UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF SMART CLAMP METER FOR ENERGY CONSUMPTION MONITORING

NORHISHAM BIN OTHMAN

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF SMART CLAMP METER FOR ENERGY CONSUMPTION MONITORING

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

by

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I hereby, declared this report entitled DEVELOPMENT OF SMART CLAMP METER FOR ENERGY CONSUMPTION MONITORING is the results of my own research except as cited in references.

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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 Electrical Engineering Technology (Industrial Power) with Honours. The member of the supervisory is as follow:

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ABSTRACT

Current consumption is one of the foremost imperative problem in recent years and one of the factors causing it is consuming more energy. Nowadays, the statistics show current consumption that uses the most come from the domestic sector such as household, schools, construction and industrial areas. The goal of completing this project is to construct basic electricity current remote monitoring system. With this system, an operator no longer needs to be at the site to monitor the clamp meter display at all time to observe the real-time current of their devices. The prototype integrates conventional clamp meter with an additional feature that will change the clamp meter from a conventional one into a smart clamp meter. This innovation has a data logging function and can be monitored online. The measured data from the clamp meter will be sent to a data log device and can be monitored remotely. This initiative makes user to be more conscious of current consumption. It also helps to monitor electricity current usage daily and make effective use of the current. This prototype has been tested to read currents for different type of loads at home. The results show that the currents were able to be correctly measured and displayed on a smartphone via Blynk apps in real-time. For improvement, the system could be redesigned to display current trends for a period in the apps interface.

DEDICATION

This is dedicated to my beloved late father, Mr. Othman Bin Abdul Samad, my beloved mother, Mrs Fatimah Bt Jimat and my siblings, Norhayatie, Noriani, Noraishah and Norsyamira. Praise be to Allah, S.W.T., that I am part of this supportive family. Thank you for your advice and best wishes

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LIST OF ABBREVIATIONS

IoT	-	Internet of Thing
CT Sensor	-	Current Transformers Sensor

CHAPTER 1

INTRODUCTION

1.1 Background

These days, innovation creates and advances quickly. With the current innovation that keeps on evolving, a few of the systems got to be continuously evolved to not be obsolete. Several years ago, control systems were monitored for monitoring purpose with human intervention. The latest discovery of technology, in particular on the Internet of Things (IoT), was offered conventional systems to evolved to meet user require. The implementation can be discussed through understanding the basic principle of IoT.

Energy consumption measurement is important because it involves operational cost. New products and services that are technologically advanced may need to be assessed in terms of their energy consumption. What is the definition of energy? Energy is defined, as the capacity to do a work utilitarian point of view of energy. In electrical, energy is derived from electric potential energy or kinetic energy. Energy can be neither created nor destroyed but only changed from one form to another. Energy also can convert from one form to another in various other ways.

An electrical test instrument which combines a basic digital multi-meter with a current sensor is called a clamp meter. For this project, a clamp meter will be redesigned to integrate it with an Arduino microcontroller to monitor energy consumption online based on the IoT concept.

The data can be observed, collected, and analyzed using predictive analysis and advanced methods to significant data in the form of reports, graphs, and charts. Thus, this analysed data in real-time can help the utilities and utilities ecosystem providers to gain significant experiences on energy consumption monitoring.

The energy service providers can utilize the control the power consumption data accessible with an analytics engine to supply adaptable and on-demand supply with appropriate energy. This is where the combination of IoT technology, between hardware and software. In designing this project using the Internet of Things can be considered as high-end products.

The concept of the energy monitoring system originally consists, high cost and inconsistency with existing devices. This is often due to the device and sort of microcontroller used which makes it very costly. Although some products may appear cheap, in terms of the total cost it is high. The major part of this project is Current Transformers which is the sensor to measure alternating current and Arduino UNO as a microcontroller which will monitor all inputs and outputs from this system.

1.2 Problem Statement

We all know about clamp meters. They are used to measure electricity consumption i.e. current and voltage. One advantage of a clamp meter over a conventional multi-meter is the convenience in measuring electrical current. By using a clamp meter, a person does not have to break the circuit to place the ammeter in series.

By clamping the meter to an electrical cable or wire, it can measure the amount of electrical current that flows through the wire. This project also aims to design the smart clamp meter as a current-reading device where the data logging process is done by providing a communication device using IoT to transfer data over the network.

Moreover, in conventional monitoring, a person needs to read the measurements on the clamp meter and record it in a logbook manually. This process has many disadvantages. One of the common errors that might happen is human error. Besides this, the number of real-time measurements that an ability to be captured by a human operator is limited. Perhaps the current can be measured only a few times in one hour or even in one day. When the measured data is less and limited, good data analysis seems impossible to be carried out.

The other conventional method of using the clamp meter, these are used for repairing accessible systems based on the requirement, troubleshoot to fixing the problems, execute last circuit tests and manage beginner electricians while fitting electrical instruments. These also used to execute scheduled, preventive protection as well as troubleshooting of the system.

This report aims to describe the design and development process of a smart clamp meter for energy consumption monitoring. The title of this project is "Development of Smart Clamp Meter for Energy Consumption Monitoring". The prototype has current transformers which are used as sensors to measure alternating current (AC). They are especially valuable for measuring current or voltage. It is a clamp meter that has a data logging function.

1.3 Objective

This project aims to develop a smart clamp meter for energy consumption monitoring. The objectives of this project are as follows:

- To design a smart clamp meter based on requirements and related standards.
- To integrate the clamp meter with an Arduino and Wi-Fi module.
- To develop a user interface using a Blynk application.
- To test the functionality of the develop prototype.

1.4 Scope of Project

This project will be focused on integrating a clamp meter with an IoT (Internet of Things) system so that the system can monitor current energy consumption online. This project is a combination of hardware and software development. To attain the primary objective, an on-shelf product such as a CT (current transformers) sensor will be used to build the prototype as one of the hardware components. To automate the current monitoring process, an Arduino will be used. The purpose of Arduino is to monitor the overall energy monitoring consumption.

There will be also an LCD (liquid crystal display) to show the measurement of the ability of the clamp meter load. The parameters will be measured is current. Then, these parameters will be sent to an Arduino that is equipped with a Wi-Fi module. The data will be transferred to a smartphone through an app called the Blynk apps.

1.5 Thesis Outline

This report starts with Chapter 1, Introduction. It explains in terms of problem statement, objective and project scope. Then the literature review will be written in Chapter 2. In this chapter, related articles from reliable journals are analyzed order to understand how current projects are conducted to find differences and similarities among relevant research work. Next, for Chapter 3, method and procedure of the project with the guide and apparatus will be explained in detail. Finally, in Chapter 4, preliminary results will be reported to show current progress of this project.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter highlights of existing systems that were researched and developed by previous research groups. These projects involved development using Arduino in general and Internet of Things (IoT). Besides, a few past related works presented, a number of articles and journals that are related to this project will be discussed too. The papers will be the one with system that used clamp meter in the industry.

2.2 Clamp meter overview

A clamp meter is an electrical test instrument that combines with a basic digital multi-meter including the current sensor. Current is measured by the clamps. The incorporation of a hinged jaw into an electric meter allows technicians to tighten a wire, cable or other conductor around an electric circuit at any point. Then, it will measure the current without breaking it or disconnecting it. Ferrite iron hard jaw underneath its plastic mount is built so that the magnetic field produced by current can be detected, amplified and measured as it passes through the conductor. (Fluke Corporation, 2020)