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FACULTY OF ELECTRICAL ENGINEERING**

FINAL YEAR PROJECT REPORT

COST MONITORING DIGITAL POWER METER

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WITH HONOUR**



UNIVERSITI TEKNIKAL MALAYSIA MELAKA
FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

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PROJEK SARJANA MUDA II

Tajuk Projek : COST MONITORING DIGITAL POWER METER

Sesi Pengajian :

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I declare that this report entitle “Cost Monitoring Digital Power Meter” is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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ABSTRACT

Projek ini dinamakan “*COST MONITORING DIGITAL MULTIMETER*”. *Robot* ini merupakan satu *PROTOTAIIP* yang dapat diaplikasikan dalam sektor industri untuk mengira jumlah kuasa electric dan mengira kos berdasarkan jumlah kuasa elektrik yang telah digunakan. Projek ini telah dibahagi kepada 3 bahagian iaitu *input*, *peripheral interface* dan *output*.

Litar kawalan masukkan kami menggunakan suis tekan sebagai Reset. Litar keluaran kami merupakan *LCD* yang akan memaparkan nilai kuasa elektrik dan kos. Manakala litar kiraan utama kami ialah *PIC16f877A*. Kelebihan menggunakan *PIC16F877A* ini adalah kerana ia mempunyai *I/O PORT* yang banyak berbanding dengan lain. Selain itu *PIC16F877A* juga mempunyai kawalan pada *pwm*, jadi ia sesuai digunakan dalam projek kami kerana litar kami memerlukan ROM yang tinggi untuk menyimpan data.



ABSTRACT

This project is called *COST MONITORING DIGITAL MULTIMETER*. This project is a prototype which can implemented in industrial that can help to calculate total electric power and calculate the cost based on the consumption. This project categorized into 3 parts, which are *input*, *peripheral interface* and *output*.

The input section of our project use's push button as Reset button, while the *output* of our project is LCD that can be seen the total power consumption and the cost base on the power consumption value. The main controller circuit we use as controller is *PIC 16F877A*. The advantages of this controller is, its have many *I/O PORT* than others. Moreover, this controller is suitable because it have more ROM to saving the data.



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CHAPTER 1

INTRODUCTION

1.1 Introduction

Malaysia is toward to a develop country and the utility is becoming very high burden for the public especially to pay the rate of electricity bills. With this, we open this opportunity to develop a new product which can calculate and presented the cost of power electric usage through a display device which is inexpensive, small size and clarity to the users. Elements of electronics hardware, digital system, programming and digital display are applied and combined into our products to make them more easy to use. Industries mostly will spend 24 hours [1] [2] [4] [5] for electricity and home housing mostly will spend an average of 18 hours a day in electricity usage. [2] [3] [4] [6] [7] [8]

Payment of electricity bills usually depends on the usage of the electricity. The more users utilize the electricity, the higher the more the user have to pay for their utility. To create awareness, users need to have a system where it can monitor the usage of the electricity. Based on this idea, Cost Monitoring Digital Power Meter device will be designed and developed. This device will measure the usage of electric power and calculate the cost of the electricity used daily for instances in houses or factories. This system will indirectly help the users to monitor the usage in electricity which will help them to control and overcome any wastage.

The main purpose of the product is to overcome the electricity wastage by giving awareness for the users by monitoring and keep track on their daily power usage. Power Consumption Meter is an automatic system to calculate the cost base on electric power unit that is used by electricity users.

