SMART ENERGY METER

KHAIRIL AIZATT BIN MOHAMMED

This report is submitted in partial fulfillment of the requirements for the award of Bachelor of Electronic Engineering (Industrial Electronics) With Honors.

Faculty of Electronic and Computer Engineering
Universiti Teknikal Malaysia Melaka

MAY 2008

UNIVERSITI TEKNIKAL MALAYSIA MELAKA
FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek : Smart Energy Meter

Sesi Pengajian : 2007/2008

Saya KHAIRIL AIZATT BIN MOHAMMED mengaku membenarkan Laporan Projek Sarjana Muda ini disimpan di Perpustakaan dengan syarat-syarat kegunaan seperti berikut:

1. Laporan adalah hakmilik Universiti Teknikal Malaysia Melaka.
2. Perpustakaan dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan laporan ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. Sila tandakan (√):

☐	**SULIT***	(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)
☐	**TERHAD***	(Mengandungi maklumat terhad yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)
☑	**TIDAK TERHAD**	

Disahkan oleh:

(TANDATANGAN PENULIS)

Alamat Tetap: NO. 14 JALAN USJ 5/1E,
UEP SUBANG JAYA,
47600 SELANGOR D. EHSAN

Tarikh: 09 MEI 2008

(COP DAN TANDATANGAN PENYELIA)

PROFESOR ABDUL HAMID B HAMIDON
Profesor
Fakulti Kej Elektronik dan Kej Komputer (FKEKK),
Universiti Teknikal Malaysia Melaka (UTeM),
Karung Berkunci 1200,
Ayer Keroh, 75450 Melaka

Tarikh: 09 MEI 2008

"I hereby declare that this report is the result of my own work except for quotes as cited in the references."

Signature : .....

Author : Khairil Aizatt Bin Mohammed

Date : 09 MEI 2008

"I hereby declare that I have read this report and my opinion this report is sufficient in terms of the scope and quality for the award of Bachelor of Electronic Engineering (Industrial Electronics) With Honors."

Signature : .....

Supervisor's Name : Mr. Prof Abd Hamid Bin Hamidon

Date : .....

PROFESOR ABDUL HAMID B HAMIDON
Profesor
Fakulti Kej Elektronik dan Kej Komputer (FKEKK),
Universiti Teknikal Malaysia Melaka (UTeM),
Karung Berkunci 1200,
Ayer Keroh, 75450 Melaka

This project is dedicated to my beloved parents, Mohammed Abdullah Allahyarhamah Hajah Siti Aminah, my family members and Ida Fadzlina. Also to my coursemate, especially my housemate and supervisor Mr. Prof Abd Hamid Bin Hamidon.

ACKNOWLEDGEMENT

First of all, I would like to thank Allah the All Mighty, which with his bless, I manage to complete this thesis. This project is inspired from John Clarke, one of the magazine writer 'Everyday Practical Electronic'.

I would like to express my greatest gratitude and sincere thanks to my supervisor, Mr. Prof Abd Hamid Bin Hamidon, for accepting me as his project student and for his valuable ideas, advice and help in the supervision and discussions of this Final Year Project. In fact, he gave me guidance when obstacles arise throughout this period of time. Once again, I thank him for his tolerance and endeavors.

I am especially grateful to my beloved father, mother, and members of my family, for all their support and understanding along my study. Lastly, my grateful goes to all my colleagues who give me guidance and help in completing this project.

ABSTRACT

This project is to design and construct an energy meter. Normal energy meter show the amount of kilowatthour used but do not show estimated cost of electricty used. The meter just show you the kilowatthour that had been used for the whole month. This project is inspired by John Clarke, one of the magazine writers for 'Everyday Practical Electronic'.This project can help electrical appliance users to see the amount of kilowatthour that had been used.

Every country has a different calculation of tariff for electricity, in Malaysia the first 200 kilowatthour is 0.218 cents, but after first 201 kilowatt the tariff is 0.289 cents. Even though cost appears cheap, at the end of the month, the amount of electricity used is high. This is because the electricity is used everyday, and sometime we do not realize the amount that we have actually used. As an electrical user, we have to use the electricity wisely to control electrical wastage even we can afford to pay.

The energy meter is based on a special Active Energy Metering IC from Analog Device, ADE7756AN. PIC16F628A will derive the digital data and convert kilowatthour into Ringgit Malaysia and display it on LCD panel.

ABSTRAK

Projek ini adalah untuk mereka dan membina sebuah meter elektrik. Meter elektrik yang biasa digunakan sekarang hanya menunjukkan jumlah kilowatt yang telah dipakai tetapi tidak boleh menunjukkan sebarang kos anggaran penggunaan tenaga elektrik. Projek ini di ilhamkan daripada John Clarke, salah seorang penulis majalah 'Everyday Practical Electronic'. Projek ini juga direka untuk membantu pengguna barang elektrik untuk melihat jumlah kilowatt yang telah digunakan.

