UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Design and Development Of Home Energy Monitoring System Using PIC For Energy Consumption Awareness

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

by

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

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DECLARATION

I hereby, declared this report entitled “Design and development of home energy monitoring system using PIC for energy consumption awareness” 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 Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Electrical Engineering Technology (Industrial Power) with Honours. The member of the supervisory is as follow:

……

(Halyani Binti Mohd Yassim)

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ABSTRACT

The purpose of this project is to giving energy consumption awareness to electricity consumer in Malaysia. Nowadays, the climate is changing and the earth is warming up. The weather in Malaysia is on a topsy-turvy situation. The country is getting increasingly hot compared to the years before. One of the reasons is global warming. It is caused by emission of carbon dioxide (CO2) to the atmosphere. One of the main sources is conventional power plants. To overcome this problem, a home energy monitoring system will be developed. The system will display additional information such as Ringgit Malaysia that been converted from kWh and percentage of carbon dioxide per kWh emitted to the atmosphere. The more electricity is consumed, the more carbon dioxide will be released from conventional power plants. Hence, this project will help consumer to giving awareness in their daily electrical consuming.

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ABSTRAK

Tujuan projek ini adalah untuk memberi kesedaran penggunaan tenaga kepada pengguna elektrik di Malaysia. Pada masa kini, iklim berubah dan suhu bumi pun berubah. Cuaca di Malaysia berada pada keadaan yang kucar-kacir. Negara ini semakin semakin panas berbanding tahun-tahun sebelum ini. Salah satu sebab adalah pemanasan global. Ia adalah disebabkan oleh pelepasan karbon dioksida (CO2) ke atmosfera. Salah satu punca utama adalah loji kuasa konvensional. Untuk mengatasi masalah ini, satu sistem pemantauan tenaga rumah akan direka. Sistem ini akan memaparkan maklumat tambahan seperti Ringgit Malaysia yang telah ditukar dari kWh dan peratusan karbon dioksida per kWh dilepaskan ke atmosfera. Lebih banyak elektrik digunakan, lebih banyak karbon dioksida akan dikeluarkan dari loji kuasa konvensional. Oleh itu, projek ini akan membantu pengguna untuk mengawal di memakan harian mereka elektrik serta mengurangkan pelepasan karbon dioksida daripada loji kuasa.

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DEDICATION

This report is specially dedicated to all those who have supported, encouraged, challenged and inspired me and specially to my beloved family, honorable tutor and friends for all their guidance, love and attention which made it possible for me to make it up to this point.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

AWER	–	Association of Water and Energy Research Malaysia (AWER)
CO2	–	Carbon Dioxide
DC	–	Direct Current
FKE	–	Faculty of Electrical Engineering
GST	–	Goods and Service Tax
h	–	Hour
I	–	Current
IP	–	Internet Protocol
IEEE	–	Institute of Electrical and Electronics Engineers
LCD	–	Liquid Clear Display
LED	–	Light Emitting Diode
kWh	–	Kilowatt Hours
kW	–	Kilowatt
kVar	–	Reactive Power
kVa	–	Apparent Power
KWTBB	–	Kumpulan Wang Tenaga Wang Baharu
NO2	–	Nitrogen Dioxide
P	–	Power
Pf	–	Power Factor
PC	–	Personal Computer
RM	–	Ringgit Malaysia
RS	–	Recommended Standard
RF	–	Radio Frequency
SESB	–	Sabah Electricity Sdn Bhd
SEB	–	Sarawak Energy Berhad
SEDA	–	Sustainable Energy Development Authority
SO2	–	Sodium Dioxide
TNB	–	Tenaga Nasional Berhad

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UTeM	–	University Technology Malaysia Malacca
V	–	Voltage
%	–	Percentage

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CHAPTER 1
INTRODUCTION

1.1 Introduction

A home energy monitoring system is a system provides feedback on electrical energy use. Normally a home energy monitoring system includes sensors, a data gateway, and a display to receive and view the information. Standard information includes energy consumption in kilowatt-hours (kWh) and power draw in kilowatts (kW). The devices can also identify the highest electricity loads in your household, and estimates the amount of carbon dioxide emission in percentage. If you want to use energy data to reduce energy usage and electrical bill, a home energy monitoring system is the right choice.

There are two types of electricity meters used by the companies utility nowadays namely electromechanical and electronic meter. These meters are also available in single or three phase basis. The display can take in many forms, for example, cyclotype, digital and dial type registers. In Malaysia, Tenaga Nasional Berhad (TNB) is the whole certified power provider, installer and maintainer of these meters. Besides that, they are also in charge of gaining the power consumption and applying appropriate charges according to certain tariff to their users.