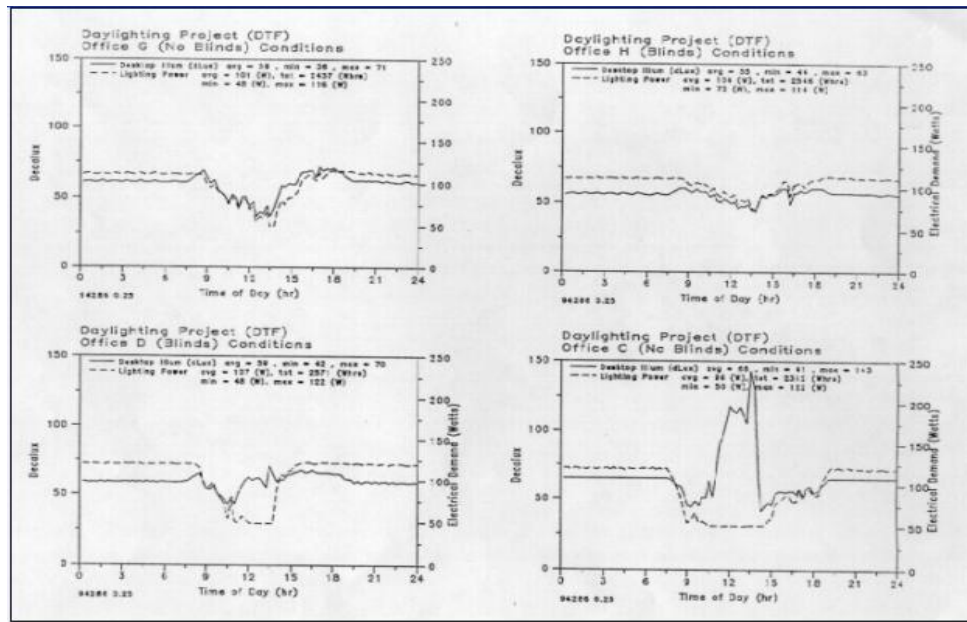


Figure 1: electric usage in industry.

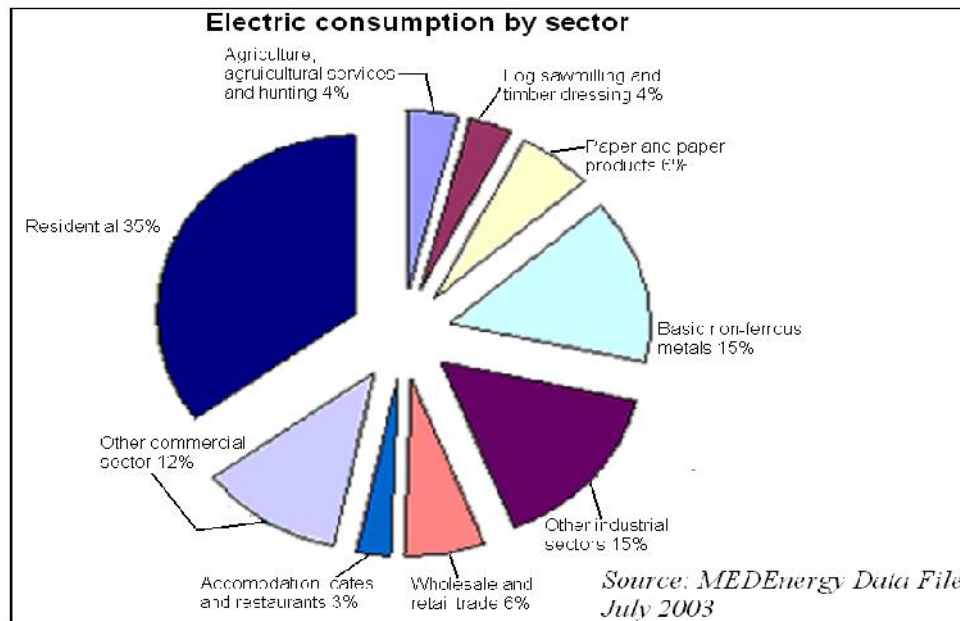


Figure 2: electric consumption by industry.

From the figure 2 the largest users of electricity in the industrial sector were basic non-ferrous metal products that is 17.9PetaJoule. For agriculture, agricultural services and hunting is 5.0PetaJoule, log saw milling and timber dressing was 4.4PetaJoule, and paper and paper products were 7.0PetaJoule. Wholesale and retail trade were the largest commercial users, which is 7.6PetaJoule, accommodation,

cafes and restaurants is 3.6PetaJoule and finance, insurance, property and business services is the less, it was 3.5PetaJoule. [5]

*peta= 10^{15}

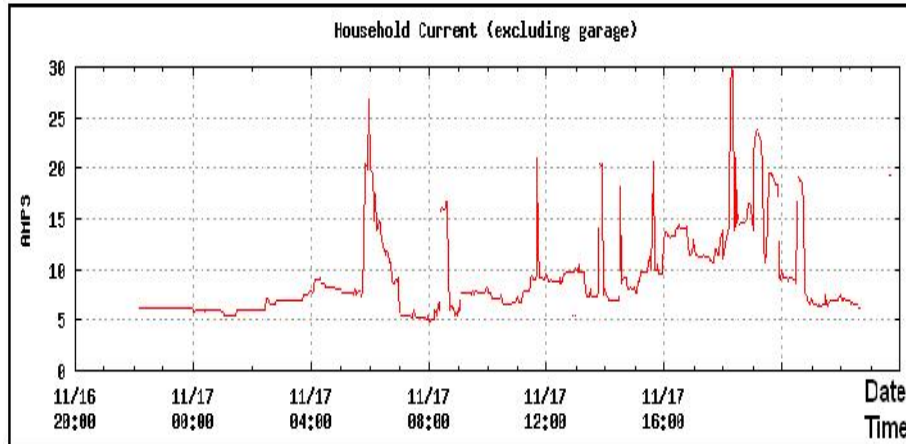


Figure 3: electric usage in home housing.

