UNIVERSITI TEKNIKAL MALAYSIA MELAKA

UNIVERSTI TEKNIKAL MALAYSIA MELAKA

FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

BORANG PENGESAHAN STATUS LAPORAN

PROJEK SARJANA MUDA II

Tajuk Projek : IOT BASED : ENERGY SAVING MONITORING SYSTEM

Sesi Pengajian : 1 3 / 1 7

Saya ADI ZAFRAN BIN ZAINEE
(HURUF BESAR)

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ABSTRACT

Nowadays, electricity plays an important role in our life. We can say that everything needs electricity to run or power up such as, mobile phones, home appliances, cars, street lights and many more. Without it, we cannot live a proper life. The rising cost of energy is causing organizations to evaluate smart ways of saving energy. Energy suppliers are increasingly penalizing organizations that use inefficient assets or devices with a low power factor. At the same time, governments are raising the bar for compliance with energy standards and reduction in carbon footprints. This paper shows the combinations of the Internet of Things (IoT) and energy monitoring system can help improve control, minimize and save energy consumption. It illustrates how this system read and collect data from electrical appliances and upload them to a cloud system where every data are recorded and saved.

ABSTRAK

Pada masa kini, penggunaan elektrik memainkan peranan yang penting dalam kehidupan kita. Kita boleh katakan bahawa segalanya memerlukan elektrik untuk berfungsi atau digunakan seperti telefon mudah alih, peralatan rumah, kereta, lampu jalan dan banyak lagi. Tanpa itu, kita tidak boleh menjalani kehidupan yang sempurna. Kenaikan kos tenaga menyebabkan beberapa organisasi menilai cara-cara yang bijak untuk menjimatkan tenaga. Pembekal tenaga semakin menghukum organisasi yang menggunakan aset dengan tidak cekap atau peranti dengan faktor kuasa yang rendah. Pada masa yang sama, kerajaan menaikkan tahap untuk mematuhi piawaian tenaga dan pengurangan jejak karbon. Laporan ini menunjukkan kombinasi IOT dan sistem pemantauan tenaga boleh memperbaiki kawalan, mengurangkan dan menjimatkan penggunaan tenaga. Ia menggambarkan bagaimana sistem ini membaca dan mengumpul data dari perkakas elektrik dan memuat naik data ke sistem "cloud" di mana setiap data direkodkan dan disimpan.

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DEDICATION

"Without Hardworks, Dreams Can Never Come True"

To Mama and Babah

CHAPTER I

INTRODUCTION

1.1. Overview

Energy saving or energy conservation refers to reducing energy consumption through using smaller amount of energy of an energy service. The user's flexibility is the latest request of the society, where an essential of user requirement is to be fulfil. Also with the rising burden of over usage of resources has encourage mankind to make a mean to restrain the insufficiency of resources with less manual work involves. Resources like, power, fuel, performance, etc. have achieved the world's necessity in every sector. Therefore, controlling the need of requirement at all cost is important. Hence, their effectual usage is imperative by fully using and keep away from nonessential wastage of them. Referring to the present ongoing in the market, the smart meter will be a new generation meter that will be implement in every home in United Kingdom by 2020 (Sinha & Alex, 2015).

The present power metering system in every households, offices, schools, universities, has the benefit of accurate measurement but the existing smart meters are not smart enough to save up the electricity bill and avoid high power consumption. This paper delivers an intuitive system that able to monitor the amount of power used in the houses, offices, universities as well as it gives the flexibility of setting limit across some high power consuming appliance such as the air conditioner, classroom lamps, etc. in a way that the device can consume power within that scope of affordability, hence improving the power usage and ultimately reducing the electricity bill.

Internet of Thing (IoT) based power monitoring system is an effective way for power consumption management. The newest development in internet of things has help researchers and industrialist to identify its role in energy management system. The utilization of Internet Protocol (IP) proves that it can be used to save energy. In the past, the internet has limited applications. Today, the internet is a chain of network connection in which the numbers of connected devices increases rapidly (Fakeeh, 2016).

1.2. Problem Statement

The difference between the speedily growing energy use and energy insufficiency has become more and more serious throughout the world with the swift economic development. The increasing usage of electrical appliances can lead to increasing of power consumption of any buildings or households. The main function of an energy saving monitoring system is to monitor, control and optimize the power consume by every electrical appliance in the building. The users only know that each of the electrical appliances consumes power but they do not know how much does each of the appliances consumed.

