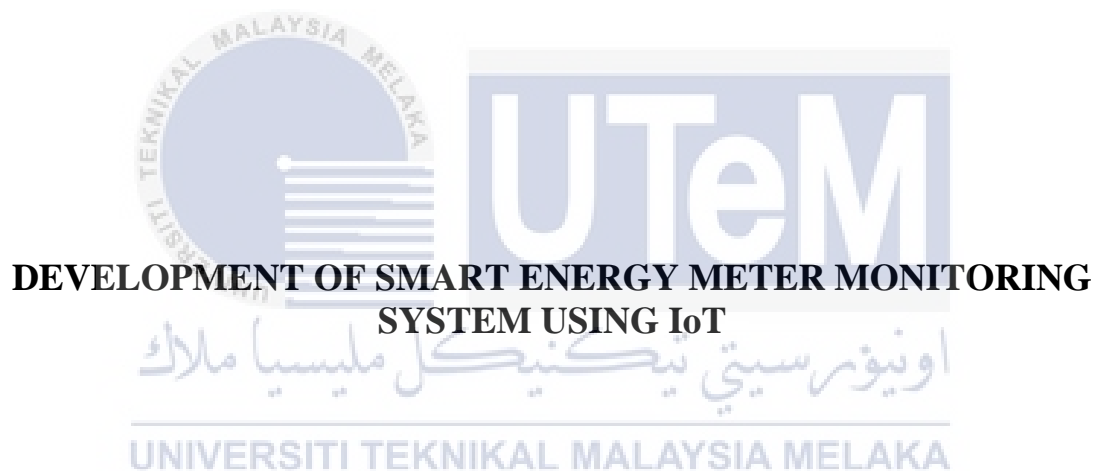




Faculty of Electrical and Electronic Engineering Technology



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Bachelor of Electronics Engineering Technology (Telecommunications) with Honours

2022

**BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II**

Tajuk Projek : Development of Smart Energy Meter Monitoring System using IoT

Sesi Pengajian : 2022/2023

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Tarikh : 24 Februari 2023

DECLARATION

I declare that this project report entitled “Development Of Smart Energy Meter Monitoring System Using IoT” is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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APPROVAL

I hereby declare that I have checked this project report and in my opinion, this project report is adequate in terms of scope and quality for the award of degree of Bachelor of Electronic Engineering Technology (Telecommunication) with Honours.

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DEDICATION

I dedicate this thesis to my parents who always been a sources of inspiration and strength in times of hopelessness and discouragement. Furthermore, their unwavering devotion has inspired me to set a higher goal. I also dedicate this thesis to my siblings who always been my backbone and who became my backbone and helped me a lot throughout the process of completing this project and thesis. Finally, I dedicate this thesis to my supervisor who always provided support and guidance from the beginning until I successfully completed my project and thesis without any difficulties.



ABSTRACT

University students who travel for studies rent homes near campus. They often have a budget for their monthly expenditure. Electrical usage is one of the highest contribution to their monthly expenditure. Students at their rental homes use more electricity than they plan to monthly that the monthly bill comes more than their budget. They have no control over electrical usage at home as they require it to charge their electronics as well as their technology. There are students who waste electricity at home by leaving it on when it is not in use. The monitoring system programmed in the energy meter using the Adafruit will monitor the current usage, voltage usage and the cost. This system will continuously monitor and keep track of the electricity consumption for verification by setting a limit of their monthly usage. Nowadays, it is important to closely monitor consumption in order to manage the use of electricity that a Hardware is needed to prevent electrical energy wastage. The meter is used to monitor units consumed, estimated cost, Line Voltage and current consumed. This system is an automated system which allows the user to monitor the energy meter reading over the internet.

