UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF SMART DOMESTIC ELECTRICITY MONITORING SYSTEM

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

MOHAMAD FARIZUAN BIN OTHMAN
B071310739
940916-03-5255

FACULTY OF ENGINEERING TECHNOLOGY

2016

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: **DEVELOPMENT OF SMART DOMESTIC ELECTRICITY MONITORING SYSTEM**

SESI PENGAJIAN: **2016/17 Semester 1**

Saya   **MOHAMAD FARIZUAN BIN OTHMAN**

mengaku membenarkan Laporan PSM ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Laporan PSM adalah hak milik Universiti Teknikal Malaysia Melaka dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan laporan PSM ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. **Sila tandakan (✔)

☐ SULIT   (Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia sebagaimana yang termaktub dalam AKTA RAHSIA RASMI 1972)

☐ TERHAD   (Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)

TIDAK TERHAD
☐

Disahkan oleh:

_____   _____

Alamat Tetap: Cop Rasmi:

PT 1474,

TAMAN SRI TANJUNG,

15300 KOTA BHARU, KELANTAN.

Tarikh: _____   Tarikh: _____

** Jika Laporan PSM ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh laporan PSM ini perlu dikelaskan sebagai SULIT atau TERHAD.

DECLARATION

I hereby, declared this report entitle "Development of Smart Domestic Electricity Monitoring System" is the result of my own research except as cited in references.

Signature   : …………………………………………….

Author's Name : MOHAMAD FARIZUAN BIN OTHMAN

Date   : 4 December 2016

APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfilment of the requirements for the degree of Bachelor Electronic Engineering Technology (Bachelor's Degree in Electronics Engineering Technology (Industrial Electronic) with Honours) (Hons.)

....

(WAN NORHISYAM BIN ABD RASHID)

ABSTRAK

Tujuan projek ini adalah untuk membagunkan dan mencipta satu Sistem Pemantauan Elektrik Domestik Pintar berasakan kuasa teknologi rangkaian, Arduino Yun mikropengawal, Google Spreadsheet dan Aplikasi Android. Tujuan system ini adalah untuk memantau penggunaan elektrik di dalam talian. Aplikasi telefon pintar membolehkan pengguna untuk memantau pengunaan elektrik dengan meghidukan Bluetooth dan disambungkan pada system. Penyimpanan maya membolehkan pengguna untuk memantau penggunaan elektrik dan trend dengan menggunakan Google Spreadsheet. System ini juaga boleh memantau luar talian degan memaparkan penggunaan pada paparan LCD. Sistem ini akan mengira bil berdasarkan tariff Tenaga Nasional Berhad(TNB). Sistem ini adalah dibangunkan untuk meningkatkan kesedaran tentang pembaziran elektrik.

ABSTRACT

The purpose of the project is to develop a Smart Domestic Electricity Monitoring System based empowered by networking technology, Arduino Yun microcontroller, Google Spreadsheet and Android application. The purpose of this system is to monitor the electricity consumption online. Smartphone Android application allows the users to monitor the electric consumption by turning on Bluetooth and connected to the system. The cloud storage allows the users to monitor electricity usage and trend by using Google Spreadsheet. This system also can monitor offline by displaying the usage on the LCD Display. The system will calculate the billing based on the Tenaga Nasional Berhad (TNB) tariff. This system is develop to increase the awareness about the wasting the electricity.

DEDICATION

Alhamdullilah, praise to the Almighty Allah S.W.T.

I dedicate this thesis to my beloved parents, for supporting me to complete this project.

Othman Bin Hassan, and Ruhani Binti Mohamed.

To my Supevisor that guidance and providing helps

En Wan Norhisyam Bin Abd. Rashid.

ACKNOWLEDGEMENT

Bismillahirahmanirahim,
In the name of Allah S.W.T, the most compassionate and the most merciful.

Firstly, thanks to Allah S.W.T because giving me a good health, huge courage and strength to complete this final project.

