WIRELESS WATER METER SYSTEM

RAJA MARIATUL QIBTIAH BT RAJA JAAPAR

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

Faculty of Electronic and Computer Engineering
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Saya RAJA MARIATUL QIBTIAH BT RAJA JAAPAR

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Dedicated, in thankful appreciation for support, encouragement and understandings to my beloved father, mother, brother, sister, lecturers and friends.

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ABSTRACT

Nowadays, a conventional method to gather water consumption data from water meters in residential areas by using human recorders are costly and time consuming at especially urban residential area. The technology of wireless water meter system is a method to send water consumption data from the resident to mobile billing units would improve the service quality of billing system and increase revenue by reducing labor cost. In this project, wireless water meter system was developed in order to give solution based on this problem. The XBee Wireless Technology are used to send the water consumption data automatically to the mobile water meter reader. Microcontroller 16F877A was used as a processor to control the XBee Wireless Technology with coverage up to 100 meter of range and low power consumption. The developed product can be integrated with existing commercial water meter and support residential, commercial and industrial consumer.

ABSTRAK

Perubahan Pengambilan data bagi penggunaan air menggunakan meter air di kawasan perumahan dengan meggunakan kaedah sedia ada seperti catatan daripada pekerja menyebabkan kos yang tinggi dan penggunaan masa yang banyak terutamanya di kawasan bandar. Sistem berteknologi meter air tanpa wayar adalah satu kaedah penghantaran data tanpa wayar daripada kediaman pengguna kepada stesen kawalan (Mobile meter reader) bagi memperbaiki kualiti perkhidmatan dan mengurangkan kadar kos pekerja. Hal yang demikian, Sistem meter air tanpa wayar dicipta bagi menyelesaikan masalah ini. XBee Wireless Technology digunakan untuk menghantar data secara automatik ke mobile water meter reader. Cip 16F877A pula digunakan untuk mengawal XBee Wireless Technology untuk penghantaran data sehingga 100 meter dan penggunaan kuasa yang rendah. Produk ini dapat diintegrasikan apabila wujudnya meter air secara komersial dengan sokongan pengguna, dan pihak perindustrian.

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CHAPTER I

INTRODUCTION

1.1 Project Background

Wireless water meter system is a system that is collect billing from residential areas where this system capable to improve the accuracy of billing system. The ZigBee wireless was use together data from the water meter. ZigBee is a wireless technology developed as an open global standard to address the unique needs of low cost, low power, wireless sensor network. In addition, the ZigBee protocol carries all the benefits of the 802.15.4 protocol with added networking functionality. The data would transmit to mobile meter reader with less of error. The develop system are more practical and affections to reduces the maintenances cost and improve the services quality of billing system.

Figure 1.1 Example of wireless water meter system from digital meter to control station.

1.2 Project Objectives

Thus this project includes several objectives and aims:

i. To design and develops a digital wireless water meter system.

ii. To study sending and communicate data with control station using ZigBee.

iii. To improve the accuracy of billing system, reduced the maintenances cost and also improve the service quality of utility authorities.

1.3 Scopes of Work

The scope of this project covers:

i. Use ZigBee as wireless system to communicate with mobile meter reader.

ii. Design and develop a wireless water meter that interface the water volume measurement instrument with wireless device that be able to communicate with a mobile meter reader.

iii. The XBee Wireless technology is used to send the water consumption data automatically to the mobile water meter reader.

1.4 Problem Statement

i. Traditional method to gather data from residential meters:
Sending technicians to a residential area then record data manually for further processing, this method usually results in high labor costs**.**

ii. It could easily cause human errors:
A technician may record wrong data from a meter because of his exhaustion or faded colors on a numerical display.

iii. Microcontroller 16F877A was used as a processor to control the XBee Wireless Technology with coverage up to 100 meter of range and low power consumption

1.5 Work Breakdown

In order to achieve the objective of this project, there are several tasks that need to be done as shown in Figure 1.2 below. These tasks are divided into three main categories that are study, design and implementation. The related items that need to study in detail are the principle of the analog to digital converter, microcontroller architecture, programming for microcontroller and programming for graphical user interface.

