WIRELESS DATA LOGGER

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DEDICATION

To my beloved father and mother

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ABSTRACT

This Wireless Data Logger project uses two types of sensors, a Programmable Intelligent Computer (PIC) micro-controller and also uses Graphical User Interface (GUI) as the control panel. The main objective of this project is to design a simple and multi-functional data logger. Two types of sensors used for these projects are temperature and humidity sensor (HSM-20G). Control panel is designed and built using Microsoft Visual Basic 6 meanwhile for the PIC micro-controller (PIC16F873); it is programmed by using C Programmer. This device uses Bluetooth communication as a transmission medium between the hardware and the control panel. A control panel on the personal computer (PC) is used as a key to monitor the system by displaying the data from sensors and then analyzing the data. Moreover, the control panel is designed so that it is able to capture the data into database and also transform the collected data into a variety of graph. As a result, the control panel is capable to displayed the temperature (in degree Celsius) and humidity (in percentage) data. It is also capable to construct graphs from the collected data. The maximum distance for this system to communicate is 15 meters provided that there are no obstacles or interference.

ABSTRAK

Projek Perekod Data Tanpa Wayar ini mengaplikasikan penggunaan dua jenis alat pengesan, pengawal mikro litar aturcara antara muka (PIC) dan alat kawalan grafik (GUI) sebagai panel kawalan. Objektif utama projek ini adalah untuk menghasilkan perekod data tanpa wayar yang ringkas dan mempunyai pelbagai fungsi. Dua alat pengesan yang digunakan untuk projek ini adalah alat pengesan suhu dan pengesan kelembapan (HSM-20G). Alat kawalan grafik direkabentuk dan dibina dengan menggunakan Microsoft Visual Basic 6 manakala alat pengawal mikro PIC (PIC16F873) diprogramkan dengan menggunakan Program C. Alat ini juga menggunakan Bluetooth sebagai medium penghantaran data di antara bahagian litar dan panel kawalan. Panel kawalan yang direka bentuk adalah alat yang digunakan untuk memaparkan bacaan daripada alat pengesan serta menganalisa data tersebut. Selain memaparkan bacaan, bacaan tersebut boleh disimpan melalui pusat data serta mampu memindahkan data-data yang telah disimpan ke dalam pelbagai bentuk graf. Keputusannya, panel kawalan boleh memaparkan data bacaan suhu (dalam degree Celsius) dan kelembapan (dalam peratusan). Panel kawalan juga mempunyai kebolehan untuk menghasilkan graf daripada data terkumpul. Jarak maksimum yang mampu dicapai untuk system ini berkomunikasi jika tidak terdapat sebarang halangan adalah di dalam julat 15 meter.

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LIST OF ABBREVIATIONS

ACL   -   Asynchronous Connection Link

ADC   -   Analog to Digital Converter

ASCII   -   American Standard Code for Information Interchange

FHS   -   Frequency Hopping Synchronization

GUI   -   Graphical User Interface

I/O pins   -   Input or Output pins

ISM   -   Industrial, Scientific and Medical Radio Band

PAN   -   Personal Area Network

PC   -   Personal Computer

PCB   -   Printed Circuit Board

PDA   -   Personal Digital Assistant

PIC   -   Programmable Interface Circuit

SCO   -   Synchronous Connection Oriented

TDD   -   Time Duplex Scheme

UART   -   Universal Asynchronous Receiver Transmitter

WLAN   -   Wireless Local Area Network

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CHAPTER I

INTRODUCTION

1.1   Introduction

There is no doubt that the growth of Bluetooth technology over the past years has been phenomenal. However, most of the users claim that Bluetooth as wireless communication only used by mobile phone to talk to headsets. Although this is still largely true, Bluetooth is finding its way into more routine form of communication such as data logging. A data logger is a device which collects and record data mostly in real time. The system gets the data by built in instruments or sensor. Unfortunately, most of the wireless data logger products in market are expensive, complicated and unfriendly with user.

The original model for this system consists of stand alone data logger. As the requests from users are getting higher, the application of wireless communication as medium transmission is more rapidly used. User will find convenience by using the wireless communication rather than the use of wires. Other than that, extra feature or some kind of bonus will be add to this system which is capable to access to wireless communication for alarming some events. Moreover, these systems which apply low power consumption are easy to manage and install. With some extra features, this system will fulfill the criteria needed by the user. All the criteria will include in this project of Wireless Data Logger using Bluetooth Technology.

