Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF IOT BASED ELECTRIC ENERGY METER USING ESP32 FOR SMART HOME APPLICATION

DINENDRAN A/L NADARAJAN

Bachelor of Electronics Engineering Technology (Telecommunications) with Honours

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**A project report submitted
in partial fulfillment of the requirements for the degree of
Bachelor of Electronics Engineering Technology (Telecommunications) with Honours**

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2022

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FAKULTI TEKNOLOGI KEJUTERAAN ELEKTRIK DAN ELEKTRONIK

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Date : 21/01/2023

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 the degree of Bachelor of Electronics Engineering Technology (Telecommunications) with Honours.

Signature : ....

Supervisor Name : TS MOHD FAIZAL BIN ZULKIFLI

Date : 23/01/2023

Signature : ....

Co-Supervisor Name (if any) : ....

Date : ....

DEDICATION

To my beloved mother, NAGESWARY A/P KESAVAN, and father, NADARAJAN A/L TULUKKANAN,

and

To dearest supervisor, TS MOHD FAIZAL BIN ZULKIFLI and

My faithful Friends.

ABSTRACT

The worldwide need for power is increasing. Current technology requires residents to visit the meter reading room and record readings. Monitoring and maintaining records of your power usage is therefore a difficult effort. Currently, most houses are linked to the Internet via Wi-Fi. Internet of Things (IoT) provides an efficient and cost-effective way to transfer the information of energy consumers wirelessly, as well as the ability to detect the usage of electricity. The primary objective of this project is to use IoT to measure electricity consumption in home appliances and automatically generate its bill. The customer may view their monthly power use using a user-friendly mobile application and a website. These websites can be linked to the power service provider in order to automatically produce electricity invoices. Real-time readings are translated to units (kW/h) and delivered over the Internet to the database. Since the findings are viewable via the website and a mobile app, the user may have a better notion of how to reduce power consumption than before. This gadget can be installed to eliminate the need for human intervention in obtaining the monthly meter reading and to prevent the occurrence of technical issues during the billing process.

ABSTRAK

Keperluan dunia untuk kuasa semakin meningkat. Teknologi semasa memerlukan penduduk melawat bilik bacaan meter dan merekod bacaan. Memantau dan mengekalkan rekod penggunaan kuasa anda adalah satu usaha yang sukar. Pada masa ini, kebanyakan rumah dipautkan ke Internet melalui Wi-Fi. Internet of Things (IoT) menyediakan cara yang cekap dan kos efektif untuk memindahkan maklumat pengguna tenaga secara wayarles, serta keupayaan untuk mengesan penggunaan elektrik. Objektif utama projek ini adalah untuk menggunakan IoT untuk mengukur penggunaan elektrik dalam peralatan rumah dan secara automatik menjana bilnya. Pelanggan boleh melihat penggunaan kuasa bulanan mereka menggunakan aplikasi mudah alih yang mesra pengguna dan tapak web. Laman web ini boleh dipautkan kepada pembekal perkhidmatan kuasa untuk menghasilkan invois elektrik secara automatik. Bacaan masa nyata diterjemahkan kepada unit (kW/j) dan dihantar melalui Internet ke pangkalan data. Memandangkan penemuan boleh dilihat melalui tapak web dan aplikasi mudah alih, pengguna mungkin mempunyai tanggapan yang lebih baik tentang cara mengurangkan penggunaan kuasa berbanding sebelum ini. Alat ini boleh dipasang untuk menghapuskan keperluan campur tangan manusia dalam mendapatkan bacaan meter bulanan dan untuk mengelakkan berlakunya isu teknikal semasa proses pengebilan.

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Ω	-	Resistor/omega
f	-	farad
µ	-	micro

LIST OF ABBREVIATIONS

V	-	Voltage
A.C	-	Alternative Current
W	-	Power(watt)
Kilowatt/hours	-	kWh
RM	-	Cost
VCC	-	Conmmon Collector Voltage
GND	-	Ground
GPIO	-	General Purpose Input Output
LCD	-	Liquid Crystal Display
Wi-Fi	-	Wireless Fidelity
GPIO	-	General Purpose Input Output
R	-	Resistance
C	-	Capacitance

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CHAPTER 1

INTRODUCTION

1.1 Background

Power Electricity is an essential commodity which is used for various purposes such as lighting, heating, and cooling. Currently, many people are obliged to remain at home due of the inability to obtain a quarantine, and thus staying at home has become the new normal. As a result of this predicament, electricity bills are increasing in price. This has led to a need for an electric energy meter which can measure the electricity consumption accurately.

The electric energy meter is a device that is used to measure the amount of electric energy that is consumed by a particular load or group of loads. It is important to accurately measure the electric energy so that the correct amount of money can be charged to the customer.

The development of an IoT based electric energy meter have some advantages. Initially, this type of meter can be installed easily and without the need for any specialist knowledge. The data that is collected by the meter can be used to provide accurate information about energy consumption. The meters can be updated automatically so that they are always up to date with current changes in electricity use. Finally, meters that are based on IoT technology can be monitored remotely, which can provide a valuable overview of energy use.

One of the main challenges that will need to be addressed during the development of an IoT based electric energy meter is the security of the data that is being collected. It will be important to ensure that the data is protected from unauthorized access and manipulation. Additionally, it will be necessary to develop robust security protocols so that the data is only accessed by authorized personnel.

The main aim of the project is to develop an IoT based electric energy meter using ESP32. The ESP32 is a low-power, single-chip microcontroller with integrated Wi-Fi and Bluetooth Classic/BLE. It is designed for mobile devices, wearables, and Internet of Things (IoT) applications. The ESP32 integrates a dual-core processor, operating at up to 240 MHz, and a Wi-Fi radio. It also includes a range of features that make it well suited for IoT applications, including an Analog-to-Digital Converter (ADC), a Digital-to-Analog Converter (DAC), and an interrupt controller.