ABSTRAK

Pelajar universiti yang melancong untuk belajar akan menyewa rumah berhampiran kampus. Mereka selalunya mempunyai bajet untuk perbelanjaan bulanan mereka. Penggunaan elektrik adalah antara sumbangan tertinggi kepada perbelanjaan bulanan mereka. Pelajar yang berada di rumah sewa, mereka menggunakan lebih banyak elektrik daripada yang mereka rancang setiap bulan di mana bil bulanannya melebihi bajet mereka. Mereka tidak mempunyai kawalan ke atas penggunaan elektrik di rumah kerana mereka memerlukan untuk mengecap elektronik mereka serta teknologi mereka. Terdapat pelajar yang membazir elektrik di rumah dengan membiarkannya menyala apabila tidak digunakan. Sistem pemantauan yang diprogramkan dalam meter tenaga menggunakan Adafruit akan memantau penggunaan semasa, penggunaan voltan dan kos. Sistem akan terus memantau dan menjejaki penggunaan elektrik untuk pengesahan dengan menetapkan had penggunaan bulanannya. Pada masa kini, adalah penting untuk memantau penggunaan elektrik dengan teliti untuk menguruskan penggunaan elektrik yang mana perkakasan diperlukan untuk mengelakkan pembaziran tenaga elektrik. Meter digunakan untuk memantau unit yang digunakan, anggaran kos, Voltan Talian dan arus yang digunakan. Sistem ini merupakan sistem automatik yang membolehkan pengguna memantau bacaan meter tenaga melalui internet.

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First and foremost, I would like to express my gratitude to my supervisor, Ts. Eliyana Binti Ruslan for guidance, words of wisdom and patience throughout this project.

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CHAPTER 1

INTRODUCTION

1.1 Background

An energy meter is a tool that measures the quantity of electricity fed on through a residence, a business or an electrically powered tool. Electric utilities use electric powered meters set up at customers' premises for billing and tracking purposes. Ordinary vitality meter which we utilize in our families to determine vitality utilization is an offline gadget, so it has to be checked physically. These days, there are Shrewd Vitality Meters accessible within the advertise whose readings can be checked from anywhere using the web and not as it were vitality utilization but ready to screen different parameters such as voltage, current, control figure, recurrence, etc. on tablet or versatile utilizing IoT. This project is more ~~focus~~ focused on student rental housing.

1.2 Problem Statement

Students use more electricity than they planned each month. They use more than they estimate for charging purposes especially when they have submissions and for gaming. There is no control over electrical usage when a number of students use the electricity at home or when the house is empty during sem break. The electricity still runs and there are possibilities of electricity theft. Students waste electricity at home by leaving it on when it is not in use. They tend to let their electronics charge overnight and the fans and lights be switched on at places that are not needed.

1.3 Project Objective

The main aim of this project is to save the electricity from wasted by measuring the current and cost of electricity. Specifically, the objectives are as follows:

- a) To program a software to monitor the energy usage using IoT.
- b) To control the usage of electricity by implementing a set limit by the consumer.
- c) To built an energy meter hardware to prevent wastage of electric energy.

1.4 Scope of Project

The scope of this project focuses on monitoring the energy meter reading and manage the use of electricity. It is a project that is suitable for residential use who prefer a system that is easily installed, controlled and monitored both indoors and outdoors from all locations. Below are a few project scopes listed based on this study:

- a) The project can only be used for student rental housing with energy consumption cost between RM10 – RM500.
- b) With a limit set, the consumer needs to set a new estimated cost using the application.
- c) The position of the hardware built cannot be relocated to any other part of the house or office.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter is to discuss about the smart energy meter monitoring system. Internet and technology advancements have made it easier for users to monitor their electricity usage using a Smart Energy Meter. Smart energy meter is able to track the consumption of data energy by light type. In order to educate the public about the importance of conserving energy. The Internet of Things (IoT) platform used in this project allows it to read energy consumption data and manage the data in the cloud, as well as collect and analyze real-time energy use.

2.2 Energy Meter

The monitoring system is developed with reference of The Smart Grid system where it is a system that can be accessed through the Internet all over the world. It is a cost saving and time saving system that can be maintained and operated from a distance. Its data received from the system is stored in its free cloud to avoid data loss[1]. From the smart energy meter, consumers are able to have control over their money. It is possible as smart energy meters monitor the consumption of the electricity to avoid the bill from hitting more than the budgeted expenditure. It was stated that as the population increases, there will be an increase in energy use as the demand goes higher[2].

In Oman, an IoT smart energy meter was implemented to ensure energy is efficient and conserving to prevent wastage of energy. Using raspberry pi, it was able to connect to the energy sources to monitor and control the energy usage as well as read the values retrieved from the system. It is an affordable and tangible energy meter to be used which notifies the users from time to time by email[3].

