



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

REMOTE MONITORING OF ENERGY METER VIA SMS

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electronics Engineering Technology (Telecommunications) Honours

by

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I hereby, declared this report entitled “Remote Monitoring of Energy Meter via SMS” 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 Engineering Technology in Electronic (Telecommunication) (Hons.). The member of the supervisory is as follow:

.....
(MR. WIN ADIYANSYAH INDRA)

ABSTRACT

This report explaining about a smart energy meter development that use the latest technology to monitoring and controlling the meter reading at user's home. Unlike other conventional meter, this project use GSM module as telecommunications equipment to enable user to get their meter reading and total bill consumption at anytime. This Remote Monitoring of Meter Energy system give information to user through SMS regarding reading at meter and also the total cost of bill in Ringgit Malaysia. Calculation cost is based on price and electricity tariff rate that is determined by Tenaga Nasional Berhad (TNB). With this project, user will be more alert about electric consumption. A user also can limit the usage of electricity by setting the limit of usage and get reminded about it when the cost reached the limit. By using microcontroller ATmega328 Arduino UNO and programming code implementation, it will control the whole system of this project according to input and outputs have been set.

ABSTRAK

Laporan projek ini menerangkan tentang pembangunan meter elektrik dengan menggunakan teknologi terkini untuk memerhati dan mengawal bacaan meter pada rumah pengguna. Tidak seperti meter konvensional yang lain, projek ini menggunakan modul GSM sebagai alat telekomunikasi untuk membolehkan pengguna mendapatkan bacaan serta jumlah bil yang telah digunakan pada bila-bila masa. Meter ini memberi maklumat kepada pengguna menerusi SMS tentang bacaan meter semasa dan juga jumlah bil dalam Ringgit Malaysia. Pengiraan kos adalah berdasarkan harga dan tariff kadar elektrik mengikut kadar yang ditentukan oleh Tenaga Nasional Berhad (TNB). Dengan adanya projek ini, pengguna akan lebih peka tentang penggunaan elektrik. Pengguna juga boleh menghadkan penggunaan elektrik dengan menetapkan penggunaan pada jumlah kos tertentu dan SMS peringatan akan di hantar kepada pengguna sekiranya jumlah bil tersebut telah mencecah pada had yang ditetapkan. Dengan menggunakan mikropengawal ATmega328 Arduino UNO serta pelaksanaan kod pengaturcaraan, ia akan mengawal seluruh system projek ini mengikut arahan masukan dan keluaran yang ditetapkan.

DEDICATIONS

Special dedicated to

My beloved father and mother,

To my family, lectures and friends

Thanks for all the encouragement and support

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CHAPTER 1

INTRODUCTION

This chapter will provide brief explanation of the Remote Monitoring of Energy Meter. Besides, it also covers the background, problem statement, objective, scope, project significance and summary.

1.1 Background

The growing demands of life, people need some alternative to reduce their monthly bill of energy usage. Recently, energy meter in every house shows the meter reading in kWh but the only person that see the energy meter is a worker who come to take the energy reading. The user will never know the amount of energy consumed for that month until the man print out the bill and gives to every house. In this situation, the user cannot monitor electricity usage and manage their costs. Remote monitoring of energy meter is project that can give awareness to user about energy consumption. This instrument will give alert to the user when the amount of bill reaches at the limit that user has set. Remote monitoring of energy meter is built for residential house use only.

Microcontroller will read the amount of electricity consumed by user. In this project Digital energy meter is used and microcontroller counts the number of units measured by sensor (light to voltage) in the digital read at energy meter (LED flash indicator). Using current wireless communication systems, the most popular of which is GSM, user can get the value of energy reading by sending a command to the GSM module at the energy meter. User will get the reading of current energy meter, calculates

the bill with respect to desired tariff when they asked. User also will be alert for limited energy consumed for example user set the limit for that month is RM50, when the consumption reach at RM50 the GSM will send SMS to user as a reminder about the energy used.

