Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF MONITORING AND REDUCING POWER CONSUMPTION IN THE HOUSEHOLD

ROZITAWATI BINTI MUHAMMAD

Bachelor of Computer Engineering Technology (Computer Systems) with Honours

2021

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A project report submitted
in partial fulfillment of the requirements for the degree of
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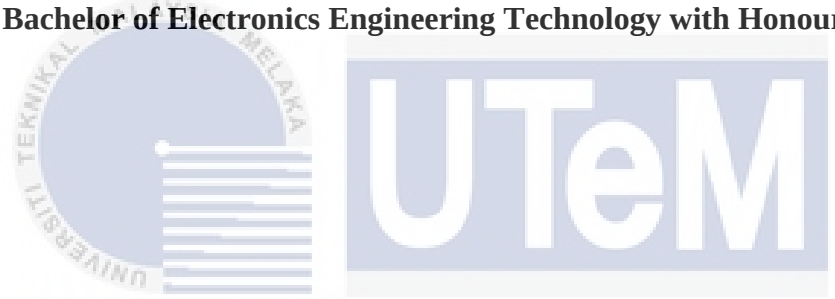

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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Disahkan oleh:

Azman Awang Teh

Alamat Tetap: No 56 Jalan Saujana 1/1, Taman Sauajana Seksyen 1, 75450 Bukit Katil, Melaka.

AZMAN BIN AWANG TEH
Pensyarah
Fakulti Teknologi Elektrik & Elektronik (FTKEE)
Universiti Teknikal Malaysia Melaka (UTeM),
Karung Berkunci 1200,
Ayer Keroh 75450 Melaka.

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I declare that this project report entitled “Development of Monitoring and Reducing Power Consumption in the Household” 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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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 Computer Engineering Technology (Computer Systems) with Honours.

Signature : *Azman Awang Teh*

Supervisor Name : EN. AZMAN BIN AWANG TEH

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DEDICATION

For Allah's sake, my Creator.

I also dedicate this work to my husband, Nizar bin Ahmad, who has supported me throughout the process and ensured that I give it everything I have to finish what I have started.

Dedicated to my parents-in-law, who always give support and prayer.

My cherished siblings have always provided me with the strength and passion needed to replace my parents who have passed away.

My beloved daughters Nurqaireen Sofia, Nurarissa Sofia, and Nurdaneen Sofia, whom I can't stop loving. The symbol of love and gifting to my entire family.

My friend always encourage support and assisted me throughout this online learning.

ABSTRACT

Electricity, gas, water, and any other energy used to live in a household are all included in energy consumption. There are a variety of approaches to reduce household energy usage and increase energy savings. The two major reasons for conserving energy are to save money on power bills and to safeguard the environment. Reducing our electricity consumption minimizes carbon dioxide emissions into the atmosphere. Consumers are sometimes unaware of the growing use of various electrical products these days. The purpose of this project is to create a circuit that can assist consumers in lowering energy use in their homes. Although this modification is little, it can help you save money on your monthly payments. As a result, the goal of this study is to reduce energy usage throughout the house. The user can learn more about this system by using it. The user can find out the consumption rate using this system. It will show the overall amount of energy consumed over some time. The daily consumption will also be delivered to the smartphone app, so customers can keep track of their electrical usage. Hopefully, this effort will help consumers in lowering their home's energy consumption.

ABSTRAK

Elektrik, gas, air dan apa-apa tenaga lain yang digunakan untuk hidup dalam isi rumah semuanya termasuk dalam penggunaan tenaga. Terdapat pelbagai pendekatan untuk mengurangkan penggunaan tenaga isi rumah dan meningkatkan penjimatan tenaga. Dua sebab utama untuk menjimatkan tenaga adalah untuk menjimatkan wang untuk bil elektrik dan untuk menjaga alam sekitar. Mengurangkan penggunaan elektrik kita meminimumkan pelepasan karbon dioksida ke atmosfera. Pengguna kadangkala tidak menyedari penggunaan pelbagai produk elektrik yang semakin meningkat dewasa ini. Tujuan projek ini adalah untuk mewujudkan litar yang boleh membantu pengguna dalam mengurangkan penggunaan tenaga di rumah mereka. Walaupun pengubahsuaian ini sedikit, ia boleh membantu anda menjimatkan wang untuk pembayaran bulanan anda. Hasilnya, matlamat kajian ini adalah untuk mengurangkan penggunaan tenaga di seluruh rumah. Pengguna boleh mengetahui lebih lanjut tentang sistem ini dengan menggunakannya. Pengguna boleh mengetahui kadar penggunaan menggunakan sistem ini. Ia akan menunjukkan jumlah keseluruhan tenaga yang digunakan dalam beberapa waktu. Penggunaan harian juga akan dihantar ke aplikasi telefon pintar, jadi pelanggan boleh menjejaki penggunaan elektrik mereka. Semoga usaha ini dapat membantu pengguna dalam mengurangkan penggunaan tenaga rumah mereka.

