DESIGN AND IMPLEMENTATION OF A SERIAL-BASED DATA ACQUISITION SYSTEM

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I would like to dedicate this thesis to my family and somebody special, whose encouragement and support was a great help in completing it.

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ABSTRACT

The objective of this project is to realize a basic serial-port-based data acquisition system. Function of my project can be use to Measure data a fixed interval by using probe and send them to a personal computer (PC) using a serial-based link. PC will receive the data and stores or display them appropriately. This project can be adopted to suit many applications such as meter level (monitoring device) and PC based oscilloscope.

ABSTRAK

Objektif projek ini ialah untuk merealisasikan satu sistem pemerolehan data berasaskan bersiri pelabuhan berpangkalan. Fungsi projek saya boleh digunakan untuk mengukur data dari satu jarak yang tetap dengan menggunakan penyiasatan dan menghantar mereka untuk sebuah komputer peribadi (PC) menggunakan satu bersiri berpangkalan hubungan. PC akan menerima data dan simpan atau dipamerkan mereka mengikut kesesuaian. Projek ini boleh diterima untuk disesuaikan banyak penggunaan laksana tahap meter (alat pengawasan) dan PC berpangkalan osiloskop.

CONTENTS

CHAPTER I

INTRODUCTION

1.1 Overview

Nowadays in real world, there were many ways to send data from one source to the destination.

This project is all about study and implementation of sending data process. The title of this project was 'Design and Implementation of A Serial Based Port Data Acquisition System'. The importance of this project was it can be used to collect data or read data from a source and send it to the destination. Example, collecting data from a source such as variable voltage by using probe and display the data or value of variable voltage on PC screen.

In this report, the process of sending data from outside world or hardware component to the PC using serial cable will be focused and how to design and implement it will be discussed.

1.2 Objectives

During this project, there were three main objectives to be completed.

1) Design a basic serial-port-based data acquisition system.
2) Implement the serial-port-based data acquisition system.
3) Test the serial-port-based data acquisition system.

1.3 Problem Statements

These are many instances in which data (such as temperature, water level, pressure, etc) need to be measured and consequently manipulated and displayed. It is proposed here to take advantage of the capabilities of a modern PC to take care of all data manipulation tasks (storage, calculation, display, etc), thus simplifying the need of external hardware to simple data measurement circuitry.

1.4 Scopes Of Work

The scope of this project will be divided into two parts that are:

i) Personal Computer (PC) Programming
   a) Data storage
   b) Serial-based communication
   c) Text-based and graphical (optional) display of measured values

ii) PIC Microcontroller Programming
   a) Usage of PIC's internal analog-digital converter (ADC)
   b) LCD interfacing
   c) Timer/interrupt programming
   d) Serial-based communication

1.5 Overview Of Project Methodology

Figure shows the flow of project methodology/approach for this project.

