Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF IOT BASED SMART ENERGY METER

NOOR ALIEA BINTI ZULKIFLI

Bachelor of Electrical Engineering Technology (Industrial Power) with Honours

2021

DEVELOPMENT OF IOT BASED SMART ENERGY METER

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A project report submitted
in partial fulfillment of the requirements for the degree of
Bachelor of Electrical Engineering Technology (Industrial Power) with Honours

Faculty of Electrical and Electronic Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2021

UNIVERSITI TEKNIKAL MALAYSIA MELAKA
FAKULTI TEKNOLOGI KEJUTERAAN ELEKTRIK DAN ELEKTRONIK

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek : Development of IoT Based Smart Energy Meter

Sesi Pengajian : 2021/2022

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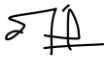
Signature : 

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Date : 10 January 2022

DEDICATION

I am grateful to my beloved parents, Zulkifli Bin Embong and Niza Binti Ibrahim, supportive family, supervisor, Ts. Ahmad Zubir Bin Jamil, lectures, friends, Mohamad Ikhmal Bin Ramlee, Nur Syafikah Binti Kamarudin and Nur Afifah Binti Azman and everyone else who assisted me directly or indirectly during this project. Thank you for all of your help, advice, and encouragement in completing this project.

ABSTRACT

Every product is made with smart operations as a result of the advancement of communication technology. Various approaches for energy demand management have been used in recent years to accurately quantify the energy needs that will be needed in the future. To overcome this flaw, an idea has been proposed that will remove the third party between the consumer and the service provider. The Internet of Things (IoT) is a technology that connects a variety of devices using sensors. Energy meter reading systems that use the Internet of Things (IoT) provide an efficient and cost-effective means to wirelessly send information about the energy utilized by the user, as well as the ability to detect unlawful electricity usage. The Arduino microcontroller is used to link the digital energy meter system to a Wi-Fi network and then to the Internet and server, as well as to coordinate operations with it. This system's major purpose is to read the number of current consumption units, calculate the amount, and send notifications to the user's website. The bill is updated on the internet via an Internet of Things (IoT) network and the energy consumptions are calculated automatically. The suggested system is capable of continually notifying the energy source and consumer of the number of units consumed.

ABSTRAK

Setiap produk dibuat dengan operasi pintar hasil daripada kemajuan teknologi komunikasi. Pelbagai pendekatan untuk pengurusan permintaan tenaga telah digunakan dalam beberapa tahun kebelakangan ini untuk mengukur dengan tepat keperluan tenaga yang akan diperlukan pada masa hadapan. Untuk mengatasi kelemahan ini, satu idea telah dicadangkan yang akan menghapuskan pihak ketiga antara pengguna dan pembekal perkhidmatan. "Internet of Things" (IoT) ialah teknologi yang menghubungkan pelbagai peranti menggunakan penderia.Sistem bacaan meter tenaga yang menggunakan "Internet of Things" (IoT) menyediakan cara yang cekap dan kos efektif untuk menghantar maklumat secara wayarles tentang tenaga yang digunakan oleh pengguna, serta keupayaan untuk mengesan penggunaan elektrik yang menyalahi undang-undang. Mikropengawal Arduino digunakan untuk memautkan sistem meter tenaga digital ke rangkaian Wi-Fi dan kemudian ke Internet dan pelayan, serta untuk menyelaraskan operasi dengannya. Tujuan utama sistem ini adalah untuk membaca bilangan unit penggunaan semasa, mengira jumlah, dan menghantar pemberitahuan ke tapak web pengguna. Bil dikemas kini di internet melalui rangkaian "Internet of Things" (IoT) dan penggunaan tenaga dikira secara automatik. Sistem yang dicadangkan mampu memberitahu sumber tenaga dan pengguna bilangan unit yang digunakan secara berterusan.