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CHAPTER 1

INTRODUCTION

1.1 Background

Electric power is the most significant component of a building's operating system. This is because all household systems operate on a scale of electrical power. Lighting systems, air conditioning systems, motor equipment systems, communication systems, and so on are examples of building systems.

In energy management, users must be taught how to make efficient use of energy in addition to the factors of using electrical equipment that can conserve energy. In other words, users should be made aware of the need for energy efficiency because it can save both the environment and money. Thus, saving power through efficient and optimal use is the best way for everyone to minimize carbon dioxide emissions while also offering financial benefits from lower utility costs.

One of the main causes of climate change is the increasing human need for energy, whether electricity, gas, or oil, and all this come from fossil fuels. Now many are worried and concerned about the increase in electricity bills. The cause is the increasing cost of energy generation and the profit gained by energy suppliers. The reality is that the more critical issue is that we use limited natural resources at an increasing rate.

Furthermore, the government was forced to increase the amount of energy produced to meet the needs of consumers due to the inefficient use of electricity. Considering these conditions, the government was forced to increase energy rates and utility bills. Excessive use of electricity, especially during peak hours, has resulted in a severe energy crisis around

the world. Among them are insufficient energy supply and erratic market prices and bring destruction to the environment (weather/climate change).

1.2 Problem Statement

How much does power consumption cost you per month? If you live a simple life, your monthly bill might be as low as RM50-60. If you have a large family and use a lot of electrical equipment, though, you may probably have to pay a few hundred ringgit every month. If you fall into the above category, you have been hit hard by the recent increase in electricity rates. However, given the rate at which gas prices are rising across the world, a tariff increase is unavoidable. Malaysia's once-abundant sources of this once-abundant fuel are gradually dwindling; we have had to begin importing coal, and we must begin conserving what remains for future generations.

Following the advice of those who say "turn it off when not in use" is the safest way to reduce energy consumption. When you are not in your home, switch off the lights, air conditioners, and fans. The larger the screen on your television, the more energy it uses. Why not take it a step further and unplug the appliance or turn it off at the source/wall socket? Even when appliances are turned off, they use electricity. Any warning lights or automated indicators are indications that your energy has been depleted, and this will be reflected on your bill.

Another factor worth considering is customer perception and attitude toward standby power use. This loss is not significant enough to pique the consumer's interest. As a result, technological solutions play an important role in ensuring that the settings in the appliances are preserved. The commercial availability of technological solutions, the relatively short replacement time of the equipment in question, and the significantly high and excessive

energy consumption due to outdated technology are all reasons for emphasizing the need to reduce power consumption in households.

There are numerous suggestions for reducing household energy consumption. For instance, set the temperature of air conditioners to between 24 to 26 degrees Celsius, which is a comfortable temperature that does not necessitate the use of sweaters or blankets. Because of the additional factor of water that must be heated, steam irons use more energy than dry irons. It is much more energy efficient to iron clothes all at once rather than piecemeal. If you have a washing machine, only do one load at a time to avoid overloading it. Before purchasing appliances, such as air conditioners, fans, refrigerators, and televisions, look for energy labels. The number of stars (1-5) shows the appliance's energy efficiency.

1.3 Project Objective

The objective of this project is:

a) To develop a system that can record the power, current, and total power consumption.

b) To produce energy-saving electrical devices that users need

c) To analyze the power consumption to adjust the usage and help in lowering the electricity bill

1.4 Scope of Project

This project's goal was to keep track of and reduce residential energy consumption. The goal is to design a circuit that assists consumers in tracking their electrical energy use and protects us from additional charges paid because of slight changes in slab categories, as even tiny adjustments can have a significant impact on the bill.