1.2   Objectives

There are several objectives for this project;

1)   The main objective for this project is to design a wireless data logger using a Bluetooth technology as a medium transmission. A Bluetooth transmission is use to transfer the data which collected from the sensor through the programmable integrated circuit microcontroller (PIC micro-controller) before entering a Bluetooth device to transmit data to PC.

2)   This project will apply the PIC micro-controller and two type of sensor; temperature and humidity sensors. The PIC micro-controller is programmed to collect the data when it received request form the control panel

3)   A logging frame work which is control panel is design by using Microsoft Visual Basic 6 to access and monitor the temperature and humidity at surrounding area.

4)   A Wireless Data Logger is design with a low cost to be a simple data logger with multiple functions. A minimize components and economical components must be use to achieve this objective.

1.3   Problem Statement

As mention before, this system used wireless communication as medium transmission rather while compared to the previous version of data logger, it only used wires. Moreover, some extra features could be installed in this project that will provide a convenience to the user. This invention is more likely could overcome the weakness of the previous data logger product.

1)   By using this Bluetooth technology, user will find more convenience to handle the system compare with the older version of data logger. By doing so, user doesn't need to alter the wires if there is situation needed. In this project, Bluetooth communication can provides maximum range of 15 meters transmission distance.

2)   This project also can access and monitor the temperature and humidity of surrounding area by using control panel on PC almost in real time. In addition, the reading data also could be placed into database and user can access the previous data logged at any time. Compared to the previous data logger, it only capable to display the reading data. Moreover, user could possible to create graphs from the database to use as analysis and reports. This factor does not included in a simple data logger previously and most likely to be installed in this project.

3)   This project likely will be done for a low cost and simple installation system as most of the products in the market are expensive and unfriendly user. With a low cost of making this project, users will have more option to buy this product.

1.4   Scope of Work

The scope for this project is divided into two part; hardware and software part. For the hardware part, it consists the designing the wireless data logger prototype which consists of two types of sensors; temperature and humidity sensors, PIC micro-controller and also capable to transmit the data through the wireless transmission. The PIC micro-controller (PIC16F873) is programmed to integrate with software part as to make sure that the connection between both parts is available. Then, the hardware is fabricated by using printed circuit board (PCB).

As for software part, it includes the development of a control panel programming for control panel and the programming for PIC micro-controller. Both programming will control and gain the connection between the control panel on PC and the hardware part via Bluetooth devices which located at each part. A Bluetooth dongle device is used for computer meanwhile a Bluetooth module component will be used for the hardware part. Microsoft Visual Basic 6 is used for development of programming for the control panel meanwhile C programming is needed to creating the source code for PIC microcontroller.

CHAPTER II

LITERATURE REVIEW

2.1   Bluetooth History

The name Bluetooth is derived from the cognomen of a 10th century king of Denmark, Harald Bluetooth. His real name was Harald Gormsson. He waged war against Germany and commanding a huge armada of Viking ships which almost of his crews overran northern Germany.

According to the inventors of the Bluetooth technology, Harald engaged in diplomacy which led warring parties to negotiate with each other, making Bluetooth a fitting name for their technology which allows different devices to talk to each other. His achievement could symbolize the unification of the technology thus the Bluetooth logo is based on the H and B runes [1].

2.2   Bluetooth Technology Background

Bluetooth is an automatic communication between various devices within a small area in a house or an office which using portable devices. Bluetooth technology has potential and is growing fast and quick. It makes all the connections between devices are instantaneous and invisible. The devices can still manage to

communicate even there are obstacles between them because Bluetooth technology utilizes a radio-based link.

Bluetooth is actually a standard for wireless communications between devices in a personal area network (PAN) using radio frequency for a short range. In addition, any two devices that follow the standard can communicate and exchange data between each other without the need of any connection to be made between them. The key features of Bluetooth wireless technology are robustness, low power consumptions, and low cost [2].

