DEVELOPMENT OF IOT BASED CURRENT ENERGY METER FOR INDIVIDUAL ROOMS

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

by

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I hereby, declared this report entitled DEVELOPMENT OF IOT BASED CURRENT ENERGY METER FOR INDIVIDUAL ROOMS is the results of my own research except as cited in references.

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Author : Navapragashen Naeer a/l Rajendran

Date: 13/2/2021

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 (Industrial Electronics) with Honours. The member of the supervisory is as follow:

Signature: .....

Supervisor : Izadora Binti Mustaffa

ABSTRAK

Terdapat masalah penggunaan elektrik meningkat tiga kali ganda dari penggunaan biasa semasa pandemik di Malaysia, yang menyebabkan pengguna membayar jumlah yang lebih tinggi daripada nilai yang sepatutnya dan tidak tahu di mana penggunaan elektrik. Pembangunan Meter Tenaga Arus berdasarkan IoT bagi setiap bilik, pengguna dapat memantau nilai tepat penggunaan elektrik dalam kWh dan RM untuk bilik individu. Perkakasan yang termasuk dalam projek ini adalah Arduino Uno, modul Wi-Fi ESP8266-01, ACS712 sensor arus, dan LCD 16x2. Untuk perisian aplikasi Blynk dibuat melalui telefon pintar untuk memantau penggunaan. Sensor arus membaca arus melalui alat elektrik dan menghantar data ke Arduino Uno untuk menjalankan algoritma untuk mendapatkan nilai kWh dan RM. Nilai yang dikira dihantar ke aplikasi Blynk dan LCD untuk menunjukkan penggunaan kWh dan RM untuk setiap bilik, bilik 1, dan bilik 2.

ABSTRACT

Electricity usage can only be monitored monthly when the bill arrives. Even though TNB has provided Smart Meters which are supposed to allow consumers to monitor how much electricity has been used, it is still not real-time. The development of "Development of IoT based current energy meter for individual rooms ", consumers able to monitor the exact value of electrical consumption in kWh and RM for individual rooms. Hardware included in this project is Arduino Uno, ESP8266-01 Wi-Fi module, ACS712 current sensor, and LCD 16x2. For software Blynk application created through the smartphone to monitor the consumption. The current sensor read the current go through an electric appliance and sent data to Arduino Uno to run the algorithm to get the value of kWh and RM. The calculated value is sent to the Blynk application and LCD to display the consumption of kWh and RM for individual rooms, room 1, and room 2.

DEDICATION

To my supportive and beloved parents Rajendran a/l Govindarajoo, Pushpa a/p Govindan.

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IoT	Internet of Things
kWh	Kilowatt per hour
RM	Ringgit Malaysia
Amp	Ampere
LCD	Liquid Crystal Display
CT	Current transformer
GSM	Global system for mobile communication
LDR	Light dependent resistor
SMS	Short message system
RTC	Real-time clock
PCB	Printed circuit board

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter describes the background of this project and the motivation behind it. This chapter also includes problem statements, three project objectives, and scope of work of the project. Lastly, the conclusion section is a summary of the chapter.

1.2 Research background

An electric meter used to measure the amount of electric energy consumed by residence, industry, or electrically powered equipment. The electric meter primarily installed for billing purposes. This meter is used to measure the entire premise. There are limitations where users can only observe the use of kWh for the whole premise, in which users cannot observe the daily usage of electricity by individual rooms.

During the pandemic movement control order spike in electricity bills a global concern. Where the school is closed, and workers have been asked to work from home. Without realizing the consumption of electricity increase. Usage of electric appliances, fan, lamp air conditioner, and many appliances are ON more often. The report shows double the sales of the electronic appliance during the pandemic. It leads to more appliances that are used during the MCO period. Because there is not an indicator that shows the consumption cost and kWh. It causes uncontrolled usage of electricity and cost.

In the year between 2016 and 2018, 300000 smart meters already installed in Melaka. TNB expected by 2026 all 9.1 million households are equipped with a TNB smart electric meter. The smart meter sends data through radio frequency, to equip with the smart meter poles are needed. Smart meter able to send data via the TNB portal. Smart meters help the consumer to read daily energy usage half-hourly and provide an accurate bill. The smart meter cannot show the value for real-time reading, the data only will be half hourly. The data recorded only for the whole premise.