Setiap negara mempunyai tarif elektrik adalah berbeza, di Malaysia setiap 200 kilowatt pertama adalah 0.219 sen, manakala selapas 201 kilowatt pertama, kadar tarif adalah 0.289 sen. Walaupun nampak seperti murah, tetapi di akhir bulan, jumlah kilowatt yang diguna adalah tinggi, dan kadang-kadang kita hampir tidak percaya dengan jumlah kilowatt yang telah digunakan. Oleh kerana itu, sebagai pengguna, kita haruslah berjimat cermat untuk mengawal penggunaan tenaga elektrik walaupun kita mampu untuk membayarnya.

Projek ini berasakan kepada sebuah IC khas yang dapat membaca tenaga yang digunakan. PIC16F628A akan mengambil data tersebut dan menukarkannya kepada Ringgit Malaysia dan seterusnye memaparkan keatas sebuah panel LCD.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATION

RM	Ringgit Malaysia
kwH	kilowatt Hours
LCD	Liquid Clear Display
IC	Integrated Circuit
PIC	Peripheral Integrated Controller
RAM	Random Access Memory
EEPROM	Electrically Erasable Programmable Read-Only Memory
I/O	Input / Output
V	Voltage
AC	Alternating Current
DC	Direct Current
MHz	Mega Hertz
PCB	Printed Circuit Board
UV	Ultra-Violet
RMS	Root Mean Square
SSOP	Shrink Small-Outline Package
DIP	Dual in-line Package

LIST OF APPENDIX

CHAPTER 1

INTRODUCTION

This project is to design a meter that measures the power used by an appliance. The meter will display the amount of energy used and the estimated cost.

1.1 Project Introduction

This project is to design a meter that measures the power used by an appliance. The meter will display the amount of energy used and the estimated cost. This meter can be used to monitor the electricity used and can help economise the electricity bill.

If we want to save power and reduce costs, we need to know how much each appliance uses over a period of time. Most of the appliances do not run all the time so we need to know the power they used while they are actually running and how much they used over a longer term.

The easiest way to determine that is to use an electronic power meter (this energy meter). Its displays the measured power in Watts, the elapsed time and the total energy usage in kWh. In addition, it can show the energy cost in RM or cents.

1.2 Project Objectives

To design and construct an energy meter that can convert kilowatt/hour into estimated cost.

1.3 Problem Statement

House owner cannot estimate the cost of electricity used. With normal energy meter, house owner can only read the kilowatt/hour without knowing the estimated cost.

Landlord cannot tell which tenant used the most electricity. If one house has 2 or 3 tenant, landlord cannot know which one tenant is using the most electricity. The bill has to separate nicely according to which tenant that using the most electricity power.

Users of appliances cannot tell which appliance consume the most power. If we can design or construct an energy meter that can show the cost of electricity in kwH is used, then the problem stated above can be solve.

1.4 Project Scope

The project scopes are:

i. To understand how energy meter works.
ii. To understand the conversion of kwH to cost in RM.
iii. To program the translation of kwH into cost.
iv. To display cost using an LCD module.
v. To fix the meter at various relevant points of the home electricity distribution.

This project will cover the design and construction of an energy meter that transfers kwH into estimated cost.

1.5 Hardware Design

The circuit for Energy Meter is based on a special 'Active Energy Metering IC' from Analog Devices, the ADE7756AN. The internal operation of this IC is quite complicated and it has a host of features, some of which are not used in this design. The Energy Meter is housed in a rugged plastic box or card box with a clear lid. This plastic case is important because the internal circuitry operates at mains potential. Two 10A mains leads are fitted to the unit – one to supply power from the mains and the other to supply power to the appliance.

The unit designed should be easy to use by simply plug it into the mains and plug the appliance into the output socket. Most of the features and adjustments available in the ADE7756AN IC are accessed via a serial interface. This communications interface allows various registers to be accessed and altered and also allows them to receive processed data.