When Arduino is used in an IoT based energy meter, it is able to run without manual labour. It is said that the theft of electricity is common and the smart energy meter is able to prevent as well detect unusual electricity flow in the system. It will then display on the LCD screen[4]. The LCD display would display the data received from the programmed system that uses Arduino UNO as a microcontroller. The details displayed would be the voltage, current, power and energy values. To better the system, sensors are installed to increase its safety to detect the overloading of energy used in appliances and to avoid a hike in the monthly electrical bill[5]. NodeMCU is used to receive data from the Arduino microcontroller that measures the energy used in the system and the blynk app where the data can be seen. On the app, we can picture the functions through the programme and the output. The mobile Blynk app is able to work as a software to control and monitor the data as well as work the system. NodeMCU is known to have a fast data transfer rate that is suitable for the system[6].

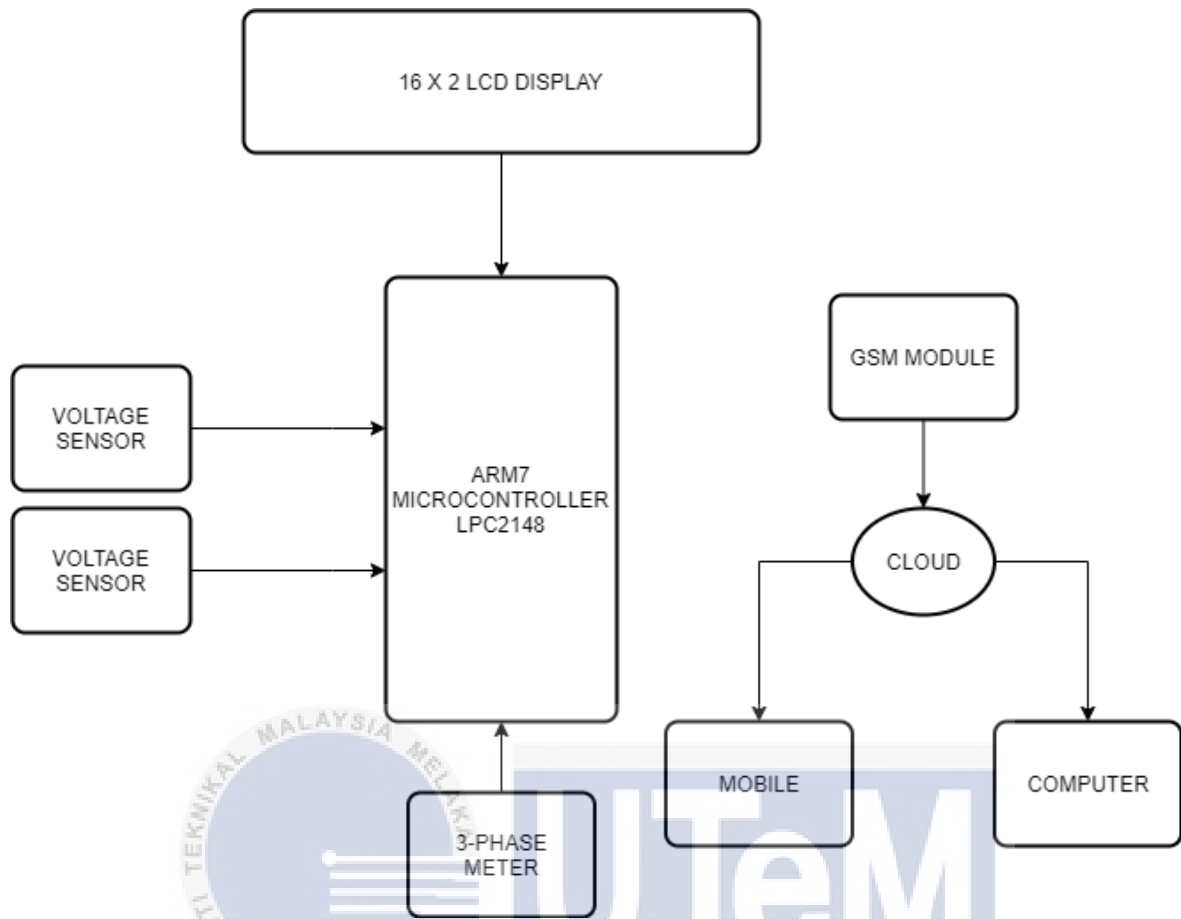


Figure 2.1: Architectural Design of Smart Meter [7].

