Faculty of Electrical and Electronic Engineering Technology

THE DEVELOPMENT OF ELECTRICITY THEFT MONITORING SYSTEM

MUHAMMAD ZAIM BIN ABUL RAZAK

Bachelor of Electrical Engineering Technology with Honours

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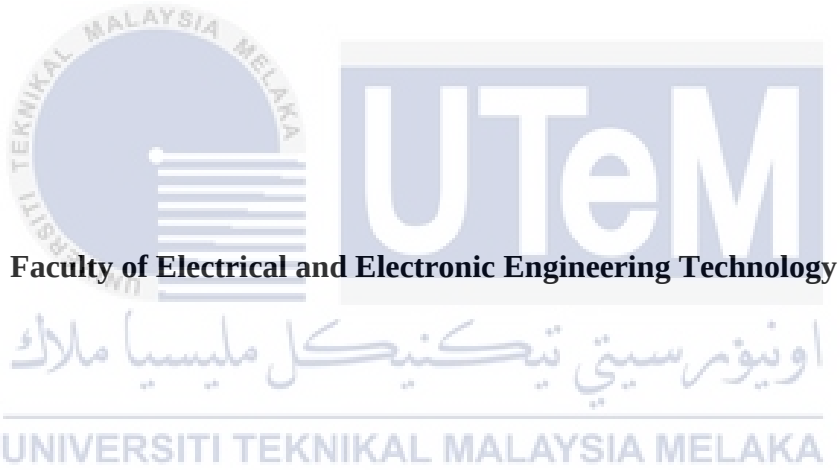
A project report submitted
in partial fulfilment of the requirements for the degree of
Bachelor of Electrical Engineering Technology with Honours



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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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FAKULTI TEKNOLOGI KEJUTERAAN ELEKTRIK DAN ELEKTRONIK

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Tajuk Projek : The Development of Electricity Theft Monitoring System

Sesi Pengajian : 2022/2023

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I declare that this project report entitled “The Development of Electricity Theft Monitoring System” 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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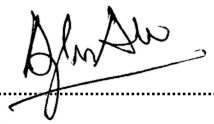
I hereby declare that I have checked this project report and in my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Electrical Engineering Technology with Honors.

Signature : 

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Date : 20/01/2023

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Co-Supervisor Name (if any) :

Date :

DEDICATION

To my beloved mother, Mariam Binti Saperi, and father, Abdul Razak Bin Wahab

ABSTRACT

Electrical energy has long been seen as a necessary kind of energy. Electricity is required for both industrial and domestic use. With the increased need for electricity, power theft is on the rise. This power theft is a serious issue, and load scheduling will become a fraud because of it. Electricity theft is often accomplished through one of two methods which is bypassing or hooking. To identify it, a system of measuring current, voltage, apparent power, and kilowatt per hour (kWh) is proposed, with the measurements taken at the consumer energy meter and distribution line. Therefore, the proposed energy meter monitors the measurements and uploads it to the Blynk cloud, where the electrical authority may examine the information. The power reading may be sent to the cloud using an ESP 32 Wi-Fi module. It leverages IoT in certain ways to automate the process of measuring energy use at the consumer energy meter and distribution line. The received data will then be analysed and compared by electricity authority to determine whether there is power theft. If the electricity authority detects a minimal discrepancy between the kWh from the distribution line and the consumer energy meter, they may trigger the online switch to disconnect the consumer electricity. As a result, the electricity authority will take the necessary procedures.

