



Faculty of Electrical and Electronic Engineering Technology



**DESIGN OF AN INDUSTRIAL GSM-BASED WIRELESS READING
SYSTEM FOR ENERGY METER**

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Bachelor of Electronics Engineering Technology with Honours

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**DESIGN OF AN INDUSTRIAL GSM-BASED WIRELESS READING SYSTEM
FOR ENERGY METER**

MOHAMAD IKHMAL BIN RAMLEE

**A project report submitted
in partial fulfillment of the requirements for the degree of
Bachelor of Electronics Engineering Technology with Honours**



**اهنفة سبتي تیکنیکل ماليسيا ملاک
Faculty of Electrical and Electronic Engineering Technology**

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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DECLARATION

I declare that this project report entitled “Design Of An Industrial GSM-Based Wireless Reading System For Energy” is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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DEDICATION

To my beloved late mother, Noor Azizah Binti Mat Noh, and father, Ramlee Bin Harun, I am grateful and thank you for always support me and gives motivation directly or indirectly throughout my life as a student in Universiti Teknikal Malaysia Melaka. A special thank you to my siblings for the support, guidance and encouragement given.



ABSTRACT

Energy meter reading systems that use the wireless communication provide an efficient and cost-effective way to wirelessly transmit data about the user's energy consumption. The Arduino microcontroller is required to interface the digital energy meter system to a mobile phone. The main function of this system is to monitor the value of current, voltage, power and energy consumption and send alerts to the user's mobile phone. The bill is automatically updated on the mobile phone through Short Messages Services (SMS). The total power consumed by each load is measured and the the total price sent to the mobile phone using GSM module. The system is capable of continually notifying the energy source and consumer of the number of units consumed.



ABSTRAK

Sistem bacaan meter tenaga yang menggunakan komunikasi tanpa wayar menyediakan cara yang cekap dan kos efektif untuk menghantar data secara tanpa wayar tentang penggunaan tenaga pengguna. Mikropengawal Arduino diperlukan untuk antara sistem meter tenaga digital ke telefon mudah alih. Fungsi utama sistem ini adalah untuk memantau nilai arus, voltan, kuasa dan penggunaan tenaga serta menghantar makluman kepada telefon bimbit pengguna. Bil dikemas kini secara automatik pada telefon bimbit melalui Perkhidmatan Pesanan Ringkas (SMS). Jumlah kuasa yang digunakan oleh setiap beban diukur dan jumlah harga dihantar ke telefon bimbit menggunakan modul GSM. Sistem ini mampu memberi notifikasi sumber tenaga dan pengguna bilangan unit yang digunakan secara berterusan.



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LIST OF SYMBOLS

δ	-	Voltage angle
V	-	Volt
A	-	Ampere
W	-	Watt
P	-	Power
S	-	Apparent Power
gm	-	gram
	-	



LIST OF ABBREVIATIONS

V	-	Voltage
A	-	Ampere
GSM	-	Global System for Mobile Communications
GUI	-	Graphical User Interface
SIM	-	Subscriber Identity Module
SMS	-	Short Message Service
LDR	-	Light-Dependent Resistor
RFID	-	Radio-Frequency Identification
LCD	-	Liquid Crystal Display
IDE	-	Arduino Incorporated Development
ARM	-	Advanced RISC Machines
LED	-	Light Emitting Diode
RTC	-	Real Time Clock
SCL	-	Serial Clock Line
SDA	-	Serial Data



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CHAPTER 1

INTRODUCTION

1.1 Background

In this current of modernity, electrical power has become a major requirement in the living rules of society and main source of operation an electrical appliances and machines. An energy meter is a device that measures the amount of electricity used by individuals, businesses, government facilities, and other entities. Electricity meters are calibrated in accordance with official billing units, with kilowatt hours being the most common. Energy meters are read periodically according to the electricity bill cycle usually once a month. Therefore, the electricity bill records the electricity consumption on that billing cycle as in the previous month. The installation of the energy meter has been determined by SIRIM Berhad and the Malaysian Communications and Multimedia Commission (MCMC) as well as under the supervision of the Energy Commission (ST). Some countries have different electricity tariffs for day and night. Therefore, electricity meters in the country will record energy consumption at peak times where electricity tariffs are more expensive. Some electric meters have relays that are capable of turning off unnecessary electrical equipment.

Metering systems have evolved greatly in recent years, and are projected to become more advanced in the future, delivering a growing range of services. Meters used to be electromechanical instruments with low precision and configurability, which are still used in a few countries today. Meters are now digital instruments with improved performance, monitoring and tuning capabilities, and burglary prevention capabilities. A digital sensor is

a modern kind that detects electrical power and records it in a memory chip. Meter controller module with power source, meter sensors, controlling circuitry, and a networking interface for data transmission from a remote computer to a primary center. Data and control signals are transmitted between the meter interface units and the central office. Modems, receivers, data concentrators, controllers, server upload connections, and a host computer are all part of the central office system.