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1.2 Problem Statement

Traditionally, the energy consumption information is collected by meter-readers on their monthly visits to the premises. Therefore, this method of gaining information of electricity consumption has some disadvantages for consumer such as unawareness of high electricity bill. This is due to overusing or wasting of electrical energy in daily life. Consumer will only realise the wasted energy they used at the end of the month.

Impact from this event, power plant are more likely supplying more electricity generation to consumer. The more electricity generated, the more power plant with gas and diesel generator emits carbon dioxide (CO2) to the ozone layer. This cause a phenomenon called global warming.

Global warming is worst year by year as we can see the country temperature is getting hot compared to the year before. This lead to El Nino phenomenon. El Nino is a periodic occurrence where the sea surface temperatures in the central and eastern Pacific Ocean become warmer. This phenomenon happens at irregular intervals of two to seven and last for as long as half a year to two years when it occurs.

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1.3 Objectives

The objectives of this project are:

i) To conduct residential energy consumption survery in Melaka.
ii) To develop a home energy monitoring system at home to give awareness to all consumers.
iii) To analyze the reading accuracy of home energy monitoring in term of Ringgit Malaysia (RM) and Carbon Dioxide (CO2) emission.

1.4 Scope of Project

The scopes of this project include:

i) Conducting studies on theoretical of a electrical meter based on how kWh is calculated.
ii) Design and develop a home energy monitoring system that can display daily/monthly electricity cost in Ringgit Malaysia (RM) and percentage of carbon dioxide (CO2) emission.
iii) Conducting a residential energy consumption survey in Melaka (50-100 respondent).

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1.6 Report Outline

This report contains of five chapters. A briefly outline of the contents of the project is organised as follows:

Chapter 1 discuss the project background and the problem statement of this project. This chapter also shows the objective and scope of this project.

Chapter 2 discuss about the literature review for this research. This including overview on home energy monitoring past project and software review that been used in collecting energy data from electric meter.

Chapter 3 discuss about the methodology of this project. The flowchart will describe all the activities that will be carried out. This chapter will also show the general block diagram of project and the survey conducted. The selection of hardware will be also choosen in this chapter.

Chapter 4 will be the software and hardware development. This include the circuit simulation, designing program code and developing circuit. A product will be produced and further hardware functionality will be tested until its perfection.

Chapter 5 shows the discussion, conclusion and further recommendation of the research.

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CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

Literature review is a process of collecting and analysis data and information which are relevant to this study. The required data and information can be collected through variable sources such as journals, articles, reference books, online database and others. This chapter has two main reviews. The first part will be a case study on previously done projects that relates to this project. The second part will be focused on the theory aspects of this project.

2.2 Overview on Past Projects

2.2.1 Digital Household Energy Meter

The Digital Household Energy Meter project, presented in 2nd Engineering Conference on Sustainable Engineering Infrastructures Development & Management, Kuching, Sarawak, Malaysia (Nor'aisah Sudin, Mohd Zeid Abu Bakar and Mohd Helmy Abd Wahab, 2008). The auther state that the prototype is combined with an interval meter, Mk 6 Genius electric meter that is able to measure the energy consumption in a specified period of time through an optical serial communication probe that is IEC1107 FLAGTM compatible to a central computer for processing. The serial port analog to digital converter was used in the communication system and attached to the computer through RS-232 interface. The computer will then display the electrical consumption pricing in a display panel. Microsoft Visual C++ is used as the development platform specifically for the data processing and user interface design. The prototype was intended to compensate the current system and able to give

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accurate, reliable and instantaneous meter reading and display the users' electrical consumption in terms of price unit.

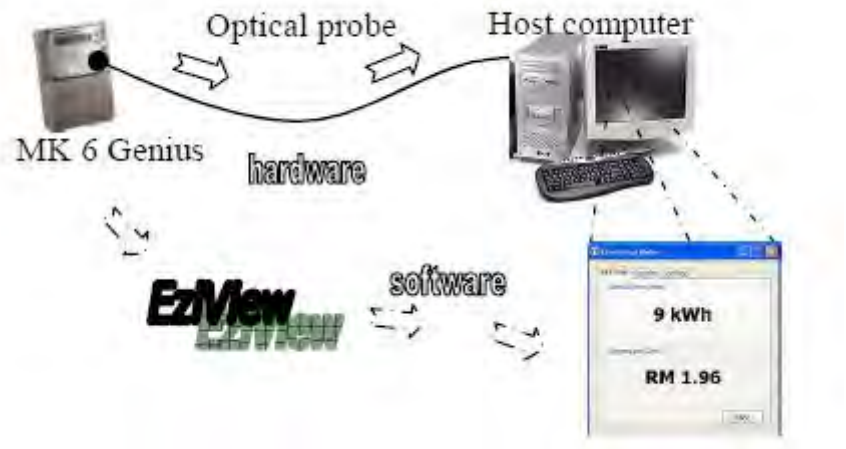

Figure 2.1: System Architecture (Nor'aisah Sudin, Mohd Zeid Abu Bakar and Mohd Helmy Abd Wahab, 2008)