ABSTRAK

Tenaga elektrik telah lama dilihat sebagai jenis tenaga yang diperlukan. Elektrik diperlukan untuk kegunaan industri dan domestik. Dengan peningkatan keperluan elektrik, kecurian tenaga elektrik semakin meningkat. Kecurian tenaga elektrik ini adalah isu yang serius, dan penjadualan beban akan menjadi penipuan kerananya. Kecurian elektrik sering dilakukan melalui salah satu daripada dua kaedah iaitu memintas atau mengait. Untuk mengenal pastinya, satu sistem pengukuran arus, voltan, penggunaan kuasa dan kilowatt sejam dicadangkan, dengan ukuran diambil di meter tenaga pengguna dan talian pengedaran. Oleh itu, meter tenaga yang dicadangkan memantau ukuran dan memuat naiknya ke (Blynk Cloud), di mana pihak berkuasa elektrik boleh memeriksa maklumat tersebut. Bacaan tenaga elektrik mungkin dihantar ke awan menggunakan modul Wi-Fi ESP 32. Ia memanfaatkan IoT dalam cara tertentu untuk mengautomasikan proses mengukur penggunaan tenaga di meter tenaga pengguna dan talian pengedaran. Data yang diterima kemudiannya akan dianalisis dan dibandingkan oleh pihak berkuasa elektrik untuk menentukan sama ada terdapat kecurian tenaga elektrik. Jika pihak berkuasa elektrik mengesan percanggahan minimum antara penggunaan tenaga elektrik dari talian pengedaran dan meter tenaga pengguna, mereka mungkin mencetuskan suis dalam talian untuk memutuskan sambungan elektrik pengguna. Akibatnya, pihak berkuasa elektrik akan mengambil prosedur yang diperlukan.

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$\pm$	-	Plus or Minus

LIST OF ABBREVIATIONS

$Vrms$	-	Voltage Root Mean Square
$Irms$	-	Current Root Mean Square
S	-	Apparent Power

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CHAPTER 1

INTRODUCTION

1.1 Background

In the generation, transmission, and distribution of electrical energy, there are several operational losses. On the generating side, electrical losses may be accurately determined. If technological losses can be reduced, electricity and manufacturing costs will be reduced, and economic growth prospects will improve. The transmitting end data cannot be used to precisely quantify transmission and distribution electrical losses. This simply demonstrates how non-technical restrictions at the transmission and distribution levels of power are linked. The variation in total energy delivered to the clients can be used to forecast these losses. Electricity theft adds significantly to non-technical losses that are difficult to predict. Bypassing and interfering with electricity meters, as well as other physical techniques to avoid payment, non-payment, fraud, pre-paid vouchers from stolen vending machines, illegal tapping of energy from the feeder, and tampering with electric meters, are all examples. These are the most popular and well-documented techniques of stealing electricity. External variables in the power system create non-technical losses. An electric power infrastructure cannot be completely safe against electricity theft, according to experts. Tampering efforts can take several forms. These attempts frequently occur on electricity meters during shutdowns at the meter/meter cable connectors. Finding unauthorized power consumption should theoretically be feasible. Nonetheless, power theft is difficult to detect due to large capacity on social resources and large amount divides on the distribution network.

This effort contributes to reducing and avoiding the challenges that the entire country is now facing. Various researchers are conducting research on power theft detection. Some academics propose using prepaid power billing meter to monitor domestic electrical equipment. A microcontroller-based invoicing system for distributed client's single-phase meters is presented. Because there are different methods for committing electrical theft, it is difficult to determine how a theft happened. This project idea is an electrical theft monitoring system that monitor the power usage at distribution line and consumer energy meter online to detects theft automatically if the meter is bypassed. A current sensor and voltage sensor is employed in this approach to measure the total amount of current and voltage absorbed by the load. If the transmission lines are tapped or an additional load is supplied, the sensor receives additional current. This causes the readings to raise to the difference required value between distribution line and consumer energy meter as it detects theft and gives the electricity authority continue with next procedure which is disconnect the consumer electricity if necessary.

1.2 Problem Statement

Nowadays, electricity is one of the most important sources of energy for daily use. Electricity theft cases increased 400%, a loss of RM2.3 billion due to bitcoin mines. Electricity theft is a criminal offence that involves stealing electricity. It is considered a felony, punishable by high penalties and, in certain circumstances, imprisonment. Direct hooking from a line is the most basic way of stealing power, and it is also the most popular. Most of the worldwide power theft occurs through direct line tapping.

From a point ahead of the energy meter, the consumer connects to a power line. The methods of electrical power theft usually bypassing the energy meter which is the energy meter's input and output terminals are short-circuited, preventing the energy from being registered.

Measuring the power usage from distribution line and the power usage at consumer energy meter. There will be unmeasured power usage at the energy meter if the meter is tempered illegally. Because of power theft, the right bills are not read by energy meters, and the electrical authority is unable to collect the correct rates for electricity usages. Power theft has caused in large earnings losses for respected authorities, causing a funding crisis for power system investment and forcing an increase in producing capacity to compensate for power outages.