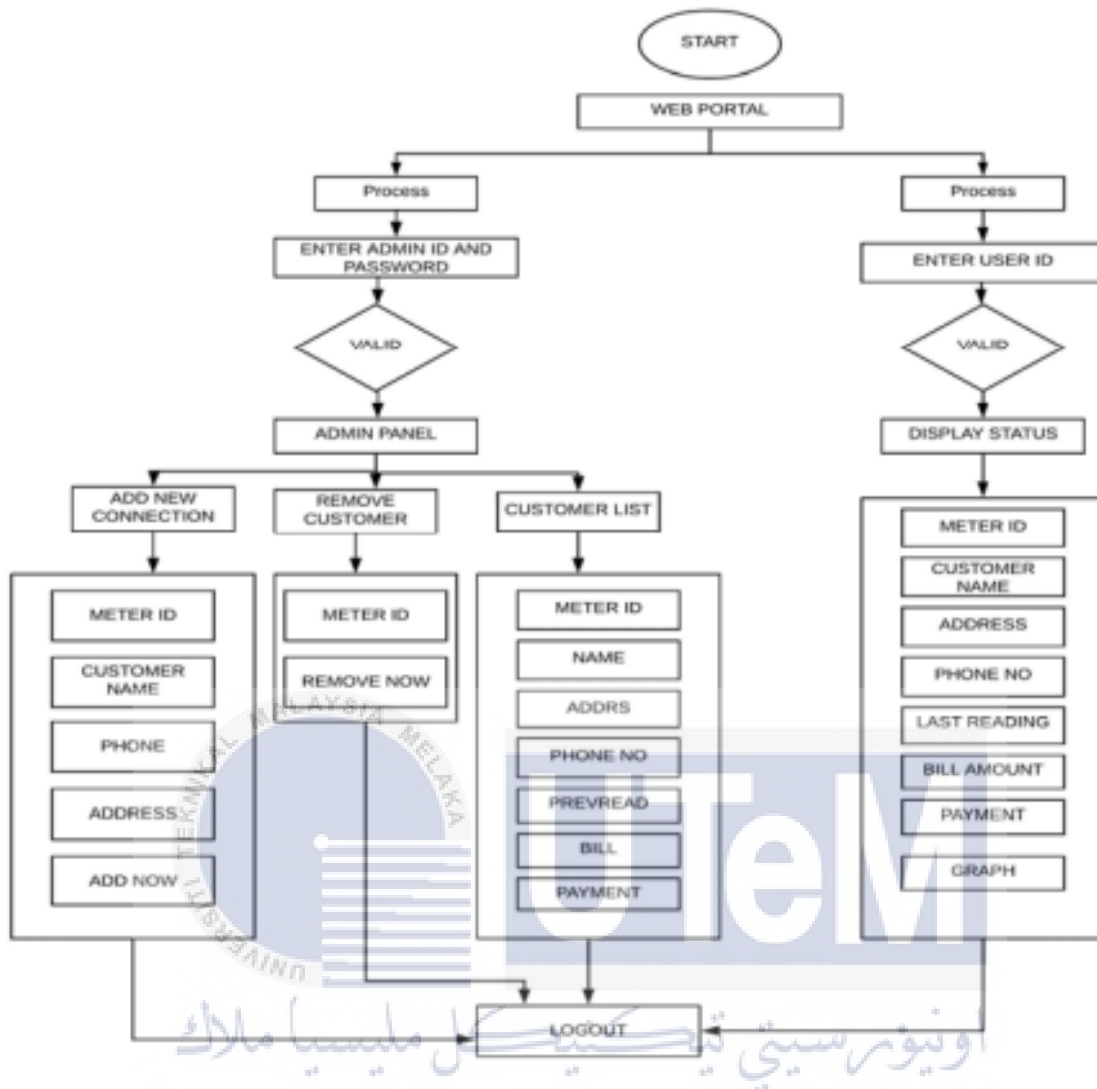
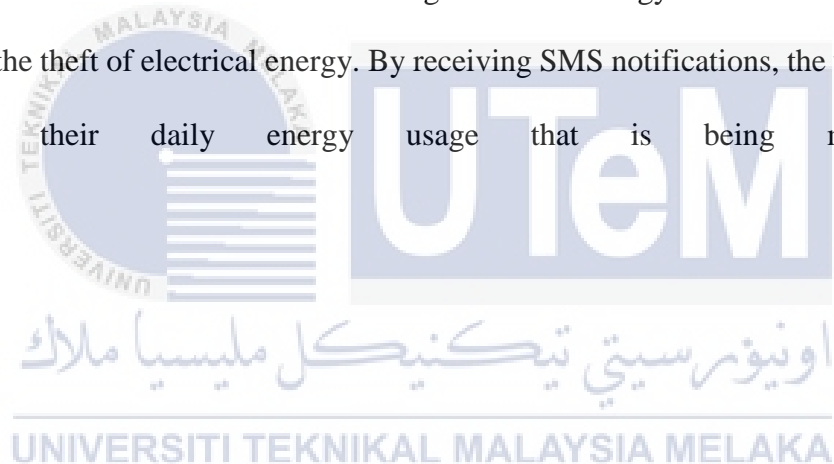