The development of remote monitoring of meter energy will gain awareness to everyone in the house. Everyone will realize that utilization of energy is attaining to the limit, so they have to manage their usage from that time. Other than that, it will detect a power thief by other user. By tapping the energy meter, the thief can get free power energy. Usually power thief occurs when nobody at home and give the thief space to jumper the wire to energy meter.

1.2 Problem Statement

Nowadays, energy billing is increasing as economy increase. We never know the value of the bill that will come for that month until we received the bill from Tenaga National Berhad (TNB). We also use energy unlimited and currently energy meter cannot set the limit for using a month. With this instrument, we can get the reading of energy consumed for our home and bill will be sent to our phone using GSM technology.

1.3 Objectives

The objectives of the project:

1. To develop a remote monitoring of energy using GSM module to monitor the reading of energy meter via SMS.
2. To verify that the remote monitoring of energy meter can accurately measure and monitor over limit energy consumed and send the notification alert to user via SMS.

1.4 Scope

The scope of this project is to introduce advanced technology to residential house for monitoring their energy meter. The new modern technology which is GSM module will be implementing to the meter energy board for electricity consumption monitoring. In this project the consumed energy price can be calculated and at the same time, price can be updated frequently by SMS. User just sent SMS to know their current meter reading and amount. The microcontroller use for this project is Arduino Uno, it consist of ATmega328 microcontroller that have 13 digital pin and 6 analog pin. For the data storage unit, the EEPROM is used to store the energy consumption and the bill. The RTC DS1307 is use to reset the counting of the unit consumption for every month.

1.5 Summary / Conclusion

This chapter covered the background of project, problem statement, objectives and scope of the project. The background of the project is about the background of the Remote Monitoring of Energy Meter. This project is designed to improve recently meter energy by upgrade to be an instrument that can help people in their daily life. The objective is discussed in detail, besides the scope discussed about the software and hardware that used in this project.

CHAPTER 2

LITERATURE REVIEW

Electrical energy meter grown as technology grows, from the traditional mechanical meter energy until the new technology based on GSM and GPRS. This chapter has covered about the previous system and the past study that related to this project. Besides, this section also explains about a component that use in this project.

2.1 Previous Systems and Existing Technologies

Various technologies have been developed and use to measure the electrical consumption. For the billing, user will get the bill from the energy board after they generated and provided using the several methods. At present, most of the house in Malaysia uses the traditional electro - mechanical watt meter and the reading are not automated. The user will wait the bill of energy consumption for every month to pay their energy bill. At the end of the month, a person from the meter board billing will come to every house to read the meter reading and at the same time, give the bill to the user.

Next generation, electronic meters was introduced and the function is same as the electro-mechanical, but it replaces from analog to digital system. With this system user can note down the voltage, power reading unit, current and the time and date of the energy consumption. This system just gives some advantages over the previous meter reading.

Then, the meter reading develop with the Bluetooth based technology which is the wireless communication and also known as Automatic Meter Reading (AMR). This system is wirelessly and the personal computer could be used to record the power consumption of energy meter. The reading meter will be saved to the database and bill will be generated. The latest technology is a GSM based system. This system replace the Bluetooth technology and the data sent using SMS to the customer and the energy board. (Dhananjayan & Shanthi 2014)

2.1.1 Smart energy meter with instant billing and payment

According to (Dhananjayan & Shanthi 2014) this project is mainly focus on the measurement of energy consumption and providing data for billing and system for payment. This project using Zigbee communication technology and the energy measured in units and the data is fed to a remote computer server software solution is provided to generate bills for energy consumption. This project consists of Automatic meter reading facility with the help of voltage and current sensor, the value is fed to controller to calculate the usage of power. Then the data is fed to remote station server with the help of ZigBee. A software is created using .Net in the server which will generate the bill for our usage according to the tariff. A database is maintained in the server which consists of customer details and his consumption. Amount of usage is again fed to Energy meter display in the home using the same ZigBee network. Thus, this project can avoid human errors in measuring the readings.