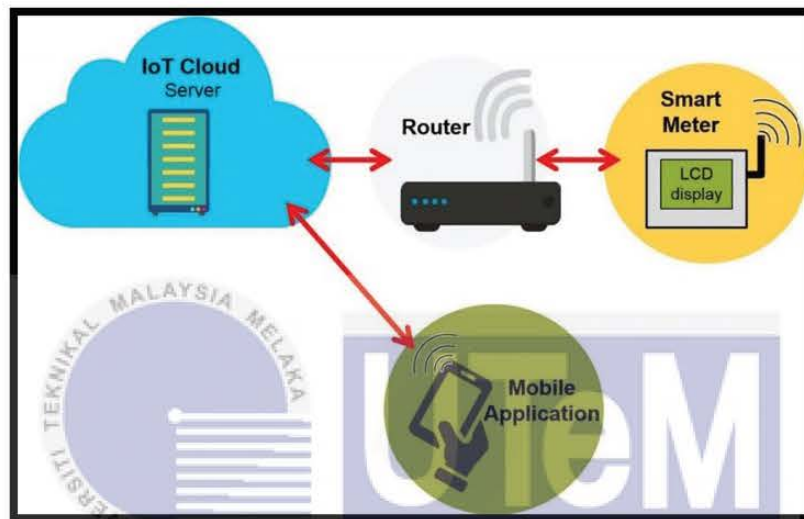


Figure 1.1: Internet of Things Diagram

1.2 Problem Statement

The rapid growth of domestic residences and commercial facilities in developing countries such as Malaysia demands the need of large number of workers and longer operating durations to perform the billing generation task [1]. The officials of Tenaga Nasional Berhad (TNB) representatives must perform this manual technique every month. These conventional and manual methods of data collection cause issues for both sides: consumers and TNB. [2]. The existing manual meter reading method proved unsuitable for long-term operations since it requires a large amount of manpower and material supplies [3]. The real usage amount of the energy bill is inaccurate, unreasonable and exceeding consumer expectations due to the negligence of the electricity meter reader. With the help of this initiative, a clear framework

is suggested that allows power providers to have complete access over energy meters and real data from a specific location with less human effort and at a lower cost than traditional approaches.

1.3 Project Objective

The objectives of this project are stated as below:

- a) To measure and collect data on total energy consumption using the current, voltage, and power readings from a digital energy meter during a specified time interval for billing generation purposes.
- b) To design a system that gives an alert on energy consumption after exceeded the billing cost set by consumers.
- c) To develop and design a wireless networking device to gather data on consumer's energy consumption via SMS using a GSM modem.

1.4 Scope of Project

The scope of this project are as follows:

- a) GSM is the main central for transferring the data via messages with a microcontroller unit with LCD display.
- b) The development model is configured with a dedicated SIM card as part of this initiative (Subscriber Identification Module).
- c) A single-phase operation two wire energy meter with voltage rating of 240V, operating at 50Hz.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter represents on the ideas and observations on the scope of the project's implementation. Furthermore, the discussion of data and techniques used in previous research has been reviewed. This wireless energy meter has been developed by various researchers.

2.2 Methods to read energy meter

In this era of globalization, telecommunication systems based on smartphones are increasingly widely for controlling and monitoring such as network device, GSM, and small-sized wireless radio with low-power parameters [4]. There are mainly few methods used by research investigators to read the energy meter. The large percentage of evolved countries are pursuing smart meters with fixed deposit features. Consumers can conveniently monitor and their energy consumption with smart meter [5].

2.2.1 Smart card based prepaid energy meter

An issue with the current billing system and the number of manpower needed to take meter readings minimized by prepaid energy meter with a smart card. This will encourage consumers for energy conservation by the details of related recharge on the smart card. The energy meter will be activated when the recharge is successful. The higher power demand will affect the recharged amount decrease. An electronic meter recognizes the energy consumed by voltage and current sensors.

2.2.2 RFID (Radio-Frequency Identification) based prepaid energy meters

An automated recognition system Radio-frequency identification (RFID) utilizes RFID tags or transmitter to store and retrieve data wirelessly. An RFID tag is a radio- frequency recognition and tracking mechanism that can be mounted to or inserted into a material, animal, or person. Consumer must display the card to the reader and recognize the special code within the card and deducting the balance of the RFID card [5].

2.2.3 Prepaid energy meter with GSM technology

Consumers are expected to recharge their mobile accounts and submit an SMS to the energy meter via the GSM network. The energy meter stores the purchased energy units based on recharged value and allow the electricity consumption until acquired units have been used and will be cut off. On the latest recharge, the control unit retrieves the SMS received by the phone, decodes and granted the phone number, and reconnects the electricity supply [5].

2.3 Study of people's behavior

Consumer attitude on electrical equipment used in a resident is pointed known as people's lifestyles. The expenditure is directly proportional to the related time periods and the usage. The consumption depends on the equipment utilization. It is necessary for energy providers to fulfill consumers' expectations. Consumers are unable to estimate the investment potential of their monthly bills and detect electrical appliances that consume a large amount of electricity, leading to failure of energy consumption management. By analyzing the total electricity consumption, we can study and do relevant research about people's behavior [6].

2.4 Conventional meter

For innovation of infrastructure grids, several countries and communities applied digital energy meter for tracking and monitor electricity consumption each minute. In conventional meter, there is no storage for data. A consumer's house or facilities must be visited by the utility company for recording of data and transfer to the Energy Provider. Expected bills cannot be sent whenever accessibility to the meter is not feasible. Electricity consumption is monitored through the monthly bill or manually meter reading. Linkages and interruption cannot be fully automated because energy providers are unable to immediately respond due to interference of supply. Due to the increasing needs of power, it is difficult to manage and retain the electricity. As the operator of Electricity Board visits the consumer's residence, utility maintenance is a vital commitment for the billing process of electricity consumption. The Electricity Board will have to visit households that are unable to pay their utility bills, which will take time and be challenging for the acquisition. The existing energy meters installed are postpaid which required computer GUI and internet and recharged through smart card [7]. Method to acquire readings from a traditional meter is risky to faults such as human mistakes when collecting meter readings [8]. Just about every facility that uses electric energy meter requires manpower for the issuance of bills or receipts. Automated power meter reading system on GSM allowed the meter reading and billing rate to consumer via SMS or email from the energy provider [9].