The power usage measurement at consumer energy meter and distribution line needs to be sent to Blynk Cloud to monitor it online. To easy the electricity authority compares the power usage at distribution line and consumer energy meter, the power usage measurement needs to be display online. There is also no automatic method for monitoring electricity. It is tough to identify the theft manually.

1.3 Project Objective

This project's major goal is to develop a systematic and effective mechanism for be alert of the electricity theft activity. Specifically, the objectives are as follows:

- To construct a circuit that can monitor the power usage at distribution line and consumer energy meter.
- To compare the measurement of power usage at distribution line and consumer energy meter.
- To design a circuit that can transmit the data measurement wirelessly from consumer energy meter and distribution line energy meter to Blynk Cloud online monitoring.

1.4 Scope of Project

This project's scope is focused on the development of electricity theft monitoring system with two energy meter that can compare the power usage at distribution line and consumer energy meter. The energy meter consists of AC current sensor and AC voltage sensor to calculate the power usage. The ESP32 Wi-Fi module needed to transfer the data from two energy meter to compare the power usage at the Blynk Cloud. ESP32 as the main component which act as the microcontroller for this system to control all the process. The relay module is added to cut-off the electricity at consumer side, if necessary, because of power theft.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter will explain the detail about the development of electricity theft monitoring system which is about the functionality, the sensor selected and the specification of the technology of electricity theft monitoring system. Electricity theft monitoring system consist of various type of system which is the main function is to achieve the goal to send notification to the electricity authority when the power usage at distribution line is higher than consumer energy meter. Research have shown various type of method that had been used and been applied to the electricity theft monitoring system to functioning well.

These areas are arranged to show the information about the process of decision making about the project. It is important to obtain clear data and must use the precise and strong database. This chapter was divided as below:

- Section 2.2 Type of Sensor
- Section 2.3 Microcontroller
- Section 2.4 Communication Device

2.2 Type of Sensor

2.2.1 Split Core Current transformers

Split-core current transformers are used to monitor alternating current for a variety of devices. The current transformer input accepts a high voltage current input and generates a proportionate low-voltage, low-current signal for measurement and monitoring.[1] The split core current transformer is especially developed for electrical metering applications and may be fitted around primary current-carrying conductors without removing wires or breaking the monitoring circuit. These current transformers are the optimum choice for energy measuring and management applications. Split core current transformer designed for simple installation in portable metering applications.

Figure 2.1: Hall-Effect Split-Core Current Transformer HSTS016L

Split core current transformers are intended for use in semi-permanent installations. They have a transformer in which one of the cores may be opened or moved to place around the conductor and then locked with a latch or some other type of flange. It can install these in electrical control panels to remotely track equipment that are occasionally monitored in

inaccessible or hostile environments while avoiding complicated wiring. Split core current transformers operate on the same principles as standard current transformers. When an alternating current flows through the primary winding, it creates an alternating magnetic field in the magnetic core, which induces an alternating current in the secondary winding.

The ring core or ring-type current transformer is a common type of current transformer. The current rail or current-carrying wire is frequently employed as the primary winding, which is led through the transformer's toroidal core. With one turn, the rail or line creates the principal winding. The ring core houses the secondary winding. The ratio of the number of main and secondary windings determines the transformation.[2]

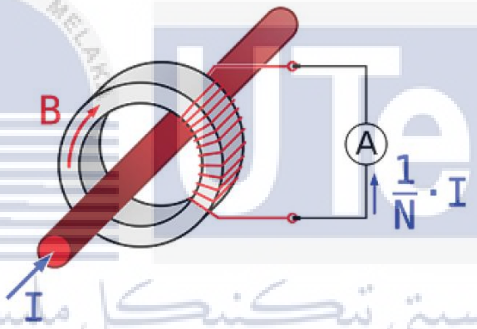

Figure 2.2: Principal Ring-type Current Transformer

The advantage of split-core is that they may be upgraded without disturbing a live network, making them a unique option for engineers developing power meters. Split-core, or clamp-on, CTs offer an option to directly connecting to measurement or relay CTs in substation upgrade or retrofit applications when monitoring and SCADA data are required. This non-invasive method allows for a faster installation with no interruption in service.