Secondly, I would like to deeply express my gratitude and appreciation to my supervisor, Mr. Wan Norhisyam Bin Abd. Rashid for his guidance, support, and helps to complete this Project Sarjana Muda.

I would like to extend my sincere to my family that's keep supporting, blessing and prays for me, and friend who has assisted and share the ideas to complete this thesis.

TABLE OF CONTENT

LIST OF TABLE

LIST OF FIGURES

LIST OF ABREVIATION,SYMBOLS AND NOMENCLATURE

Wi-Fi	-	Wireless Fidelity
TNB	-	Tenaga Nasional Berhad
SoP	-	Standart of Procedure
IPP	-	Independent Power Procedure
kWh	-	kilowatthour
CO2	-	carbon dioxide
LCD	-	Liquid Crystal Display
Irms	-	Current root mean square
SoC	-	Small Computer
RAM	-	Random Access Memory
ROM	-	Read Only Memory
OTP	-	One Time Password
CT	-	Current Transformer
AMR	-	Automatic Reading System
SMS	-	Short Message Service
GSM	-	Global System for Mobile Communication
ADC	-	Analog Digital Converter
TCP/IP	-	Transmission Control Protocol/ Internet Protocol
USB	-	Universal Serial Bus
LED	-	Light Emmiting Diode
OS	-	Operating System

App	-	Application
HTML	-	Hyper Text Markup Language
IDE	-	Integrated Development Enviroment
ICSP	-	In-Circuit Serial Programming
URL	-	Uniform Research Identifier
AC	-	Alternating Current
DB	-	Decibel
ICT	-	Information and Communication Technology
IoT	-	Internet of Things

CHAPTER 1
INTRODUCTION

1.0 Overview

This chapter explains briefly about The Smart Domestic Electricity Monitoring System project. This chapter exists a background of study, problem statement, objective and scope.

1.1 Background

The Smart Domestic Electricity Monitoring System are to allow user to check the electricity consumption and billing based on TNB tariff. The system can be monitor through liquid crystal display (LCD) that accompanied together with the device. In others way, the system also can be monitor online by using Google Spread Sheet (email account) and Bluetooth on Android application. This project is divided into three sections;

    i.   Sensor ;
   ii.   Microcontroller ;and
  iii.   Monitor.

When the Microcontroller receives the signal from the sensor, it will calculate the data and be on display at LCD. At the same time, the data itself will transmit to Google account and Android Application via Bluetooth.

Wi-Fi is a highly created correspondence standard and it is broadly acknowledged by the technologies. This Wi-Fi technology easiers the extension to others application, which possibly to interfacing with sensors to monitor the electricity (Sanchez et al. 2014). Remote information, correspondence systems give lessened costs, better power management, easier upkeep and easy organization in remote and difficult to-achieve regions (Manfredi 2012). Notwithstanding the quick improvement of science and innovation, particularly the broad use of advanced mobile phones with Bluetooth remote innovation, by using Arduino HC 06 Bluetooth module with smartphone together, it have ability to make communication process the data then form the wireless monitoring system based on Bluetooth Smartphone and apps (Society et al. 2010). The most important is this device will increase the public awareness about energy saving. This device also will alert the user when it reaches the point of electricity uses or limit bill amount (limitation will be set by user). By monitors the electricity usage its leads to a significant cost reduction and to a reasonable administration of vitality asset valuable for nature (Sanchez et al. 2014).

1.2 Problem Statement

Electricity is the most demanded necessities for human nowadays. The worldwide utilizations of electricity have been progressing quickly and the industries started using a lot of power in lighting house, air conditioning and creating energy to all different innovations that require electricity (Ahmad 2014). On 9 March 2016, power utilization ranges to the most noteworthy in peninsular Malaysia, with Tenaga Nasional Berhad (TNB) recording an unequaled high pinnacle request of 17,175MW by The Star Online. From this statement its show that is was difficult for the users to know the electricity usage and updated bill charges. Wasteful and inefficient energy consumption

can result in environmental externalities in the forms of acid rain and global warming, which today has ended up vital worldwide concerns (Ahmad 2014).