Figure 2.2: Functional Diagram [7].

Figure 2.1 and 2.2 are show the architectural design of smart meter and functional diagram. It show the block diagram of the equipment connection and the flow of the system. With home appliances in play, there is a fire hazard that home owners are aware of that a flame sensor that is attached with relay to avoid it from happening. Cloud storage “Thingspeak” that works over Wifi[8]. It is know that the traditional way also known as the manual way of retrieving the electric bill is by the person on duty has to go house by house to print and monitor the electrical bill. This system is able to avoid contact with the person in charge and

the process of going house by house. With this smart system, it is efficient where bills will be sent and notified to the home owner itself at a timely manner[9]. The energy smart meter is usually used in areas that are sized close to a house. The function of the components such as the transformer, the current sensors and the wires play a role in the system to ensure the smart meter works[10]. The energy meter is able to detect when energy is lost in the flow of the system. The Wifi is used in Arduino and the components used are transformers, relay, rectifier and LCD for display[11]. Using Arduino Uno, optical sensors were used to retrieve information using the pulse of an electric meter. Using this system, human error would be reduced as well as human labour which saves costs[12]. This approach is able to solve problems that were faced such as an increasing amount of energy used as well as the increase in cost and the theft of electrical energy. By receiving SMS notifications, the users are more alert on their daily energy usage that is being monitored[13].