Bluetooth wireless technology is a specification designed to enable wireless communication between small, mobile devices. Functionally, Bluetooth is no different than a physical cable. The key difference is that Bluetooth uses a radio link to connect devices instead of a cable. From that end, Bluetooth is an enabling technology and not an application. The inspiration behind this technology was the desire to eliminate the need for proprietary cables which are currently required to enable device connectivity.

For instance, in order to transfer images from a digital camera to a laptop PC, a cable is needed in order to connect the camera to the laptop. Each camera manufacturer and model has a different cable requirement. In fact every hand held device manufactured which allows connectivity with a PC has a different cable configuration. Imagine a scenario in which both the laptop PC and the digital camera use Bluetooth wireless technology. In this case there is no need for cables to transfer data between devices. Instead, the data can be transferred over a radio link. Expanding that idea to include all hand held mobile electronic devices is, in a nutshell, the Bluetooth wireless technology vision [3].

Basically, Bluetooth devices are classified according to three different power classes as shown in the following table;

Table 2.1: Power Classes for Bluetooth Services [4].

Class	Maximum Permitted Power (mW/dBm)	Distance Covered
Class 1	100mW (20 dBm)	100 meters
Class 2	2.5mW (4 dBm)	10 meters
Class 3	1Mw (0 dBm)	1 meters

2.3   Bluetooth Operation

The Bluetooth device (physical layer) operates in the unlicensed ISM band at 2.4GHz. This system applies a frequency hop transceiver to avoid interference and fading. During the operation, a physical radio channel is shared by a group of devices that are synchronized to a common clock and frequency hopping pattern. Master is known as a device which provides the synchronization reference. All other devices are known as slaves. Then, a group of devices which included master and slaves synchronized in a form of piconet. This is the fundamental form of communication for Bluetooth wireless technology.

Devices in a piconet use a specific frequency hopping pattern which is algorithmically determined by certain fields in the Bluetooth specification address and clock of the master. The basic hopping pattern is a pseudo-random ordering of the 79 frequencies in the ISM band. The hopping pattern may be adapted to exclude a portion of the frequencies that are used by interfering devices. The implication of hopping technique improves Bluetooth technology co-existence with static (non-hopping) ISM systems when these are co-located [4].

The physical channel is sub-divided into time units known as slots. Data is transmitted between Bluetooth enabled devices in packets that are positioned in these slots. When circumstances permit, a number of consecutive slots may be allocated to a single packet. Frequency hopping takes place between the transmission and reception of packets. Bluetooth technology provides the effect of full duplex transmission through the use of a time-division duplex (TDD) scheme [3].

Above the physical channel is a physical link. Physical links formed a connection between two devices and transmit packets either way between them. In piconet concept, there are connections between the master and slaves but slaves are not connected directly between them. A Bluetooth device can communicate with up to seven slave devices and has mention before; it has its own address and internal clock to calculate the frequency-hop sequence. If it is connected to more that one, it is a point to multipoint connection.
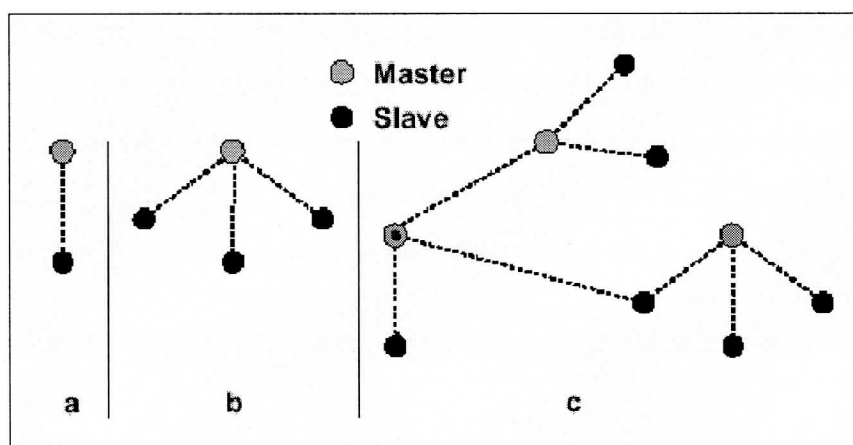

Figure 2.1: Piconet with a single slave operation (a), a multi-salve operation (b) and scatternet operation (c) [4].