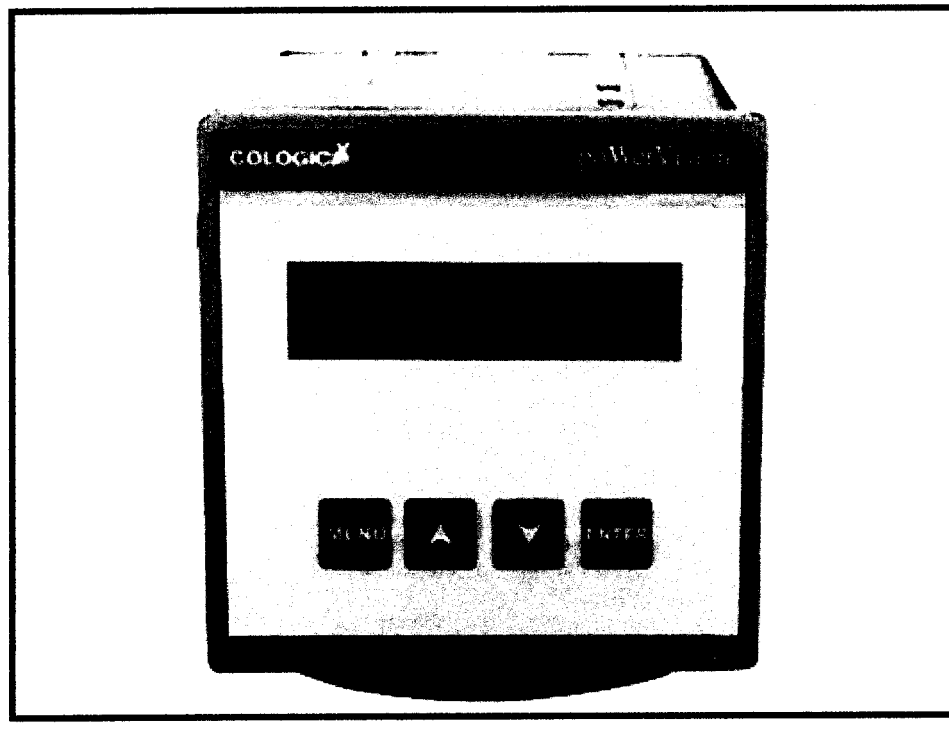

Figure 1.0 Sample of Energy Meter[1]

[1] Picture from: http://product-image.tradeindia.com/00139173/b/Energy-Meter.jpg

1.6 Software Development

A PIC will be programmed in to some source code that will be written in .hex coding. The program will calculate the kilowatt/hour then convert into the total estimated amount Ringgit Malaysia that we have been used.

An LCD display is visible through the lid of the case and the only exposed parts are four mains-rated switches. These switches are used to set the display modes, reset values and (initially) to set the calibration values. In use, the Energy Meter is simply connected in-line between the mains supply and the appliance to be monitored. The LCD shows two lines of information and this information includes: (1) the elapsed time; (2) the power consumption in watts; (3) brownout indication; and (4) the energy consumption in kWh (kilowatt-hours). The elapsed time is shown in the top, left-hand section of the display and is simply the time duration over which the energy has been measured.