1.2 Problem Statement

The way that technology is now designed, you will need to walk into the meter reading room in order to record any readings. Therefore, keeping an eye on how much power had been use and recording it may be a time-consuming and laborious effort. Furthermore, the problem in the modern home is the inaccurate measurement of energy usage. This is often since different devices use different amounts of energy, and there is no accurate way to measure this energy usage. This leads to resident either over or underestimating their energy usage, which can lead to large financial penalties. Additionally, some resident may not know how to track electric energy consumption. Tracking electric energy consumption can help householder understand how much energy they are using and help them save money on their energy bills.

The Internet of Things is a useful tool that can help us automate this process. By automating the gathering of remote data, the Internet of Things helps users save both time and money. In recent years, the Smart Energy Meter has been the subject of a significant amount of praise all throughout the world. Implementing IOT-based energy meter in house will help to:

1. provide real-time data about energy consumption.
2. identify areas where they can save energy.
3. provide data about energy usage patterns, which can help to improve energy efficiency.
4. identify potential problems with energy usage, such as electrical faults or leaks.

An IOT-based energy meter could help to accurately measure energy usage in the home. This would be done by having sensors attached to different devices in the home, and then using a computer or smart phone to analyse the data. This would allow people to see exactly how much energy each device is using and would help them to better manage their finances

1.3 Project Objective

The main three objective of the project is:

a) To design a device that enables users to monitor the electricity consumption for the household equipment.

b) To develop Smart energy meter with IoT based to easily keep on track with electricity consumption via app in computer or smartphone.

c) To analyse the reading of smart energy meter and collect data by tracking the power consuption by taking reading of voltage and current in sensor.

1.4 Scope of Project

The scope of the project is to build smart energy meter using microcontroller ESP32 which able to collect data on electricity usage from a sensor and then transmit it to an energy meter. This is displayed on an app made with MIT App Inventor which can keep track of their electricity consumption. Using current and voltage sensor which able to keep track on total power consumption and consumed. For the current sensor, we are using the SCT-013 Current Sensor and for the voltage sensor, which is ZMPT101B Voltage Sensor, which can measure all the relevant parameters for an Electricity Energy Meter. The SCT-013 Current Sensor and ZMPT101B Voltage Sensor will then be interfaced with the ESP32 Wi-Fi Module, and the data will be sent through MIT APP Inventor. The Voltage, Current, Power, and Total Unit Consumed in kWh will be shown on the MIT APP Inventor Application Dashboard.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter talks about the research that has been done on this project before. This chapter is about finding information about the project's concepts and ideas. It also has detailed information about the software and hardware that will be used. The idea of this project is started from the problem that resident facing high electrical billing due to not keep in track power consume.

2.2 Previous journal summarization

2.2.1 IoT based smart energy meter monitoring and controlling system

The suggested solution adds IOT to regular energy meters. Power theft and meter tampering cause economic damage to the nation and must be addressed. Better system goals include monitoring, optimized power utilization, and reduced power waste. Current billing relies heavily on humans. Billing needs a person to visit each customer's energy meter and take unit measurements. Time-consuming. We designed an IOT-based solution to solve all the restrictions. Smart Wi-Fi energy meter has three main goals which is:

- Immediate automated meter reading is to be provided.
- To use power in the most efficient manner.

In this project has a controller, theft detection circuit, and Wi-Fi. The controller calculates and handles data. Theft detection circuits detect metre tampering, and Wi-Fi units relay controller data over the Internet. Over a message network, the service end may remind the consumer of the bill. Arduino controllers must be configured with the Arduino software IDE. Its code is c-based. Arduino UNO, ESP 8266 Wi-Fi module, and 16*2 LCD display make up the block diagram. IOT relies on Wi-Fi modules. Arduino board connects system components. ATmega 328p powers Arduino UNO. The heart of the system is required for key functions such as automatic power billing and tampering circuit inputs. Load is the electricity-using gadgets. Transformers give the system with ac power. The Meter is connected to the system to automate residential power use. The ESP 8266 Wi-Fi Module updates the energy meter's values through Wi-Fi.

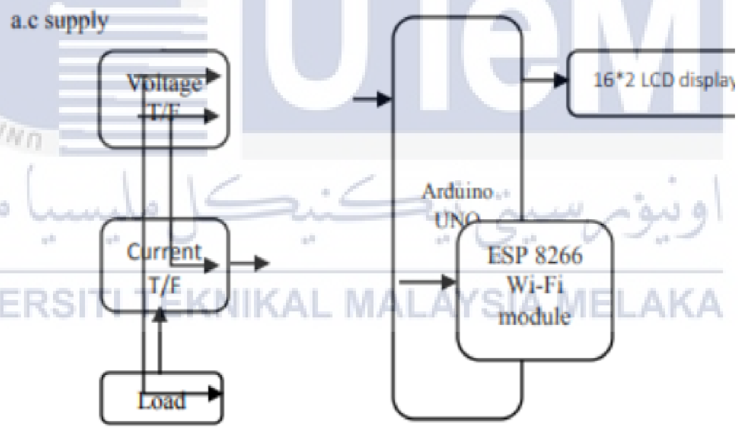

Figure 2.2.1 : Block diagram of smart energy meter using ESP 8266

IOT-based E-meters cut home power usage. It lowers human intervention, costs, and power. Automatic and manual operation. This metre sends bills to mobile without human interaction. This computerization reduces work expenses and improves framework accuracy. The technology targets smart cities with Wi-Fi hotspots. The project uses IoT. This replaces obsolete energy metres with sophisticated technology. Automatic power