Next, in our modern world every information can be easily acquire and send at our fingertips. The recent system that is widely known is the Internet of Things, which define in Wikipedia as a proposed development of the Internet in which everyday objects have network connectivity, allowing them to send and receive data. With the

present power meter, we can only know how much power that our appliances consumed at the end of the month when the electricity bills arrived.

1.3. Project Objectives

1) To develop an Internet of Things (IoT) based system on monitoring and controlling the power usage.
2) To monitor and control the power usage of an electrical appliances through mobile applications daily and monthly.

1.4. Project Scope

This project concentrates on monitoring the power usage of an electrical appliances and notify the consumer using Arduino Uno R3 and Blynk application. The measurements and calculations of the power consume are measured by the SCT-013-000 Non-invasive AC current Sensor Clamp Sensor 100A which detect current later then calculated by the microcontroller which is the Arduino UNO R3. Then the end calculation will show the energy used in Watt (W) and also in kilowatt hour (kWh). Hardware parts in this project are the current sensor, the Arduino UNO R3 and the ESP8266 Wi-Fi module which are mounted together as one unit.

This system should be able to show the following:

i. Energy in Watt (W)
ii. Energy per hour (kWh)
iii. Total payment

1.5. Project Contribution

By carrying out this project, many people will get benefits and advantages from it. When the user utilizes the system in their building or household, they do not need to worry about their total power consumptions for the month when the electricity bill arrives because they can monitor the power consumptions by simply check it on a website or on a mobile application.

This way of monitoring the power consumption of electrical appliances, the user able to know which appliances contributes high power consumption. Observation and solution can be done by the user to decrease the power consumption of any electrical appliances and the expenses on the electricity bills can be reduce as well.

1.6. Thesis Organization

Chapter I: Introduction

This chapter discuss about types of energy resources that presently become one of the biggest wastage in the world and why we should control and reduce this type of wastage. The background of the energy monitoring system is discussed. The problem statement, problem objective, project scope and project contribution are highlighted.

Chapter II: Literature Review

This chapter will discuss about the literature review for my project. It contains the existing information including practical results as well as theoretic and practical contributions to my project.

Chapter III: Project Methodology

This chapter will discuss about the design, planning, implementation and achievement of my project objectives.

Chapter IV: Results and Analysis

This chapter discuss the results and analysis that has been done with the system to monitor the power consumption and reduce as well as save the energy used.

Chapter V: Conclusion

Conclusion and future works. This chapter summarize the entire project. The commercialization and recommendations for future development are also outlined.

1.7. Conclusion

The background and history of energy saving and conservation has been elaborated in this chapter. Energy saving in terms of electrical appliances is very essential in our daily life as the world evolves and the total of power consumption increases. The problem statement, problem objective, project scope and project contribution has also been elaborated.

CHAPTER II

LITERATURE REVIEW

2.1. Introduction

A literature review is a text of an academic paper, which consist of the present knowledge, findings, as well as theoretical and methodological contributions to this project. This chapter reviews article, journals and books in order to understand the idea that is needed to complete this project such as about how to reduce the energy consume within our electrical appliances and what are the system that is used nowadays. The main topic that will be discuss in this chapter is literature review on monitoring energy usage using specific components and microcontroller in order to develop the proposed system This review was done to get information in order to help achieve the objectives of this project. All the information was collected from the internet and other related resources as references.

Throughout the years, there are many issues about power consumptions. A lot of company present plans for energy reduction and efficiency, but it has not seen the full effect because the Internet of Things (IoT) is not widely extend into each private house. To implement such measurable devices for power consumption into private

houses would be the best option instead of waiting the market to catch up. Air conditioner is one of the frequently used home appliances and it consumes the most amount of power. With the help of such system which is the power monitoring system, every consumer would definitely know exactly how much energy does one air conditioner consumed.

In order to develop such system, it is important to review the latest research advancement for based knowledge. This chapter gives an overview of the recent hardware and component used. Also, this chapter describes the use of IoT in developing the system.

2.2. Arduino Uno

Arduino or Genuino Uno is a microcontroller board based on the AT-mega328P. It has 14 digital input and output pins, 6 analogue inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It includes everything needed to assist the microcontroller. It can be simply connected to a computer with a USB cable or power it with AC-to-DC adapter or battery to power it on (Fallis, 2013).

The "Uno" means one in Italian and was selected to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the referral versions of Arduino, now evolved to latest releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform. The power source of the Arduino board is selected automatically. External power can come either from an AC-to-DC adapter or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the GND pin and Vin pin headers of the “POWER” connector.