2.1.2 A Smart Energy Meter for Power Grids

Refer to (De Capua et al. 2014), this paper is propose a smart energy meter for energy management in power grid. With power grids consumers will get electricity by the interconnected network from suppliers. In this paper, the author has explained more about power quality which is the quality of electrical service and the power quality

regulation. In the power quality regulation, the IEEE standards have been used as a reference and guideline to define the power quality and the impact of the power quality on supplier and on user loads. This smart energy meters can enquires the energy data producer, both for consumption and production, allowing a bi-directional control of energy flows. Using mobile application, it can remotely manage the hardware to dedicate to the acquisition through the internet network. This application can save and store the data window and duration, date and time of all events that have detected during analysis. It also allows accessing the historical of data because the measurement of currents, voltages and power are averaged over difference time intervals and stored on shared variables.

2.1.3 GSM Based Automatic Energy Meter Reading System with Instant Billing

According to (Ashna & George 2013), this project used GSM technology network and the graphical user interface is develop using Microsoft visual studio .NET framework and C#. The meter reading of energy meter is sent through a GSM periodically to the billing point and updated in central database. After data process, customer will get back the message of complete monthly usage. For the design, energy meter specifications and tariff structure followed by the Kerala State Electricity Board are adopted. This project are user friendly, any employee with minimum knowledge of also computer can work in this software and read the meter by sitting in their office.

2.1.4 GSM Based Automatic Energy Meter Reading

According to (Qamar et al. 2014), the purpose of this project is to remote monitoring and control of the domestic. The system provide freedom to electricity companies to take action against lenient customers who have outstanding dues, they can disconnect the power and re-connect the after deposition of dues. This system not only can send the data but it does provide the power disconnect and connect. It will help

customers and energy service provider to access the accurate and updated data from the energy meter. It can send energy consumption in hourly, monthly or on request. It allows the companies' energy services provider collect the reading without visiting the site. The proposed building blocks of this project are:

- a) Microcontroller based control system with regulated power supply.
- b) GSM modem for remote communication
- c) Electromagnetic relay and relay driver for power supply control.
- d) Digital/ conventional energy meter.
- e) LCD display to display the meter readings.

2.1.5 Electronic Energy Meter with Instant Billing

This paper is present automated billing of energy meter same like postpaid mobile connection. GSM modems that have its own SIM is connected to the energy meter. PC that contain of data base is connected to other modem. The message will be sent to the user about due bill by implementing the SIM card to the meter energy. For the user interface, LCD is used in the hardware module. By using the given code which is fed in the meter, the user can pay the amount of bill instantly. This project also use microcontroller IC AT89S52 with programmed using assembly language to control whole the system. (Kumar Sehgal et al. 2010)

2.1.6 Design and Implementation of Digital Energy Meter with Data Sending Capability using GSM Network

According to (Shahidi et al. 2013), this paper depict the design and implement of a digital meter energy based on PIC microcontroller. Current Transformer is used to measure the current signal in this project while step down potential transformer is used to measure the voltage. The wireless technology that use in this project is GSM module

with SIM9000. Microcontroller will calculate the power, power factor and energy from line voltage and line current.

2.2 Hardware Overview of the System

The hardware overview is an analysis of the component that should be considered in the design of remote monitoring of energy meter which is microcontroller, energy meter, GSM module, LCD display and other component. Besides, in this part it also discusses about the component that have been used in past project such as ZigBee.

2.2.1 Microcontroller

A microcontroller is single integrated circuit that contains processor core, memory and programmable input and output peripherals. It also known as small computer that designed for embedded applications. On the other hand, the microcontroller incorporates all the features that founds in microprocessor. However, it has also added features to make a complete microcomputer system on its own. The microcontroller has built-in ROM, RAM parallel I/O, serial I/O, counters and clock circuit. (P.Godse, n.d.)