Block Diagram

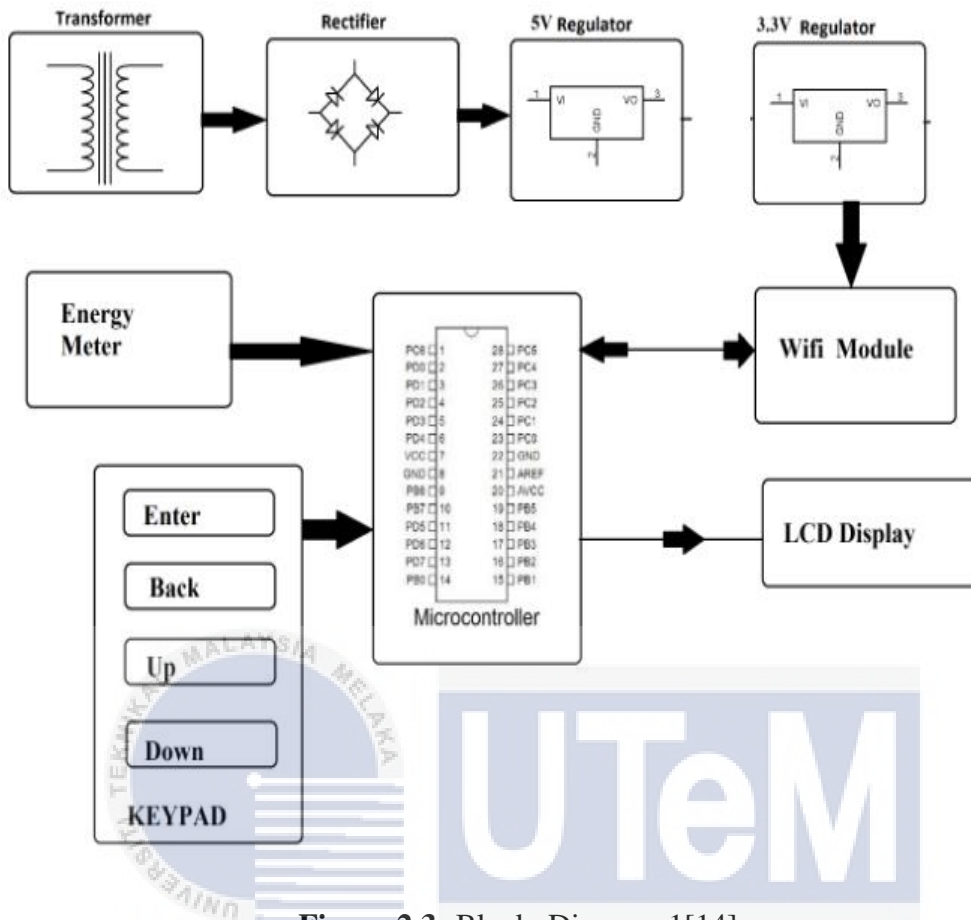


Figure 2.3: Block Diagram 1[14].

Figure 2.3 show the block diagram of the smart energy meter monitoring system which show the connection of the equipment used. The energy meter and the keypad is the input of the system and the wifi module and LCD display is the output of the system which connected to the microcontroller.

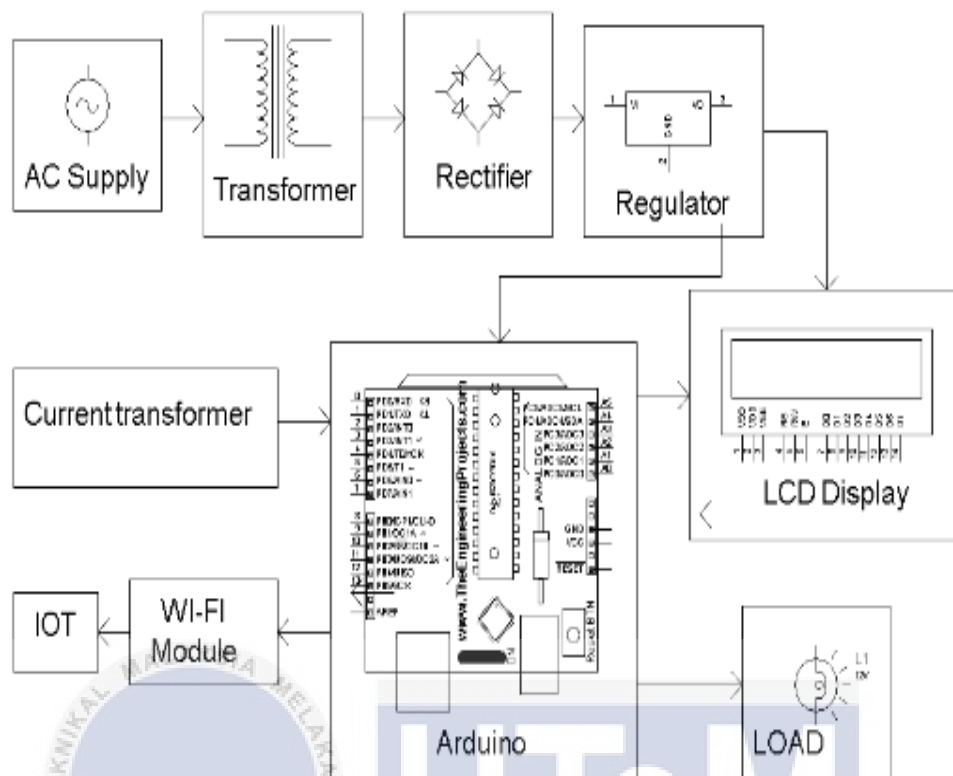


Figure 2.4: Block Diagram 2[15].

Figure 2.3 and 2.4 show the block diagram of the smart energy meter monitoring system which show the connection of the equipment used. The energy meter and the keypad is the input of the system and the wifi module and LCD display is the output of the system which connected to the microcontroller.

2.3 Energy Consumption

The energy consumption is measured through the amount of energy used by each component in the system as well as the amount of energy used to run the IoT system. The amount of energy consumption between the type of home as well as a smart home concept will determine the amount it uses[16]. The consumption of energy can be high although a home may be a smart home. It is how well the advantage is taken to save energy using a smart system. Some smart systems consume more energy than they are actually used. There are smart systems that run when it is not needed and there are systems that turn off when it is not in use[17]. The energy used in a system is measured to compare the energy consumption of a house with a smart system with a house that does not have a smart system. There are energy meter system that implements a Smart Cap to control the energy used in a month. Other than that, there are systems that automatically reduces energy consumption by being on standby mode[18].