Therefore, the mounting of the meter is high that distress the user to monitor the electricity usage and it depends on the TNB Standard of Procedure (SoP) to install the metering. The meter reading display in kWh per hour also gives difficulties to user that need to calculate in Ringgit Malaysia and knows the trend of usage. The electricity cost relies on upon Fuel costs (e.gz gas, coal, and different sorts of energizes used by the generators). Independent Power Producers (IPP) and TNB generators control the pricing. Industry get the supply of the electricity from this company.(e.g. transmission and dispersion arrange, sub-stations, control focuses and control plants) .The price is known as tariff price depends on the usage of the power in kWh.

In other hand for example the business such as "Guest House", the owner facing problem to impose bill amount suitable with daily usage because of some rental not turn off their air-conditioner and television 24 hours. Other than that, the rising of households for quarters, dormitories and rental house especially for student hard to calculate and control the daily usage of electricity. This has suggestions both for the arrangement of fitting lodging and for energy use in homes. Without enhancing the energy productivity of homes, or the ways individuals utilize energy at home, development in family unit numbers and littler normal family unit size would prompt to higher per capita energy utilize. In Malaysia, the domestic area has been viewed by researchers as an important target group for energy management. The energy use of the residential sector represents around 15% of that devoured by all sector, energy consumption in the household segment has turned out to be critical on the grounds that the expansion of energy consumption will go about as a noteworthy danger to the maintainability where it will expand the CO2, and will create major worldwide issues like nursery gas impact, ozone layer exhaustion and corrosive rain (Siti et al. 2015) .

The most common reason why the energy conservation is high is the user didn't alert when the usage of electricity high. Family members or household need to learn about how to save energy and also need to be uncover on how to use energy efficiently, the users must find the alternative to decrease energy consumption for example by using technology (Siti et al. 2015).

1.3 Objective

1. To design device that can measure electricity usage.
2. To design the computing, data transfer between microcontrollers to Android Apps by Bluetooth.
3. To send the trend and data in LCD monitor, Android Apps and Google spreadsheet.
4. To integrate all circuits to become the complete monitoring system.

1.5 Scope

Display power consumption and bill amount.

The current clamp sensor will measure electrical load and generate output that. This sensor will measure the current flow through it. The winding current act as and react to the magnetic field around the sensor, that carrying conductor. Therefore, the data will send to microcontroller and produce an output (display) for the user. It will display power consumption and bill amount by setting the calculation and instruction in the microcontroller.

Display the output from the smartphone Google spreadsheet, Android Apps and LCD display.

Arduino Yun is an open-source prototyping and programming platform. Its can connect the hardware and software to become a complete system. Arduino yun microcontrollers can read inputs from the current sensor and turn it into digital input to monitor as output by using monitoring system. The system will compute a set of instructions on the board the microcontroller and will run the process based on programming. Arduino Yun allows

Wi-Fi communication, by using this microcontroller it will send the data that generated from the programming to the Google spreadsheet.

Bluetooth is a popular method of communication between devices. Smartphones have the capability to communicate using Bluetooth. So this system will monitor by the Smartphone Apps. Bluetooth terminal is a based application to monitor the data and Bluetooth module as a device to send the data.

Transmit power consumption bill through google account.

After microcontroller receive the data, it calculates the current usage and bill by following the instruction to be set in the microcontroller then the set of data are sent to the LCD monitor, Android Apps, and Google Spreadsheet.

Calculate tariff and usage.

After the sensor detects the current Irms(A) the value of Irms(A), the power consumption is calculated by using the calculation provided by Tenaga Nasional Berhad.

1.6 Conclusion

To conclude this project report consists of five major chapters. This chapter gives general overview of the entire project. It explains the synopsis of the project. It discusses more on the objective, scope, applications and advantage of this project.