The board can function on an external supply from 6 up to 20 volts. If supplied with less than 7V, however, the 5V pin may provide less than five volts and the board may become unstable. If using more than 12V, the voltage regulator may become overheat and could damage the board. The advised range is between 7 to 12 volts. Arduino boards as in Figure 2.1 below, offer one crucial advantage which is the open

source philosophy (both hardware and software), which capitalizes on the massive nonexpert community that has flourished around the Arduino concept (D'Ausilio, 2012).

Figure 2.1: Arduino UNO R3

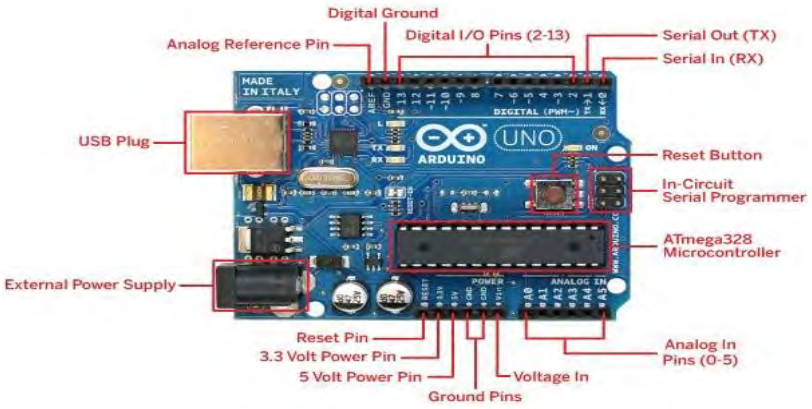

Figure 2.1: Pinout of Arduino UNO R3

2.3. Wi-Fi Module ESP8266

ESP8266 is a highly integrated chip designed for the demand of a new connected world. It provides a complete and self-contained Wi-Fi networking solution, enabling it to either host the application or to offload all Wi-Fi networking functions from another application processor (Datasheet, 1994).

ESP8266 has powerful on-board processing and storage abilities that enable it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime. Its high degree of on-chip integration allows for minimal external circuitry, and the entire solution, including front-end module, is designed to occupy minimal PCB area.

The ESP8266 as in Figure 2.3 below, supports Automatic Power Save Delivery (APSD) for Voice over IP applications and Bluetooth co-existence interfaces, it includes a self-calibrated radio frequency enabling it to work under all operating conditions, and need no external radio frequency parts. There is a nearly limitless source of information available for the ESP8266, all of which has been supplied by amazing community support.

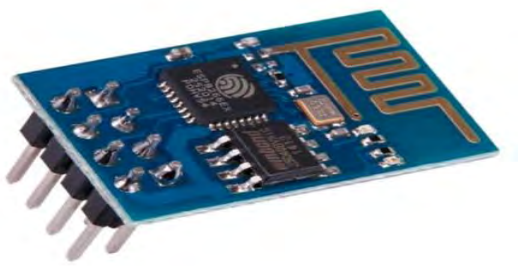

Figure 2.2: ESP8266 Wi-Fi Module

2.4. Non-invasive Current Sensor

The non-invasive current sensor which is also known as the split core current transformer can be attach around the supply line of an electrical load to measure how much current is passing through the wire. It does this as an inductor and responding to the magnetic field around a current-carrying conductor. By reading the total current

being generated by the coil, the user can calculate how many current is passing through the conductor.

This precise current sensor able to measure a load up to 100 Amps which makes it great for building an energy monitor to keep the power usage down, or even building an over-current protection device for an AC load. This sensor does not have a load resistor embedded in, for that in most cases it is compulsory to put a resistor across the output to convert the coil's induced current to a very small measurable voltage. Just as any other transformer, a current transformer has a primary winding, a magnetic core, and a secondary winding. In the case of whole building monitoring the main is the live or the neutral wire coming into the building itself and goes through the hole in the current transformer("Non-invasive AC Current Sensor (15A max)," 2016). The secondary winding made up of many turns of fine wire housed within the casing of the transformer. Figure 2.4 and Figure 2.5 below are the current sensor and the datasheet of the sensor.

