DEVELOPMENT OF HOME ENERGY MANAGEMENT SYSTEM (HEMS)

CHEA MENG HUAT

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF HOME ENERGY MANAGEMENT SYSTEM (HEMS)

CHEA MENG HUAT

This Report Is Submitted In Partial Fulfillment of Requirements For The Bachelor Degree of Electronic Engineering (Computer Engineering)

Faculty of Electronic and Computer Engineering
Universiti Teknikal Malaysia Melaka

JUNE 2014

UNIVERSTI TEKNIKAL MALAYSIA MELAKA
FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek : DEVELOPMENT OF HOME ENERGY MANAGEMENT SYSTEM (HEMS)

Sesi Pengajian : 1 3 / 1 4

Saya CHEA MENG HUAT
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)

_____
(COP DAN TANDATANGAN PENYELIA)

Tarikh: ……..

Tarikh: ……..

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

Signature : ……

Name : CHEA MENG HUAT

Date : ……

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

Signature : .....

Name : DR. SOO YEW GUAN .....

Date : .....

Specially..

To my beloved parents

To my kind brother

And not forgetting to all friends

For their

Love, Sacrifice, Encouragements, and Best Wishes

ACKNOWLEDGEMENTS

At first I would like to thanks all the people who are helping me and give me advice will I am lost in the junction of the Final Year Project (FYP). My FYP is done in Univesiti Teknikal Malaysia Melaka (UTeM). Thanks god that enable me to complete this project in time during my last year study.

I would like to thanks the people who are patiently give me guide and explanation when I am not understand what is the situation. He really help me a lot in my FYP journey, if they did not advice me, I think I already fail or lost my way to do my FYP. I would like to thanks him again my FYP Supervisor Dr Soo Yew Guan which is kind and full patient in teaches their student. I am so lucky able to do my FYP under his supervision.

Last but not least, I appreciate Faculty of Electronic and Computer Engineering (FKEKK) for giving me a chance to design and implement my project. Lastly, my gratitude also goes to all my family members and team members for their continuous encouragement and financial support.

ABSTRAK

Development of Home Energy Management System (HEMS) adalah satu projek yang dapat menyedari pengguna eletrik tengah membazir teenage eletrik atas sebab kelakuan yang cuai dengan cara analisasi graph. Kecuaian menyebabkan mereka perlu bayar lebih banyak bill kepada Tenaga National Berhad (TNB). Selain itu, projek ini membenarkan pengguna mengguna kawalan jauh untuk matikan atau hidupkan peralatan rumah di tempat yang jauh. Factor ini akan memudahkan kehidupan kita menjadi lebit senang pada masa hadapan. Sebab pengguna dapat matikan atau hidupkan peralatan eletrik rumah semasa mereka tidak ada di rumah. Cara menghasilkan projek ini adalah dengan menggunakan board Arduino Uno, Ethernet Shield, Xbee shield , Xbee dan router. Board Arduino Uno, Ethernet Shield, Xbee Shield dan xbee dapat dijadikan satu block dengan cara stack semua sekaligus untuk mengurangkan penggunaan ruang kosong dan senang menangani masalah yang akan berlaku. Apabila semua telah stack menjadi satu block ia dipanggil sebagai penyelaras. Tambahan pula, ia juga senang diprogramkan dan menjalani ujian keatas block. Bagi sebelah soket, dalam block soket tidak perlu Ethernet Shield sebab ia tidak perlu diguanakan. Di sebelah soket juga dinamakan sebagai node, ia berfungsi sebagai penghantaran nilai yang telah diukur oleh pengukur arus kepada penyelaras serta menerima arahan daripada penyelaras untuk tutup atau buka node tertentu. Bagi pihak penyelaras, ia berfungsi sebagai memuat naik nilai yang telah terima dari node ke web server Xively. Ia juga berfungsi sebagai menerima arahan daripada penggguna dari web server Xively dan hantar arahan itu kepada node untuk buka atau tutup node. Kesimpulannya, projek ini berjaya berfungsi seperti yang dijangka.