Electricity usage is read from the Ada fruit and communicated to Node MCU ESP8566 regularly in this project. The Node MCU ESP8566 is the microcontroller utilized in this project. For monitoring our electricity consumption from anywhere in the world and receive a telegram/e-mail when it hits a certain threshold.

In this project, requires to construct a Smart Electricity Energy Meter using the Node MCU ESP8266 Wi-Fi, which can not only send you a Telegram/Email of your electricity bill but also allow you to check your energy usage at any time. To monitor the energy consumption, used an ACS712 Current Sensor.

Other than that, need to use an MQTT broker to monitor our energy usage via the internet. To make an IoT Energy Meter, utilize the MQTT broker as the Ada Fruit IO platform and follow the steps below.

- Create an Ada Fruit account to save electricity meter readings.
- IFTTT Applet for Energy Meter Telegram/Email Triggering
- Codes for Node MCU ESP8566 and current sensor ACS712.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

According to the study, there are numerous methods for reducing household energy consumption. Because the cost of power is increasing every day, customers are looking for ways to reduce their usage. There are products on the market that can help with energy consumption monitoring and appliance reduction. These devices allow you to keep track of how much electricity various devices use. Some of these suggestions will be discussed briefly in this section.

2.2 Theoretical Background

Nowadays, electrical equipment is quite essential. Electrical appliances are required in every home. If electrical equipment is not used properly, the cost of the bill may rise. As a result, we need to know a little bit about how to lower the monthly increase in the price of electricity bills.

For instance, air conditioners: Ideally, temperatures should be adjusted to between 24 and 26 degrees Celsius, which is a comfortable temperature. Air conditioners should also be installed out of direct sunlight, maintained regularly, and have a horsepower that is appropriate for the size of the room. This will ensure that they function at their best. When the air conditioners are on, close the windows and doors.

Guide for Appropriate Air Conditioning and Room Size

Room Size	Air Conditioner Unit Size (HP)
12 x 12 feet	<1
14 x 14 feet	1 – 1.5
14 x 16 feet	1.5
15 x 16 feet	1.5 – 2.0
18 x 18 feet	2.0 – 2.5
21 x 21 feet	2.5 – 3.0

Source: CETREE, Your guide to Energy Efficiency at Home, July 2003

Table 2.2.1: Guide for Appropriate Air Conditioning and Room Size.

Refrigerators should not be placed near a stove, oven, or another heat source, and should not be exposed to direct sunlight. Air should be able to circulate freely above, behind, and around it. Adjust the temperature according to the amount of food in the refrigerator - never overfill it. 15°C is a good temperature, while -18°C is a good temperature for the freezer. When defrosting, never allow the frost to accumulate more than 6mm and always turn off the machine. Before restarting, make sure all the extra water has been removed.

Steam irons consume more electricity than dry irons due to the additional element of water that must be heated. It is also more energy-efficient to iron clothes all at once rather than piecemeal. Washing machines: If you have one, use it only with a full load and avoid overloading it. If possible, use the cold-washing cycle instead of the hot-washing cycle. Lights: Replace your incandescent bulbs with energy-saving bulbs. Change your bulbs to light-emitting diodes (LED) if you can afford it, as they last far longer, use less energy, are eco-friendly, robust, light up instantaneously, and can be turned on and off repeatedly without impacting their lifetime or light emission.

On various items, such as air conditioners, fans, refrigerators, and televisions, look for energy labels. The number of stars (1-5) shows the appliance's energy efficiency (more stars

mean less energy used). The sticker should also state how much energy this appliance will save you when compared to a typical 3-star model.

The amount of electricity you use is measured in kilowatts per hour (kWh). The number of kilowatts utilized is determined by the size and number of electrical equipment in your home (ranging from small items like lights and phone chargers to large appliances like refrigerators). The larger the capacity and the number of appliances you have, the more electricity you will need.