Other than that, for this system it is needed to design the system block Diagram, hardware circuit, software algorithm and software programming. Following the design is the implementation of the hardware, software and system integration.

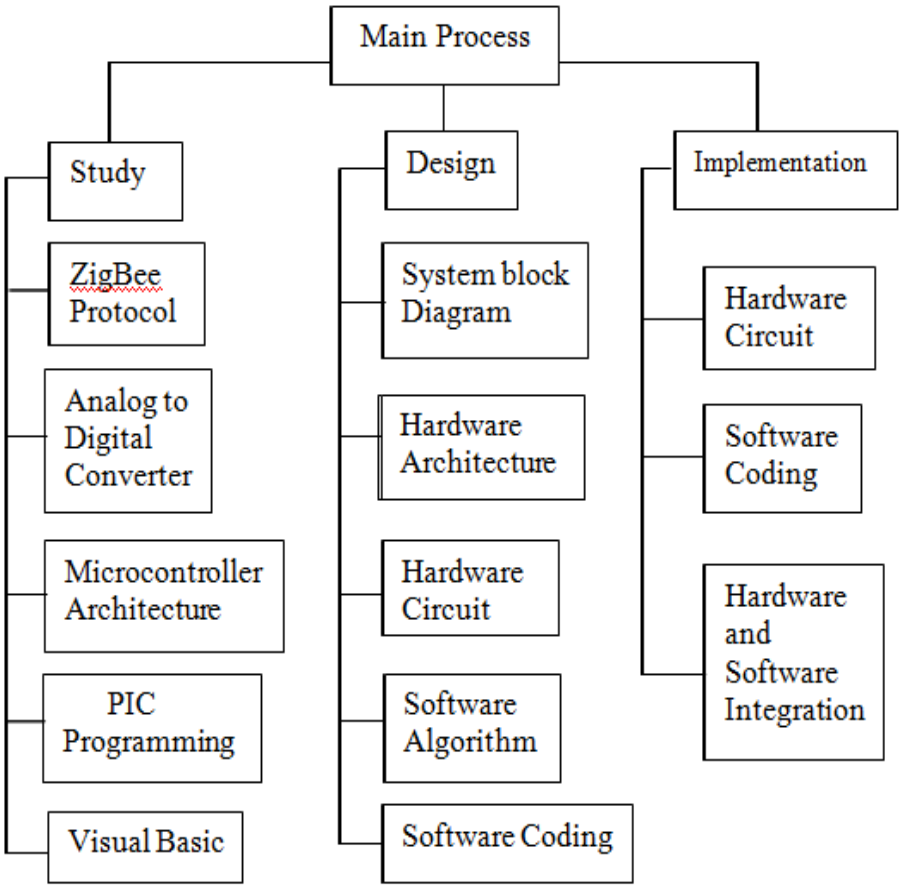

Figure1.2 Work Breakdowns for the Project

1.6 Work Flow

The summary of work flow for this project is simplified into block diagram as shown in the Figure 1.3 below. The starting point of this project is the literature review and theoretical study. But, these actions are continuous as new information must be gathered from time to time in order to proceed with this project.

After having an overview of the component to include in this project, the suitable components were selected based on the scope and limitation of this project. Hardware implementations begin after the components were available. On the other hand, software implementations begin with algorithm for the analog to digital 5 converters and continue with the graphical user interface. After that, the whole system was integrated for testing and optimization before the real demo and presentation to the panel of the final year project.