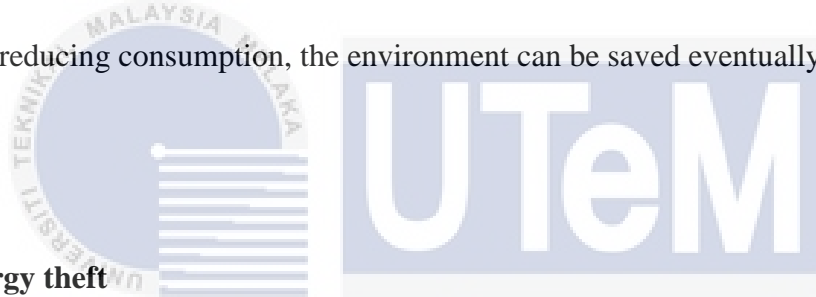
The generation is working towards reducing the consumption of energy to avoid wastage and making use of energy efficiently within the resource allocation. By using Cloud where the data stored will then be evaluated to make comparisons and improvisations[19]. The patterns of energy consumption would be recorded for further analyzing to be carried out. With the data, the home owner would be able to reduce electrical consumption where needed so the cost and inefficiencies can be reduced as well[20]. To save energy, methods are commonly used are solar panels or wind turbines that are renewable energy which works well in a household but it is not a cheap method to adopt. The bigger the building, the higher the cost and the amount of electrical consumption. IoT sensors are a new way of adopting a more improved and sustainable method in reducing energy consumption[21]. It is stated that IoT companies are suffering a loss when products produced are not energy saving instead it

consumes more energy which is a product that only lasts a short period of time when it comes to battery life for portable items.. It is not worth the money for the future of technology when energy saving is a product that households look for. Therefore, IoT power consumption testing is important[22].

Mario Campolargo a director for Net Features department of Europe Commission, DG Connect has stated in an article that is written on “How IoT Will Play A Crucial Role In Slashing Energy Use”,that IoT Cloud and Smart systems are important in Smart Homes where there is demand for devices that are the technology that interests the future generation which are reliable[23]. When it comes to battery life, even if it is rechargeable or reusable due to its battery life that decreases with time that it will need replacements. With that said, it would have a bad impact on the environment as businesses and users have taken saving the environment into consideration and it is not cheap to maintain battery changing in the long run[24]. IoT is used in smart devices to ease the application of smart systems and wireless networks in the medical field, communication and environmentally.IoT has improved the performance,data transfers and access for data information[25]. Using Cloud, the worry that users have is their privacy being penetrated by unknown hackers that would be aware of their personal information as well as their home privacy. Cloud data may have its advantages and disadvantages that user will take into consideration in sharing their information[26].

2.4 Energy Wastage

It is known that when there is less wastage, more cost can be saved. Energy saving is the direction that investors are investing in that will cost saving for consumers as well as energy[27]. Using IoT, the most important element that will be constantly monitored is the consumption of the home appliances in electricity power[28]. Energy can be detected in many other ways through installed sensors whether it may be through temperature, weight or air pressure. The system is controlled remotely that makes it convenient whether it is through Wifi connection that actions can be controlled or through a short distance where bluetooth can be implied[29]. In Africa, the way that energy consumption can be reduced was by increasing the prices of electricity to reduce the demand than the supply they can provide. By reducing consumption, the environment can be saved eventually[30].



2.5 Energy theft

Electrical companies ensure that homes that uses electricity all over have sufficient amount to run their daily house appliances or machinaries at factories. They do electricity supply readings daily which now energy meters are able to provide the service and system for users to know of the hardware energy utility and electrical supply[31]. In this day and age, electrical theft is a common thing that happens even more often. The system will alert the electrical company and the consumers as well. The web will display the data and the company will take certain actions to locate the location where the power theft had be done. The energy meter in houses are helpful to indicate the flow where the power was lost[32]. Raspberry Pi is used to alert and detect the power theft act. When the energy meter is implied, it will be able to save the supply of the electricity that is needed for other locations[33]. A smart monitoring system is commonly used in Smart Homes where it monitors the demand