ACKNOWLEDGEMENTS

First and foremost, I would like to express my gratitude to my supervisor, Ts. Ahmad Zubir bin Jamil for his precious guidance, words of wisdom and patient throughout this project.

I am also indebted to Universiti Teknikal Malaysia Melaka (UTeM) for the financial support which enables me to accomplish the project. Not forgetting my fellow colleague for the willingness of sharing his thoughts and ideas regarding the project.

My highest appreciation goes to my parents and family members for their love and prayer during the period of my study. An honourable mention for all the motivation and understanding.

Finally, I would like to thank all the staffs, fellow colleagues and classmates, the faculty members, as well as other individuals who are not listed here for being co-operative and helpful.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS

V	-	Volt
A	-	Ampere
W	-	Watt
P	-	Power
S	-	Apparent Power

LIST OF ABBREVIATIONS

V	-	Voltage
A	-	Ampere
Wi-Fi	-	Wireless Fidelity
IoT	-	Internet of Things
AMR	-	Automatic Meter Reading
SEM	-	Smart Energy Meter
GSM	-	Global System for Mobile Communication
LCD	-	Liquid Crystal Display
IDE	-	Arduino Incorporated Development
SSR	-	Solid State Relay

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Background

The demand for electricity has increased as a result of the rapid expansion in human population and humans' reliance on electrical energy. In order to analyze and control power consumption, an appropriate system must be developed. As a result, the smart energy meter is the solution to this problem.

This project shows an IoT-based system in which both the consumer and the service provider receive a reading of the consumed energy along with the appropriate amount at each time interval [1]. IoT may be utilized for a variety of applications, including monitoring distributed power plants, power consumption monitoring, smart metering and electric car charging.

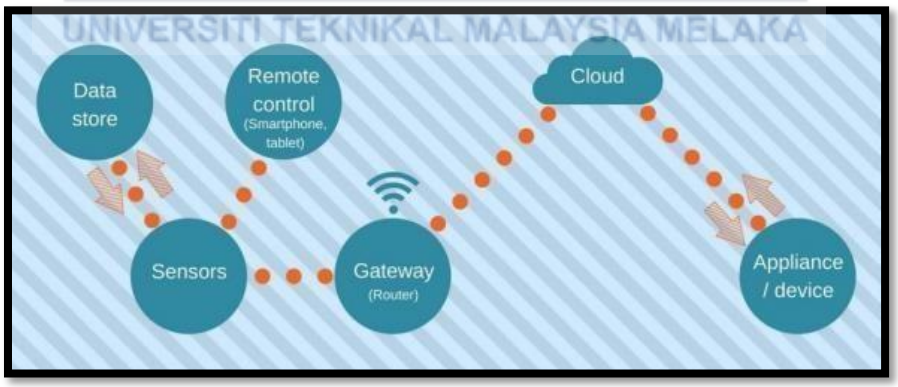

Figure 1.1: Concept of IoT Based Smart Energy Meter

A smart energy system is being developed for residential clients. This device is simple to use, makes users aware of how much energy they use, and contributes to the conservation of already depleted resources. This will assist to save electricity by ensuring that loads are used efficiently. As a result, the consumer becomes an active participant in energy management.

1.2 Problem Statement

I. SMS and other traditional methods, which are still in use today are expensive. As IOT is less expensive than SMS, it is possible to monitor energy usage at a reduced cost. The system is more dependable, and reading values collected from energy-using devices are more accurate. The readings are available to view on the internet. In addition, the server is available 24 hours a day, seven days a week.

II. Energy consumption patterns in particular equipment, processing, or manufacturing are required for energy efficient operation and preventative maintenance based on power analysis data. This demands the collection of enough data for analysis, which involves the real-time acquisition and transfer of data from many sources high processing power and data storage capacity.

III. The task of reading the meter will be made simpler with a wireless digital energy meter. Installing a smart meter allows you to get the amount of energy you've used and analyze the data from anywhere. The features assist in the control of consumer energy use. The implementation of a smart meter system, on the other hand, is very expensive. This is out of reach for low-income city dwellers.