2.2.1.1 Microcontroller 8051

The big family of microcontroller is 8051. It is an 8-bit processor, meaning that the CPU can work on only 8 bits of data at a time. Data larger than 8 bit has to be broken into 8 bit pieces to be process by the CPU. The 8051 has a total of four I/O ports, each 8 bits wide. As refer to (Dhananjayan & Shanthi 2014), the microcontroller act as the central processing unit or brain of the system and the function is to control whole system. It able communicates when there is a need to access the network for sending or

receiving data. Since the microcontroller is an electronic device, the signals that enter it must be electrical.

Table 2.1: Features of the 8051

Feature	Quantity
ROM	4K bytes
RAM	128 K bytes
Timer	2
I/O Pins	23
Serial port	1
Interrupt sources	6

The AT89S52 microcontroller has 35 instruction cycles and 4 different ports with 8 analog to digital pins that mean 8 input/output lines providing a total of 32 I/O lines are available in inbuilt microcontroller, RA and RE PORTS are analog to digital ports, RC0, RC1, RC2 Ports are timers, RC6 is Transmitter, RC7 is Receiver pins. (Jonnala & Ieee 2014)

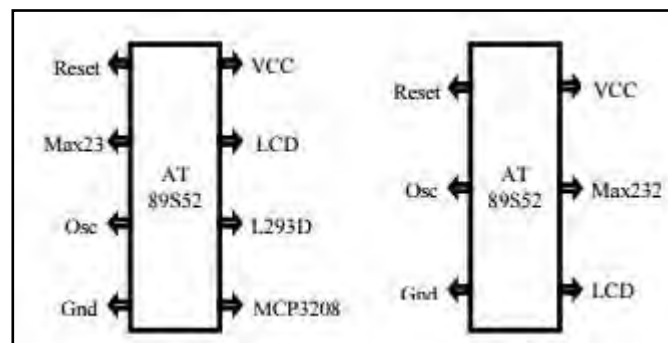


Figure 2.1: Port of Microcontroller AT89S52

The function of every port is different such as to perform input/output and implement special features like counting external pulse, execute program and perform a

serial data transfer to update software. Every pin will connect to different input/output pin, each port has 8 pins and will be treated from the software point of view as an 8-bit variable called registers.

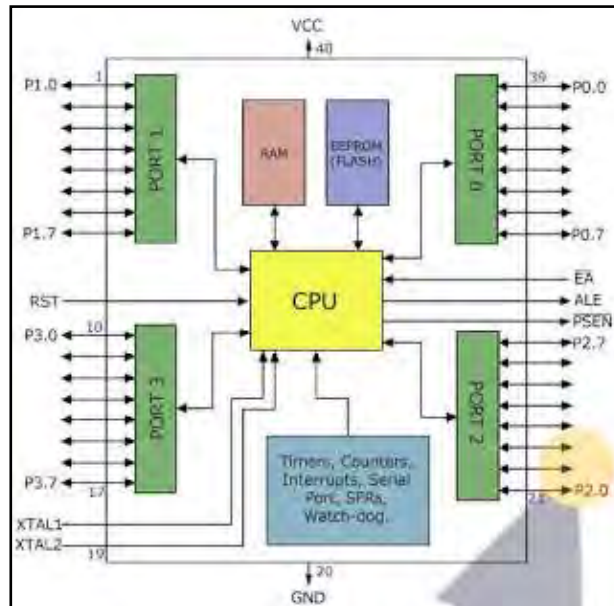


Figure 2.2: AT89S52 Architecture

AT89S52 have two different type of memory which is RAM and EEPROM. RAM is used as temporary storage of programs that computer is running, the data is lost when computer is off. The store information also can be change with time because it is not permanent, (Mazidi 2014). While the EEPROM memory is a program memory, it used to store the program itself. It is clear that the CPU (Central Processing Unit) is the heart of the micro controllers. It is the CPU that will Read the program from the FLASH memory and execute it by interacting with the different peripherals.

2.2.1.2 Arduino UNO

The host processor for the arduino UNO is the Atmel Atmega328. The „328“ is the 28 bit microcontroller. The architecture is based on Reduced Instruction Set Computer concept which allows the processor to complete 20 million instructions per seconds