2.2.2 Design and Implementation of a Home Energy Monitoring System Using LabView

Another project use labview to create a home energy monitoring system communication between LabVIEW and ATmega32 using the serial interface or Bluetooth module to help consumer in monitoring power consumption for plotting recent and historical data to reduce energy usage and planning of energy consumption (Loo Hoe Fieh, 2013). Figure 2.2 shows the overall view of the project.

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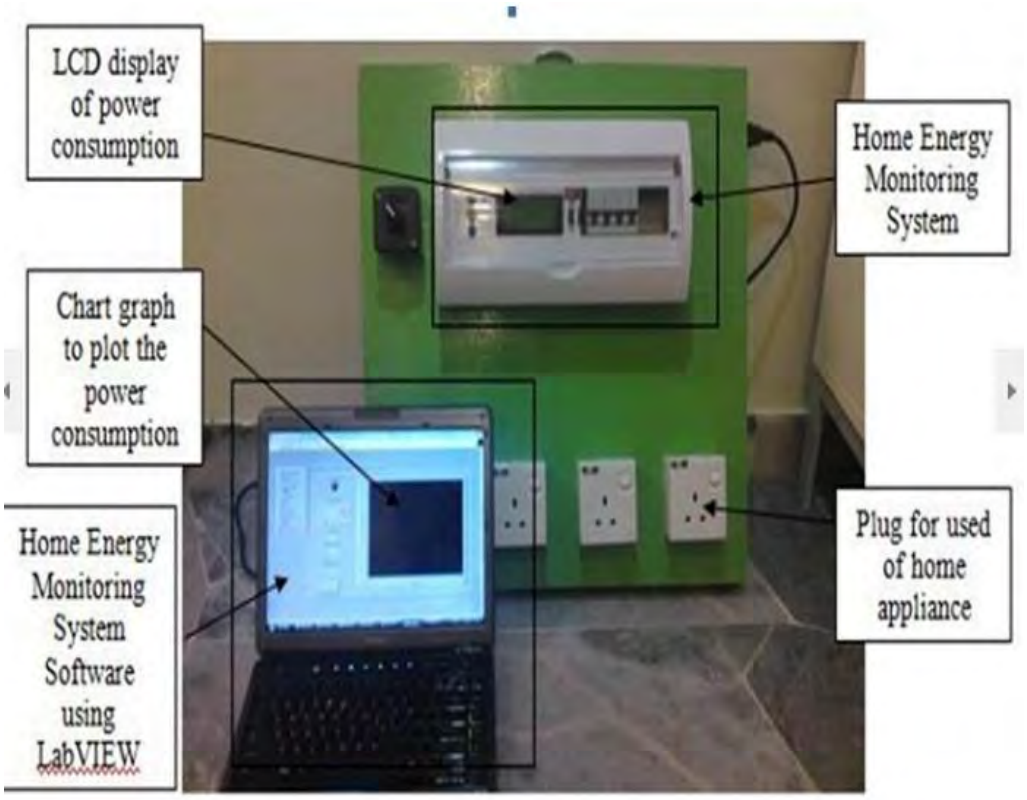

Figure 2.2: Overview of Design and Implementation of a Wireless Automatic Meter Reading System (Loo Hoe Fieh, 2013).

The home energy monitoring system in(Figure 2.2) is placed inside the fuse box casing. The ATmega32 microcontroller will measure the power consumption and a real-time clock will keep recording data of the power consumption. The RS232 serial communication standard and the Bluetooth module will transmit the data to the computer from inside the casing. When the user plugs home appliances in and switches them on, they will be powered by the electricity supply.

The power consumption will be calculated by the home energy monitoring system as the electricity flows through it. Serial communication and the Bluetooth module is used to transmit the data to a computer that running the home energy monitoring system LabVIEW software. LabVIEW is use to received the data and data will be presented in graph so the consumer can easily understand their power consumption.

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