ABSTRACT

Development of Home Energy Management System is a project that able to make home user realize that they are wasting electric power with their careless attitude by graphical analysis method. Careless attitude causes them need to paid extra to the Tenaga National Berhad (TNB). Besides, this project enable user to remote their home appliances over long distance. This factor was helping and makes life become more convenient in future. Can help user easily turn on or off those appliances in the home although, he or she is not at home. This project enable user to reduce energy consumption in each home. By creating this project I have to use Arduino Uno board, Ethernet Shield, Xbee shield, Xbee and router. It can be stack up to become a block between Arduino Uno board , Ethernet Shield, Xbee shield and Xbee to save up the space, easy handle and it is called as coordinator. Besides, it is easy to be programmed and testing. For the socket side, Ethernet shield is not used in the stack, because socket side also called as node, it responsible to be sending measured reading to the coordinator and receive command to turn on and off the socket. For the coordinator side is function to upload the data receive from the node then upload to the Xively web server. Furthermore, it also receives the command from the Xively web server key in by user then to the node to trigger on and off of the node. In conclusion, the project is successfully works as expected.

TABLE OF CONTENTS

LIST OF FIGURE

LIST OF TABLE

LIST OF ABBREVIATION

PLC	Programmable Logic Controller
HEMS	Home Energy Management System
EM	Energy Monitor
TNB	Tenaga National Berhad
AC	Alternative current
DC	Direct Current
LAN	Local Area Network
ACS	Alternative Current Sensor
PHP	Pre-Hypertext Processor
HTML	HyperText Markup Language
PIC	Programmable Interface Controller
GMR	Giant Magneto Resistance
ADC	Analog to Digital Converter

LIST OF APPENDIXE

CHAPTER I

INTRODUCTION

Home Energy Management System (HEMS) is system that helphome user to save electrical energy and utilities bills. The aim of this study is to enable long distance control and remote the home appliances. Once the system detected the home appliances are in ON mode when they are not using, it will send the electric consumption data to the web server so that user will realize it and will make decision to turn on or turn off the home appliances.

1.1 Introduction

Residential and business buildings account for approximately 20% of the overall worldwide energy consumption [1], with an increasing trend over time. The major causes of energy consumption in buildings are space heating and conditioning, water heating, lighting, and the use of computers and other electronic devices [2].

Besides, the electric charge is increase gradually. This problem will cause home user need to paid high amount of electric bills. Why they need to pay more, this is due to they having weak management on electric consumption. That's the reason I came out with

the idea Home Energy Management System (HEMS). Home Energy Management system is a system that helps household's in the world to save energy and makes their life easy. HEMS are able to help our home user to realize that there are wasting electrical power consumption. The data in the Xively web server will show them the electric consumption. Nowadays, user did not realize that sleep mode electrical device is consuming electrical power approximately to 10%. If an electrical user implements HEMS, it will collect and show the data in the Xively web server real time. This function is making a easy way to electric user for checking their home appliance status. In addition, they also can monitor and remote it from far distance over internet access. HEMS are a system that is going to upgrade human life and also save the world.