Figure 3 is a graph that is showing about the electric power consumption of a home housing in US, the graph show the electric consumption time is about 16hours and it starting increased from time 4am then it is slightly decreased from 4am till 6am, then it is increased highly from 6am when people is rushing for school and work, but it dropped about 1hour after that. Then the consumption starting increased again on 8am till it reaches the maximum because of daily activities then it is slightly decreased till rest time that is 9pm. [7]

This system will indirectly help the users to monitor the usage in electricity which will help them to control and overcome any wastage. Therefore the purpose of this project is to overcome the electricity wastage by giving awareness for the electricity users by monitoring and keep track on their daily power usage. With this system, it can help industries and home housing save a lot of money for paying the electric bills by monitoring and planning their daily spend for the electric power usage. Because of the unstable economic flowed many of individual, private and also government needs this technologies in term of reducing their bill payment.

As we know the electrical energy consumption is proportional towards the usage of electrical devices. The higher the usage of electrical devices, the higher the electrical power used which will lead to higher bill costing. Users do not realize that if they did not switch off the electrical devices, this will lead to the increment of the

electrical billing cost. Hence a bill monitoring electric power meter is developed to monitor the usage and spending of electricity. [9] [10]

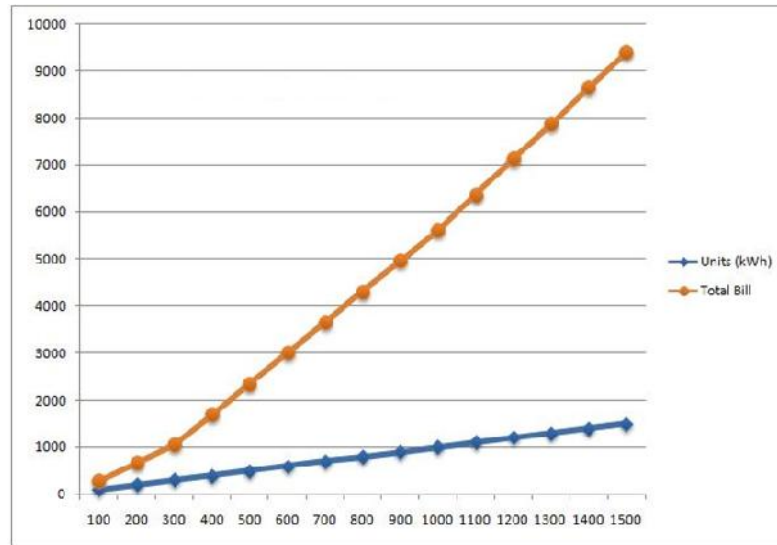


Figure 4: electrical energy consumption is proportional towards the usage of electrical devices.

The concepts of this system is each time the electricity users is using the electricity, the LCD display will show the cost, and digital counter will show the unit of power that have been used by the user. All information and notification will be shown on the LCD displays. By using this product, users are able to manage their electricity consumption in daily used. Customer can compare the original meter reading from supplier with our product to ensure either the usage is synchronized.

The monitoring power meter are able provide information about power flow and demand and help identify the total of the cost. Effective monitoring programs are important for power reliability assurance for both utilities and customers. While power quality problems can and do occur on utility power systems, many surveys have shown that most customer power quality problems originate within the customer facility.

With this in mind, it is clear that monitoring is essential for both power suppliers and users to ensure optimal power system performance and effective energy management. Cost Monitoring Digital Power Meter can provide information about power flow and demand and help identify the cause of power system disturbances. It can even help identify problem conditions on a power system before they cause interruptions or disturbances. Effective monitoring programs are

important for power reliability assurance for both utilities and customers. While power quality problems can and do occur on utility power systems, many surveys have shown that most customer power quality problems originate within the customer facility.

With this in mind, it is clear that monitoring is essential for both power suppliers and users to ensure optimal power system performance and effective energy management. Metro Power Enterprise offers product to help users monitor and manage power system. These solutions provide powerful access and analytical capabilities along with event notification, with a high degree of flexibility.