The kWh value of an 'hour' is determined by the length of time that the electrical appliances are used. The more time they are turned on, the more energy they consume. We can do our energy audit at home. What you require is:

1. Power rating/energy usage of the appliances
2. The number of hours we spend using appliances
3. The electricity tariffs

(i) Calculate the energy consumption in kWh:

$$\text{A: kWh} = \frac{\text{Power (Watt)} \times \text{Hours of operation}}{1000}$$

(ii) Calculate the cost of energy:

B: Cost per day = kWh x TNB tariff

C: RM X 30 days = Energy cost of a month.

Figure2.2.1: Energy audit formula that you can do by yourself at home.

2.3 Related Research

Based on research from Korakot Luechaphonthara, Vijayalakshmi at the Department of Computer Science, CHRIST (Deemed to Be University) in India, traditional electrical meters provided by energy suppliers assess a building's power use for a month and give the consumers the reading for that month. In this circumstance, the consumer is unable to examine and monitor the daily electricity use of his building/appliances. Electricity usage of various appliances can be monitored and managed separately using electricity meters. This will help the consumer identify the main sources of electricity usage about any equipment so that appropriate measures can be taken to help the environment. In this project, we used both hardware and software.

The ESP8266 Wi-Fi Module is a self-contained SOC with an integrated TCP/IP protocol stack that can connect any microcontroller to your Wi-Fi network. The ESP8266 may either host an application or offload full Wi-Fi networking capabilities to another processor. Each ESP8266 module is pre-programmed with AT command set software, so all you have to do is put it into your Arduino and you'll have roughly as much Wi-Fi functionality as a Wi-Fi Shield. The ESP8266 module is a low-cost board that has a huge and growing community.

The ESP8266 supports APSD for VoIP applications and Bluetooth co-existence interfaces, as well as a self-calibrated RF that allows it to work in any environment without the need for extra RF parts. There is an almost infinite quantity of information for the ESP8266, all of which has been made possible by great community support.

Second, it used the ACS712 current sensor that detects currents. The ACS712 Current Sensors are designed for ease of use, and full-scale values of 5A, 20A, and 30A are available. Each of these devices has the same basic functional procedure. The scale factor of the output is the only difference. This sensor can measure positive and negative current and 5V from

the power supply and the middle sensing voltage is 2.5V when there is no current. This current sensor accurately measures current in both AC and DC signals.

Via a Wi-Fi networking device, the next module is the Data Processing module, where we can collect information on the electricity consumption sensed from each of the sensors mounted on the appliance. Furthermore, this data is saved in a MySQL database and can be used to respond to user requests. The proposed system aims to provide consumers with smart energy consumption monitoring services.

According to (Md Sadequr Rahman Bhuiyan of Georgia Southern University's) research, electricity is used for a variety of purposes. It is one of the most significant areas of a country's economic development. The energy infrastructure in Bangladesh is quite tiny, insufficient, and poorly managed. Many technical and non-technical losses are among the problems in Bangladesh's electric power sector. Non-technical losses include meter tampering, illicit methods of paying electricity bills, and so on. Due to the inconsistent review of meter data, the home meter billing system is ineffective, and most invoices are issued based on assumptions. As a result, even though consumers use roughly the same amount of energy each month, they are subjected to uneven invoicing. The network meter reading management system is created based on the given specifications. This system is based on network technology, automatic meter-reading technology, and modern management ideas, allowing for controllable, customizable, and predictable energy consumption management.

Traditional meter reading methods are replaced by the proposed system, which allows authorities to remotely view current energy meters. It may also regularly monitor meter readings without having a person visit each household. A GSM 900 module is integrated with each entity's electronic energy meter to provide remote access to electricity usage and to form a wireless network.

All customers' homes have a GSM modem and other essential equipment installed on the server end. The blinking LED of a meter is used to collect data from an energy meter. The LED impulse rate per unit can be estimated using energy meter specifications.

Another GSM 900 module receives this SMS as a string on the server end. This string is segmented, and a C# form application program performs numerous logical and arithmetical methods to obtain essential information such as meter issue date, paid energy, last payment date, payment status, current used energy, and bills. A MySQL database holds all of the customer's information.

On the consumer end, the setup includes a load, an energy meter, an LCD, and a GSM module, among other things. Each unit performs a distinct function, making up the entire consumer-end system. After a month, the consumer receives a bill SMS. It tells the customer how much energy they used last month and how much they paid. Figure 1 also depicts the procedure for paying a bill.

Figure 2.3.1: Consumer unit