As consumption rises, proportionally the generation of electricity also increases, it may cause global warming where the authorities have to generate more electricity to be supplied to consumers(Santamouris *et al.*, 2015). Nevertheless, when the electricity been abused and the usage in uncontrolled, heat pollution rises. Therefore, no indicator or measurement shows cost RM for consumption.

Internet of Things (IoT) is a technology widely used today. Refer to growing network-connected devices, capable of exchanging data over a network with low bandwidth. IoT is used in various sectors including logistics, automotive industry, smart cities, home, and healthcare. Thus, a current energy meter based on IoT is introduced to measure the usage of current individual rooms. The device generates the current usage and converts it to the power that allows to calculate the cost and sent it to the user's smartphone. This could help the user to monitor the current usage, which helps to save costs.

1.3 Problem Statement

Uncontrolled current consumption is causing an increase in monthly bills. The available electric meter only shows the reading kWh for whole consumption and without showing the cost RM.

As a result, consumers are faced with a high electricity bill every month. Therefore, to reduce the cost of electricity bill a device IoT based current energy meter for individual rooms is developed. This project will help consumers to monitor the use of current kWh and cost RM in individual rooms, allowing the consumer to identify uncontrolled use of current.

1.4 Objectives

There are three objectives to be achieved in this project, which are:

i. To design IoT based current energy meter.

ii. To develop an IoT based current energy meter that can measure current for four loads.

iii. To implement the IoT based current energy meter for individual rooms.

1.5 Scope

The project uses a current energy meter with a 240V voltage rating and current rating of 20Amp, to monitor the consumption of power kWh and cost RM for individual rooms which helps the consumer to monitor and help reduce the usage of unwanted current. Arduino is used to run the algorithm to calculate the electrical usage. ACS712 current 20Amp is used to measure the current and Wi-Fi modules used to send the data to the server (Blynk apps). Finally, four loads are used for the measurement of this project.

1.6 Conclusion

This project focuses on developing an IoT based current energy meter for individual rooms. The background, problem statement, objective, and scope were explained in this chapter. This is an important chapter in which we identify the problem and find the solution. Also, an objective that could guide us towards a smooth completion of the project. Finally, the scope is important where we list out the specific component and function of the project set the limitation for the project. The next chapter discussed previous similar projects within the last 5 years, consisting of 10 articles as references.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter discusses chronologically related article to the project. The project mentioned here is on which calculate the energy consumption based on unit kilowatt per hour(kW/h) and the monthly cost will be displayed. Summarization of literature review shown in appendix.

2.2 Related previous work

2.2.1 Arduino and GSM Based Smart Energy Meter for Advance Metering and Billing System

This smart energy meter shows how much energy and its cost via SMS user and provider. The meter is developed Energy meter IC (1600imp/kWh), LCD, Arduino Uno 3, GSM modem, Relay, Optocoupler, and EEPROM. Arduino read EEPROM and calculated data would display on LCD. The load such as lamp are connected via the relay. The Arduino will detect the pulse from the energy meter IC and will count and display it on LCD. Few instructions set "DATA" to get data kWh, "LINE CUT" turn OFF the relay, and "LINE OK" turn ON the relay. Any tampering attempt happens, Arduino turns OFF the relay, turns ON buzzer, and sends SMS to the provider(Rahman *et al.*, 2015)

2.2.2 IoT Based Smart Power Metering

In this system, the smartphone application is added to enable the user to monitor and control.There are three sections: internet of things, Analog measurement circuit, and controller. When the current sensor ACS712 gets values, Arduino will calculate power consumption. Raspberry pi is used to upload the power level on the web page and to control turn ON/OFF the load through relay driver IC ULN2003A. Two web page SmartLiving Maker create a web page for user interface and ThingSpeak cloud for storage which analyzes and visualizes the data(Kurde, Arati;Kulkarni, 2016)

2.2.3 IoT Based Smart Energy Meter

In India, plug-load devices consume approximately 40% of overall electricity usage in the building sector and there are few studies on the level of consumption in plug level consumption. Hence, the device described in this work monitors the usage of energy in the plug- load devices.This IoT based smart energy meter display data on the smartphone which Android apps will send HTTP request to the Arduino and LDR will be connected to smart energy meter which to sense the rotation of meter and calculates units. Data units and the bill will be saved on the server to allow the user to access it. The interesting feature is that users can set the limit of consumption which will alert the user and there has an option for online payment via credit card or specific card(Joshi *et al.*, 2016)