The next chapter is literature review, the theory that will be discusses from the related research Development of Smart Domestic Electricity Monitoring System to get idea for complete this project to be complete monitoring system. The methodology and procedures applied in the project are clarified in detail in Chapter 3. This chapter also discusses theory of the element uses in this project.

CHAPTER 2
LITERATURE REVIEW

2.0 Overview

This chapter literature review was about summarized the whole of the project to obtain the realistic information for this project. The main sources for this project are previous projects carried out by engineers and other sources such as books, journals, articles and other reliable sources related to this project. This chapter also explains about related research which being conducted from previous projects.

2.1 Introduction to Monitoring System

Monitoring is the regular observing and recording of actions and reaction taking place in a system. It is a process of routinely gathering information on all aspects of the project. The overall system needs to monitor several kinds of data. The data can divide into two kinds; they are 1) the analog signal and 2) the digital signal. From the study many of the implemented systems and projects of smart monitoring for electricity are focus on measuring the total amount of energy consumption or electricity at a home. The system communication based on data exchange (Kim et al. 2011).

2.1.1 Variant of Electricity Monitoring System

Recent research shows that the main component of this system is microcontroller and act as brain of the system. A microcontroller is very basically simple. It contain small computer (SoC) on a single integrated circuit containing a processor, memory, converters, timers and programmable input/output peripherals. The program of a memory is in the form of Ferroelectric RAM, NOR flash or OTP ROM is also often included on chip, as well as a typically small amount of RAM. Microcontrollers are designed for embedded applications, in dissimilarity to the microprocessors used in personal computers or other general drive applications that contain various discrete chips.

Then the current sensor will collect and measure the value current flow. Fundamentally, there are two sorts of current detecting technique which is invasive and non-invasive. From the study of invasive system, the sensor is straight forwardly associated into the mains. Some common invasive current sensors are one-axis Hall Effect sensor, a simple inductor with a high inductance value, resistor, solid core CT and so forth. From the non- invasive method, direct association with the mains is stay away from. Some non-invasive sensors are split core current transformer, Hall effect sensor and so forth (Guimarães et al. 2015).A Hall effect sensor is a transducers that varies its output voltage in response to a magnetic field. The advantage of this sensor it can be used as proximity switches, speed detection, positioning, and current sensing application. The working principle of this sensor its operates as analog traducer and directly turning it to the voltage. The distance from the Hall plate can be determine by knowing the magnetic field. The relative position of the magnet can be deduced by using a group of sensors (Paun et al. 2013).Current transformers sensor are devices used to measure the large primary currents to a smaller.

2.2 Previous Related Project

Since 20th century there are many developments of the electricity monitoring system. Basically, smart online electricity monitoring system refers to intelligent communication between the monitor with sensor. Sub topic 2.2.2.1 to 2.2.2.5 shows that the previous research of the electricity monitoring system.

2.2.1 Design and Development of GSM based Energy Meter

This project present of plan and improvement of Automatic meter perusing (AMR) framework. Amr framework is a blast for remote checking and control residential energy meter. The AMR framework give the data of meter perusing, control cut, add up to stack utilized, control disengage and treating the demand or frequently in specific interim through SMS. This data being sent and got by the concerned energy company provider with the assistance of Global framework for versatile correspondence(GSM) organize. Energy provider receive the meter reading within a second without going on individual. Microcontroller At89s52 is used for controlling of complete AMR system and GSM module. AMR minimize the quantity of conventional visits required by employs of energy provider company. This framework decrease the work cost,, but also increase the meter reading accuracy and save time.

2.2.2 Real-time Energy Monitoring and Controlling System based on ZigBee Sensor Networks

This project proposed an energy management and controlling system. Based odf this project is wireless sensor network. The proposed of this projects is compose of two main parts, which is wireless sensor network and intelligent home gateway.