1.7 Methodology

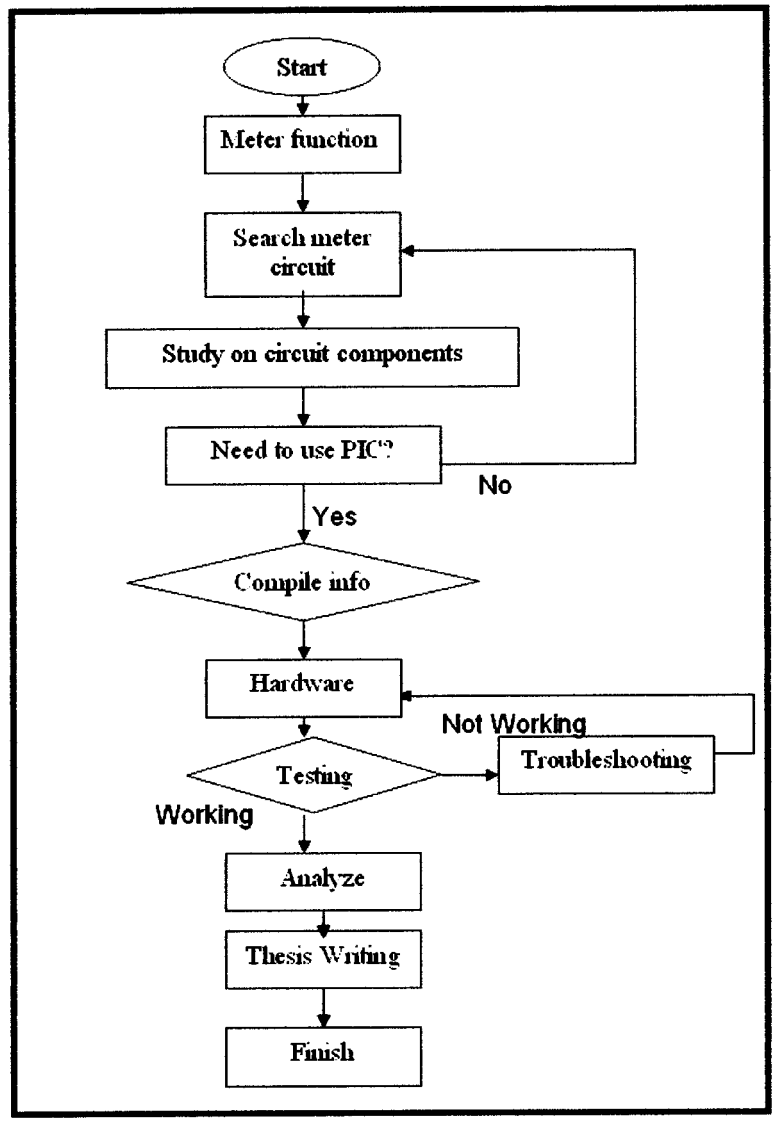

Figure 1.1 Methodology of report

Basically this energy meter has four stages, first the input, then an analog to digital converter, which is ADE7756AN. Then after the data been converted, PIC16F628A will translate the data from kwH to RM and display the cost on an LCD panel.

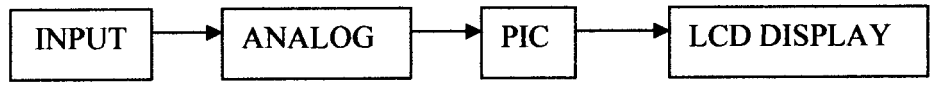

Figure 1.2 Block diagram of process Energy meter.

1.8 Report Structure

This report will be divided into five chapters where the first chapter is project introduction. The second chapter is on background study that will explain the theory and procedure used in the project. The third chapter is mostly about the project methodology, the components used and the implemented design

CHAPTER 2

LITERATURE REVIEW

Energy Meter is simply connected in-line between the mains supply and the appliance to be monitored. The LCD shows two lines of information and this information includes: (1) the elapsed time; (2) the power consumption in watts; (3) brownout indication; and (4) the energy consumption in kWh (kilowatt-hours). The unit is easy to use: simply plug it into the mains and plug the appliance into the output socket.

2.1 Microcontroller

Microcontroller that is used is PIC where PIC stands for Peripheral Integrated Controller. PIC is a family of Harvard architecture microcontrollers made by Microchip Technology, derived from the PIC1650 originally developed by General Instrument's Microelectronics Division. PICs are popular with developers and hobbyists alike due to their low cost, wide availability, large user base, extensive collection of application notes, availability of low cost or free development tools, and serial programming (and re-programming with flash memory) capability.

2.1.1 PIC16F628A

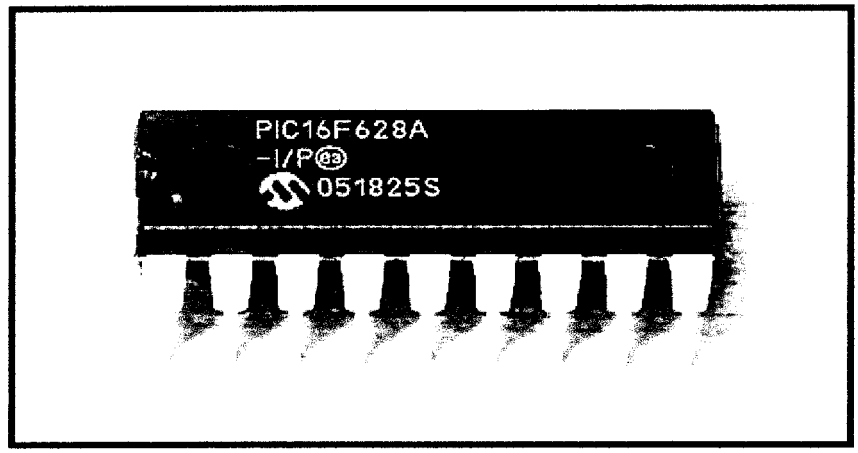

Figure 2.0 PIC16F628A[1]

PIC that is used in the circuit is PIC16F628A. PIC16F84 belongs to a class of 8-bit microcontrollers of RISC architecture. The two most important features are that there is 2k of program memory and 224 Bytes of RAM. This last one is nearly four times as much as the 16F84 and for high level language use this makes it much easier to use as it is the resource that you run out of most quickly. [1]

This PIC use flash memory for program memory for storing a written program. Since memory made in FLASH technology can be programmed and cleared more than once, it makes this microcontroller suitable for device development. Instead of EEPROM. RAM is data memory used by a program during its execution. In RAM are stored all inter-results or temporary data during run-time. PORT A and PORT B are physical connections between the microcontroller and the outside world. Port A has five, and port B has eight pins. It features a wide voltage range, low power consumption, 3 internal timer, and PIC I/O controls. This PIC has 18 pins. Figure 2.1 below is the pin diagram for PIC16F628A. [2]

[1] Picture from: http://electronics-diy.com/store/pic16f628a.jpg