1.3 Project Objective

This project's main goal is to design a smart energy meter that is low-cost, efficient, simple to use and reasonable. This project was created to allow for real-time monitoring from any location in the world. Specifically, the objectives of this project are stated as below:

I. To measure total power consumption using the current, voltage and power values from a digital energy meter within a range of time.

II. To develop a real-time platform for collecting data on building energy consumption and reduce the amount of energy wasted.

III. To analyze and implement a low-cost wireless automated digital energy meter with IoTs concepts and reduce the need for manual labor.

1.4 Scope of Project

The scopes of this project are stated as below:

I. The NodeMCU is the key hub for data transfer to the ThingSpeak

II. The ThingSpeak serves as a control platform. This device continuously records the readings and the user may request that the live meter reading be shown on a webpage.

III. The Arduino controller is programmed using the Arduino software IDE (Integrated Development Environment) which is necessary in order for the Arduino board to function.

IV. This program enables the electricity department to scan monthly without having to send anyone to each house to capture the readings.

V. A two-wire energy meter for single phase operation with a voltage rating of 240V and a current range of 25-100A running at 50Hz

1.5 Organization of Thesis

In general, the final report is divided into five chapters: Introduction, Literature Review, Methodology, Results, Discussion, and Conclusion. The background of the study, the project's problem statement, the project's objective, the project's scope, and the report's organization were all discussed in Chapter 1. This chapter will discuss all of the theory that is relevant to Chapter 2. Each research has been compared in terms of hardware and the benefits and drawbacks of each research. The methodology, methods, and project planning used in this project will be detailed in Chapter 3. It will be created a conceptual model. This chapter will cover simulation, coding, and the project's expected outcomes. Results and discussion are covered in Chapter 4. This chapter summarizes the findings of this pro ject. Furthermore, the data based on the project's satisfaction will be shown in this chapter. Finally, the fifth and final chapter is the conclusion. This chapter will cover the broad scope of this project as well as the achievement of the objective.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The smart meter is made up of several hardware and software components. The installation of this proposed system was very difficult to compare with an existing traditional system. This new system has been widely distributed and is well-organized throughout the newly joined network. With the Internet of Things, the electricity bill was calculated automatically and transmitted directly to the customers [2]. The Arduino UNO microcontroller was used in this project, as well as IoT techniques. This proposed technology will be utilized to generate precise outcomes and amounts. It was built with the help of the new IoT concept. This system will reduce human energy and prevent the machines from repair.

In 2011, cloud computing technology was used to find a solution for measuring the performance of individual equipment. In 2013, the smallest Zigbee-compatible node was built using GREEN technology. This technology will allow for the sensing of various data types in any area, ranging from energy metering to environmental monitoring. In the year of 2016, using wi-fi technology application can be developed for Apple and BlackBerry 10 OS, thus providing support for multiple platforms. Using IoT technology in 2017 In a laboratory building, an IoT system was developed to calculate the voltage, current, power and energy of a three-phase four-line powerline

2.2 Traditional Electricity Meters

The word "electricity meter" refers to a device that can detect and display energy in the form of readings. Traditional meters have been in use since the late 19th century. They share data across electrical equipment in a computerized environment for both electricity production and distribution. Although today's electricity meters are automated, they do have some limitations.

Figure 2.1: Traditional Meter

There are some other factors that have resulted in a major disconnect between the user and the distributor as a result of conventional meter installation. Even though timely installation of electricity meters allows consumers in gaining information about electricity usage, consumption statistics cannot be updated. The following are some of the disadvantages of the traditional electricity meter:

i. New hourly tariffs cannot be implemented without equivalent meters in order to attract customers.
ii. A large number of technicians must be employed in order to conduct meter readings.
iii. Meters are inherently inefficient since customers must budget for their monthly energy bill.
iv. Payment processing is time-consuming and costly.