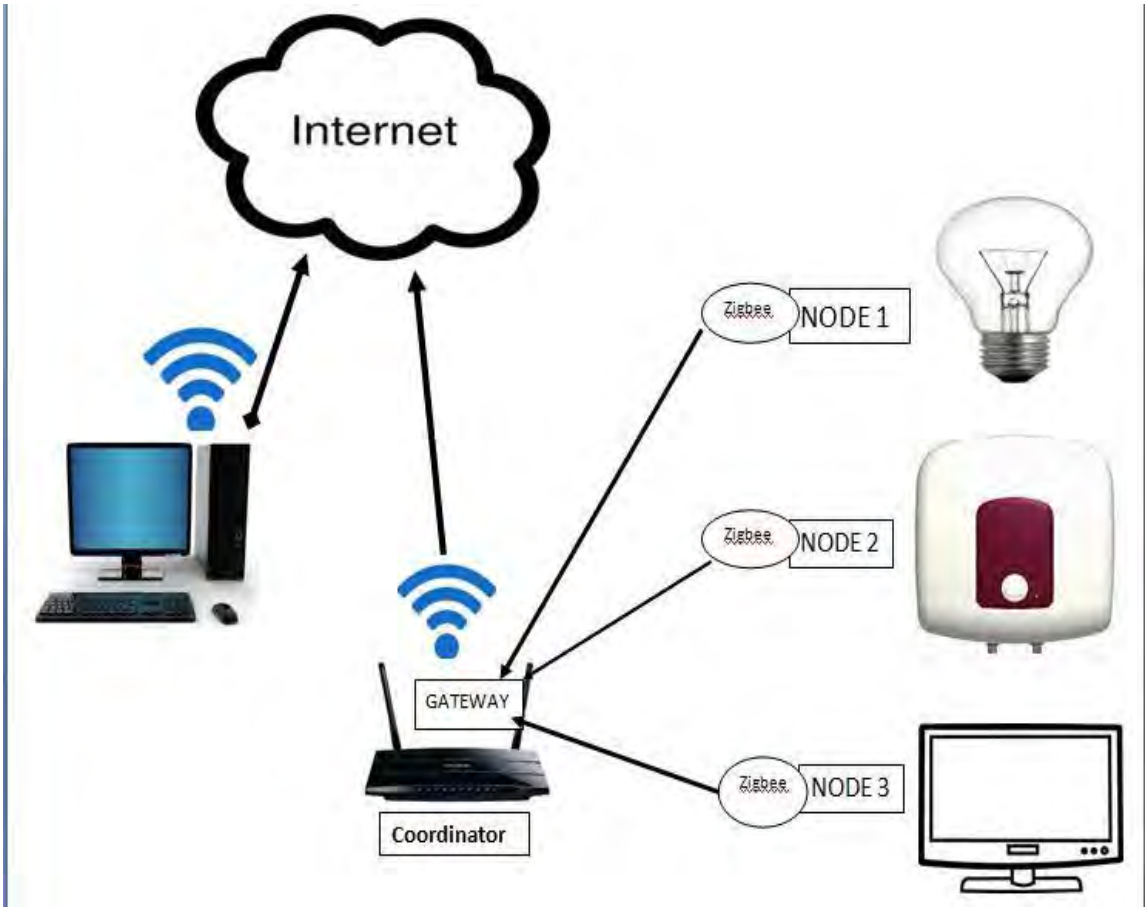

Figure 1.0: Concept of Home Energy Management System

1.2 Objective

The main Objective of this project are:

- To develop a system those can long distance remote the electric consumption.
- To design a new measurement hardware.
- To develop gateway for send the power consumption information to web server.

1.3 Problem Statement

Nowadays, there few products had been created which is similar to the HEMS but there are some weaknesses. For the previous product is big size, bulky or look very significant that is an Energy Monitor (EM) device. With previous EM will showing the electric consumption at every socket located. It makes the user needs to read the value by going around the place that EM deivce located. This is not convenient and will easily make the user abandon the device.

For the existing product is implement with wireless and able to upload the electrical consumption data to the web server but they are still not able to monitor and remote. For existing product problem that is:

- Monitoring over internet.
- Real time monitor by human is impossible.

For the Figure 1.1 it showing that the trend of bill of Tenaga National Berhad(TNB). TNB are increasing their charge on electric consumption from time to time.