1.2 Background of problems

As we know, the electrical energy consumption is proportional towards the usage of electrical devices. The higher the usage of electrical devices, the higher the electrical power used which will lead to higher bill costing. Users do not realise that if they did not switch off the electrical devices, this will lead to the increment of the electrical billing cost. Hence, Cost Monitoring Digital Power Meter is developed to monitor the usage and spending of electricity.

This system will indirectly help the users to monitor the usage in electricity which will help them to control and overcome any wastage. Therefore the purpose of this project is to overcome the electricity wastage by giving awareness for the electricity users by monitoring and keep track on their daily power usage. With this system, it can help industries and home housing save a lot of money for paying the electric bills by monitoring and planning their daily spend for the electric power usage. Because of the unstable economic flowed many of individual, private and also government needs this technologies in term of reducing their bill payment.

1.3 Objectives

The objectives of this project are:

1. To study on the users comment on increase of electricity billing cost.
2. To design a system that will monitor the usage of electrical energy being used by users.
3. To design a system that calculates the payment for the electrical energy being used by users.
4. Electric users can plan out on their daily power usage by monitoring the cost that is show by the device.

1.4 Scope

Firstly, the electric power from Tenaga Nasional Berhad (TNB) will be sent to electrical power meter located at the user's house or factories. The input power that is sending by Tenaga Nasional Berhad (TNB) will connected through the meter then electric power will be converting to digital waveform to peak the clock of the counter, and then the counter will show the units of the power that is used by the user through the LCD display. The digital data that is from step up counter will be transferred to the PIC16F877 microcontroller [11] [12]. The digital data that was transferred to PIC16F877 microcontroller will be analyzed and the cost will be calculated based on the program which was integrated in the PIC16F877, The cost of the units based on the electric power will be shown in LCD [13] [14]. This can be seen in Figure 5.

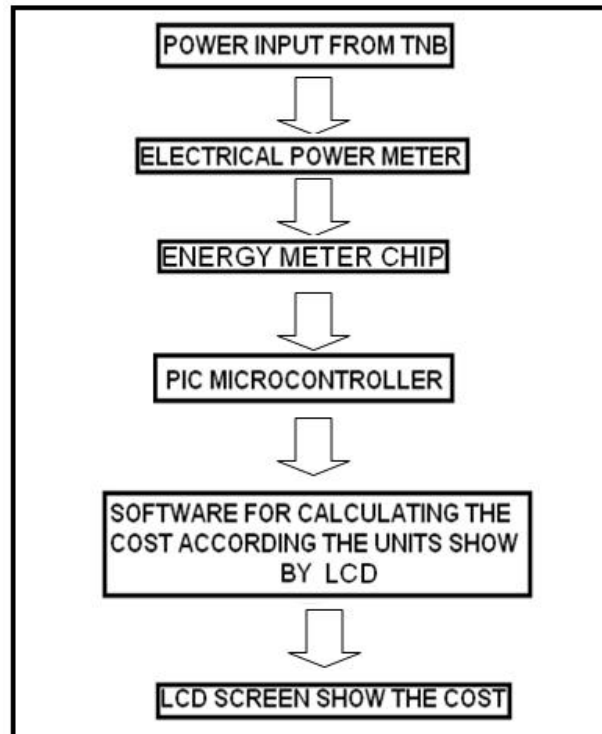


Figure 5: System Flow

1.4.1 Flow of the System

PIC16F877 is one of the most commonly used microcontrollers especially in automotive, industrial, appliances and consumer applications. In this section, properties of PIC16F877 microcontroller, CCS compiler, ICD-S, the reference book “Embedded C programming and the microchip PIC” will be used for software implementations [15]. Following are the reasons why microcontrollers are incorporated in project systems:

- a. **Cost:** Microcontrollers with the supplementary circuit components are much cheaper than a computer with an analog and digital I/O
- b. **Size and Weight:** Microcontrollers are compact and light compared to computers
- c. **Simple applications:** If the application requires very few number of I/O and the code is relatively small, which do not require extended

amount of memory and a simple LCD display is sufficient as a user interface, a microcontroller would be suitable for this application.

- d. **Reliability:** Since the architecture is much simpler than a computer it is less likely to fail.
 - e. **Speed:** All the components on the microcontroller are located on a single piece of silicon. Hence, the applications will run much faster than it does on a computer.
1. The functionality of the components such as digital counter, 240volts AC power step down transformer, I/O Ports will be explained in detail as they will be used for this project, the fundamental concepts would be better understood and, the reader can flashback to this section to view the schematics and the specifications.
 2. This project is based on cost monitoring for electric power usage, so the digital counter will be implemented to sense the electric power unit as an input signal for the PIC controller [16]. Therefore, the calculation programming system application will be using.