Figure 2.3: Non-Invasive Current Sensor

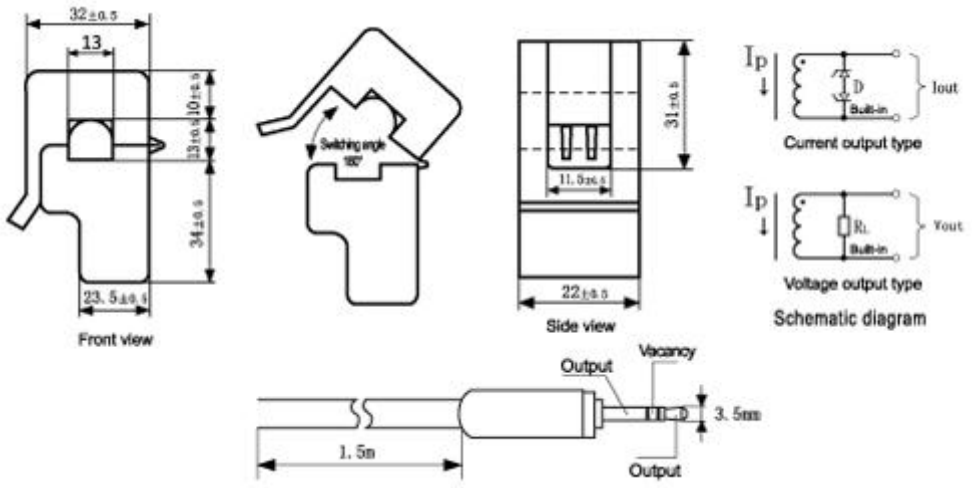

Figure 2.5: SCT-013-000 Non-invasive Current Sensor

2.5. TRRS 3.5mm Jack Breakout

TRRS (Tip, Ring, Ring, Sleeve) as Figure 2.6 below, is different from a standard stereo connector, this has three conductors and a ground. TRRS connectors are the audio-style connectors that is use in some phones, MP3 players and development boards. Some devices use the extra conductor for a microphone or to carry a video signal. This breakout board makes it easy to add a TRRS jack to the prototype by breaking out each conductor.

Figure 2.6: TRRS 3.5mm Jack Breakout

2.6. Blynk Application

Blynk is a platform with iOS and Android apps that able to control Arduino, Raspberry Pi and another similar microcontroller over the Internet (Teleoperation, 2016). It is a digital dashboard where the user able to build a graphic interface for their project by simply drag and drop widgets. It is actually easy to set the application.

Blynk is not restrain to some particular board or shield. Instead, it supports hardware of the user's choice, which in this paper is the Arduino board. Regardless the Arduino or Raspberry Pi is linked to the internet over Wifi, Ethernet or the ESP8266 chip, Blynk as Figure 2.7 below, will be online and ready for the Internet of Things (IoT).

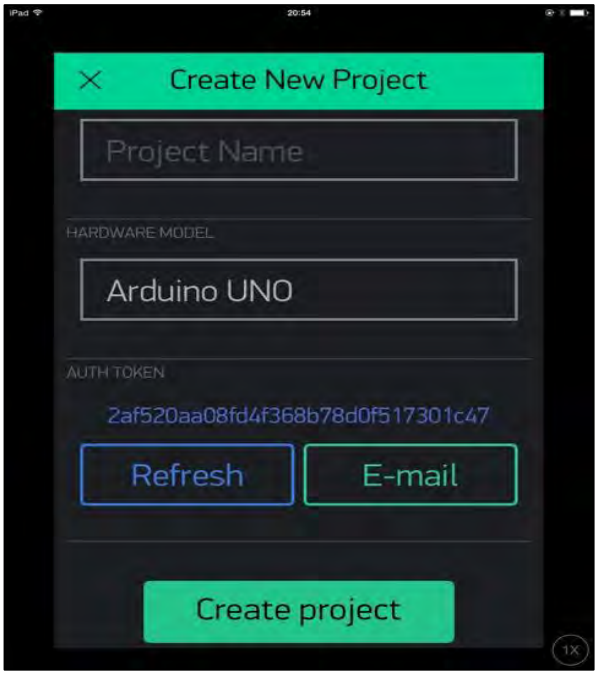

Figure 2.7: Blynk Interface

2.7. Fritzing Software

Fritzing is a great open source tool for anyone. This software enables designing circuit and schematics diagram which can be a professional-looking wiring diagrams. It also gives the user to even design their own Printed Circuit Board or PCB. Fritzing allows developing amateur or hobby CAD software for the design of electronics hardware, to help designers advance from experimenting with a prototype to building a more lasting circuit.

The software is created in the spirit of the processing programming language and the Arduino and allows designers or researchers to record their Arduino-based prototype and make a PCB layout for manufacturing. Fritzing can be seen as an electronic design automation (EDA), (Knörig, Wettach, & Cohen, 2009) tool for non-engineers: the input metaphor is encouraged by the environment of designers which is the breadboard-based prototype, the output is offering nearly no choice and is concentrated on accessible means of production. Fritzing as Figure 2.8 below, offers three alternative views on the circuit: A real-world-like breadboard view, a classical schematic diagram view, and a PCB design view.

Figure 2.8: Fritzing Interface