Figure 1.1: TNB charge keep increase

1.4 Scope Of Work

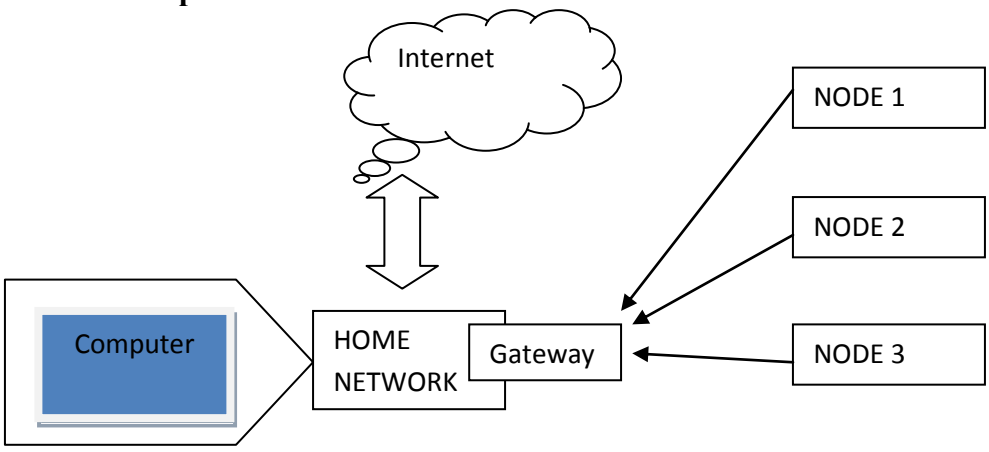

Figure 1.2 Scope of work

For the scope of work will be similar as the block diagram above. It will only target for 1 nodes only (will implement in 1 socket only). Besides, that this project is only targeted Home User only, it does not apply to the industrial area or offices. If for other, it may need some modification and improvement.

.

1.5 Methodology

The methodology of this project will focus on hardware and software. For hardware part, I will focus on the measurement device that implement in the socket. This is because the measurement device having some zero error needs to be fixed for future product. So that need to solve the error by modified the measurement hardware to avoid the problem occurs again. Below is the hardware design block diagram.

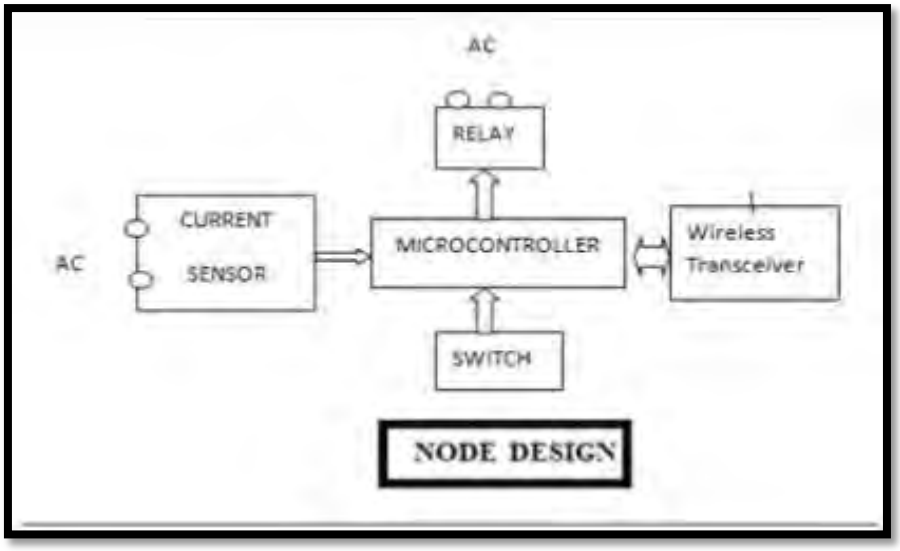

Figure 1.3: Block diagram for Node Design

For the software part, I will focus on showing real time data and also monitoring system at the web server. Real time uploading data and monitoring is tough part because it need to create a gateway, port forwarding and public IP address must be fixed because public IP address will change if the router restart.

CHAPTER II

LITERATURE REVIEW

This chapter discusses the literature review which is similar prior work and discuss about existing technology.

2.1 Conventional Technology

2.1.1 Automatic Meter Reading (AMR) and Advanced Metering Infrastructure (AMI)

AMR system or device is used for collecting real time power consumption and monitoring the total power usage[3](Addis, Capone, Member, Carello, & Gianoli, 2013). This device able to transfer data to a central database for analyzing for saves the expense in utilities expense. On the other hand, AMI system is metering system which provides two way communications between company of utilities control centre and end user [10](Liu et al., 2011). This system is able to provide nearly real time data to the Utilities Company [7](D. Han & Lim, 2010).

Figure 2.0: AMR

Figure 2.1: AMI structure

2.1.1.1 Microprocessor Based

Recently, microprocessor is able to control the logic of all devices. Microprocessor normally builds in the in device, user will not able to see it [10](Liu et al., 2011). Microprocessor normally converts the current and voltage measured value to digital value so that it can store in memory, and display the value in the LCD to show end user. Energy Monitoring is achieved by using microprocessor based.