LCD screen will be implemented as the output of the mechanism. In this project, C language will be used in the PIC16F877 which will do the calculating process.

1.5 Importance of Study

Based on survey and study on the electrical power consumption by the user's to get the idea of designing a system which is user friendly and efficient to observe the usage and spending electrical energy. Metro Power Enterprise has wide knowledge and experiences in research and development of power solution applications. Almost all of our current staffs have a research background and are actively doing research in the power technical areas, power application market and its trends and users' needs. We will continue to conduct R&D to ensure that our products are competitive on the market, will not obsolete quickly, and we are able to produce innovative products that support the current market needs and trends.

The Cost Monitoring Digital Power Meter is important to develop system due to the market needs. Research on the condition to be convenient up the Cost

Monitoring Digital Power Meter user, the circuit will be integrated in PIC, and impact of the actions are continuously conducted to create the best products which can be used to help the user by let them plan how to use the electric power, thus creating satisfied while using it. This satisfactions will increase the amount of time that the user will use the products, thereby increasing the effectiveness of the program thus help us quickly gain market share.

This project is important to giving awareness for electric utility users. This system can be applied on housing and industries where it is used as power meter and cost calculation. Due to this, electric power is not widely utilizes, and thus user have to pay very expensive price. If this project proves that the meter are showing same value as the appearance meter nowadays, then there will be investors to invest on this system because it have market. This will reduce the cost of paying for wasted electric energy. Hence, there will be wise applications of this system in future.

CHAPTER 2

LITERATURE REVIEW

This chapter describes the system design and methodology of the study. The study is done by reviewing each part of the process. Each part required the design of the idea and related system for the Cost Monitoring Digital Power Meter system. The methods are also discussed through this chapter.

2.1 Related system

Chun-Lien Sua, and Jen-Ho Teng (2007); They stated that deregulation of electric power industry has motivated electricity customers to pay more attention in evaluating both the direct cost of electric service and the monetary value of reliable electric service. This movement has been recognized by the utilities and the value-based aspects are introduced into the planning and design of power systems to consider the outage costs [17]. With this electric consumer will pay more attention to prevent the waste of electric energy power, with this a lot of electric energy will not be wasted.

Single Phase Low Voltage PLC Energy Meter operation data and PC management function of energy data. The power line carrier wave technology is applied for the communication between the data concentrator and each data collector and data remote transmitter terminals for realizing the dual-direction data transmission. Meanwhile the data interchange between the data concentrator and main station PC is processed through public network or other ways. The management of energy data gathering, price/payment calculation, power line loss calculation and report creation have been entirely automat zed and computerized. The master

computer is installed in the power authorities, and it communicates with the meter-reading concentrator through the public line. The meter-reading software is installed in the master computer, and it is a consummate power consumption management system integrating the functions of meter file management, meter data collection, meter data management and meter abnormality analysis. The software is developed by DELPHI7. The ACCESS97 database is the existing database at the software launch. The system user can upgrade the database to ACCESS2000 or higher edition [18]. This system is a system that is used to calculating the cost of based on the usage and the timing for serving internet. The total cost of serving internet will be shown on the LCD screen based on the calculation and the speed data that have been transfer.

Phason electronic control system The PLC case study is an overview of the features of Phason.s PLC-1 and PLC-2 Programmable Lighting Controls. The case study briefly explains the features and electrical ratings of the controls and then shows an example of how to create a lighting program [19]. This is a system from Phason Company (a smart electric lighting device manufacturer) that have design a system by using PLC to control and manage the usage of lighting to prevent energy waste by using PLC as switching to control (ON / OFF) of the switch by detecting whether the place have people or not, based on the system it will show the and calculate the electric consuming value in the LCD screen.

Shun-Yu Chan , Jen-Hao Teng , Chia-Yen Chen , David Chang (2010) This peoples tries to use USB and personal digital assistant to develop a novel power quality (PQ) monitoring platform and then integrates GPRS technique into the proposed PQ platform to realize a wide-area PQ monitoring and report-back system. The works of this paper can be divided into three parts. First, a small-scale PQ monitoring platform with appropriately designed I/O interfaces and peripherals is designed and implemented. Next, a GPRS module which can be integrated into the designed PQ monitoring platform is developed. Finally, a web server with well-designed database and web human-machine interfaces used to record abnormal PQ data and display PQ data are designed [20]. This system is a system that can calculate the total number of data and the accuracy of the GPS system based on the power transfer and received of the PQ digital data value that have flowing of the GPS