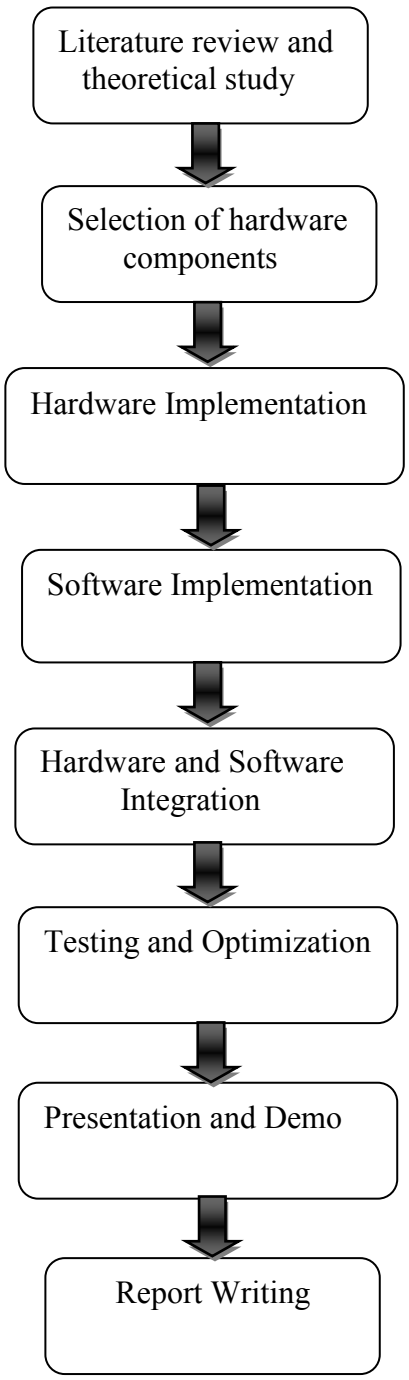

Figure 1.3 Work flow of This Project

Figure 1.3 shows the detail of the works done with the time spending on it for the duration of two semesters.

1.7 Thesis outline

This thesis is a report of a final year project of title “Wireless Water Meter System”. There are five main chapters explained in detail within this thesis. Chapter 1 explain in detail the information about the project background, problem statement, objectives, scope, work flow, thesis content and work breakdown. In this chapter, the reader could find out the overview of this project and also the significant of this project. Next in chapter 2, the related literature to this project is provided in detail. The topic explained in this chapter included approaches, Design issues, Radio frequency utilization, software programming and basic of hardware involve. Chapter 3 is about design and implementation. In this chapter, the design and implementation step is explained in detail including the prototype. In Chapter 4, all the results and analysis about the system either it achieve the objectives or not and the last, Chapter 5 summarizes this project and with recommendations.

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

This chapter presents the fundamental of ZigBee Protocol and the principle used to transmit and receive the data by using wireless communication system. This chapter also describes the content of PIC architecture, types of LCD Display, software programming, communication standard and other relevant fundamentals and components used in the project.

Traditional method to gather data from residential meters such as water meters to by sending technicians to a residential area. The technicians then record data manually into notebooks or electronic PDAs and store these data into a database for further processing. This method usually results in high labor costs and could easily cause human errors due to several factors. For example, a technician may record wrong data from a meter because of his fatigue or faded colors on a numerical display. To do remote metering, existing analog water meters have to be converted to digital ones. Also the information consumed water volume must be transmitted to the center through wireless communication equipments.

2.2 Approaches

There are several approaches have been proposed to improve meter data gathering to reduces costs and error. Currently applied approaches can be categorized as follows:

2.2.1 Radio Frequency (RF)

RF communication is applied to transmit data from the water meters to a base station as follows:

i. **Fixed Based Station**

In this method, meters directly transmit data using RF links to a fixed based station. However, this method can cover only a small area close to the station since the effective distance of RF propagation from a water meter to a high gain antenna at the base station is limited to short range due to limited battery powers of meters.

ii. **Mobile Radio Station**

This method is known as “walk-by” or “drive-by” method. A technician can carry a mobile station to read data from meters by either walking or driving into an area within an effective RF distance. For a small antenna, the effective distance is about 50–100 m from a meter.

2.2.2 Mobile Telephone Network

In this approach, a meter utilizes a cellular telephone network to send data via MS or GPRS to a base station. Although this method offers a longer effective distance, less human labor costs, and ease to gather data, but communication equipment and calling services from many meters to a based station are expensive. Thus, this approach is usually applied at where the number of meters used is low and for large consumers such as industrial plants. With a capability to collect data from areas to a base station using an ad-hoc manner, a wireless sensor network becomes an alternative for data gathering of water meters. An ad-hoc configuration can be utilized to gather data from a large number of sensor nodes to a sink node or a base