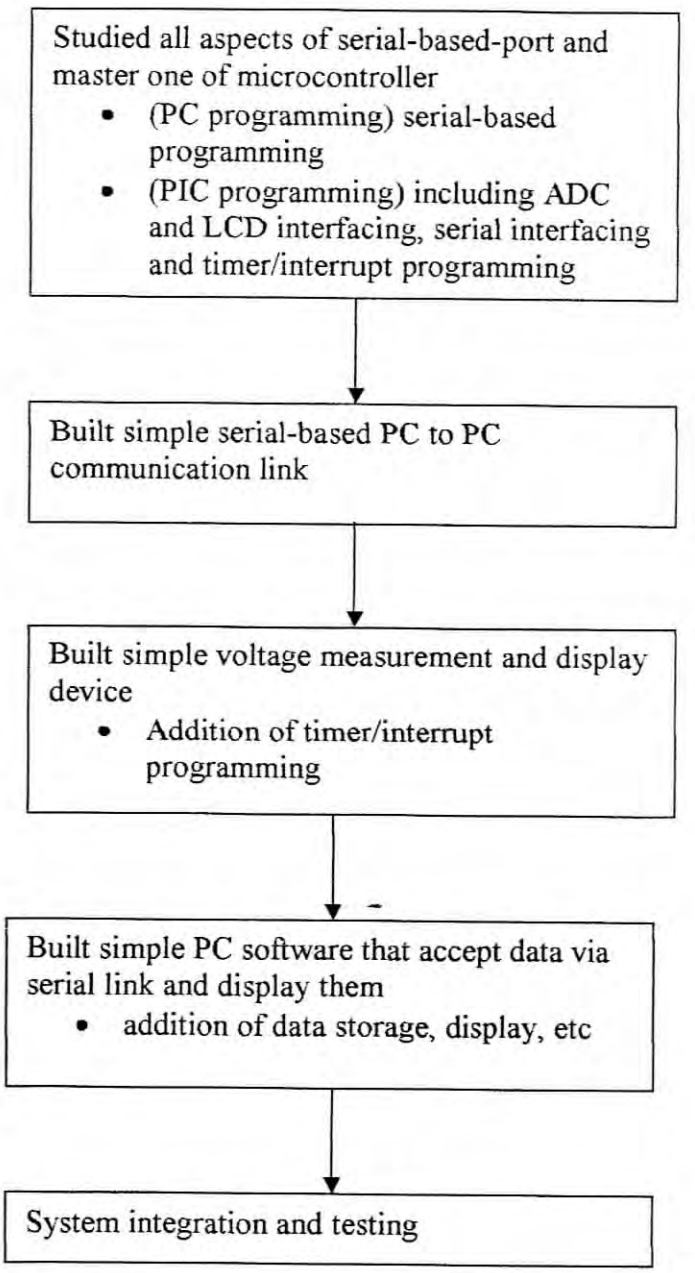

Figure 1.1 : Flow of Project Methodology

1.6 Report Structure

This thesis represent by five chapters. Chapter I will focus on brief introduction of the project carried. The important overview or description including the problem statement, project objectives and project scopes are well emphasized in this part.

Chapter II will be discussing based on the literature review of this project. It is mainly focused on PIC microcontroller characteristic and their functions. In this chapter also will be discussing on information related based on serial port functions, characteristics and samples of implementations.

Chapter III will explain on the concepts, theories and principles used in order to complete the project. This part consists of the methodology and also the information on research and experiment carried during the project development.

Chapter IV is mainly focused on the result and analysis done using the device. All testing and verification result are attached with the aid of figure, table and statistic related to the project.

Chapter V is a complimentary of previous four chapters. It describes on the overall project, discussion and suggestion for the project. All matters arise including the problems and unachieved objectives will be described clearly in this part.

CHAPTER II

LITERATURE REVIEW

2.1 Overview

This chapter is discussing about the theory and components use on this project. There are some theories in this project such as serial-based theory, parallel-based theory and visual basic theory.

2.2 Radix

Now, the personal computer which you are using is working with the software. The software is the one to have written the operation order of the hardware (the personal computer). It is possible to make do the various operations to the hardware when making memorize this procedure at the memory and making execute it in the order. It is possible to make do the operation which is different with the same hardware by changing the software. It is very convenient. In the software of the computer, hexadecimal is often used.

2.2.1 Decimal

In our daily life, 10 numbers from "0" to "9" are used. In case of the count-up, after 9, the carry is done and becomes 10. We are using properly but this is the count method of the number which the human being decided. This seems to depend on that the fingers of the hand of the person is 10.

2.2.2 Binary

Only two values of "0" and "1" are used to express a condition by the digital world which included a computer. These are sometimes expressed by "Low level " and "High level ", too. Like 0 1 10, after 1, it is 10.

2.2.3 Hexadecimal

In the condition to be handling with the computer, it is a binary number but it is difficult to understand for the person who is using the decimal.

163(Decimal) → 10100011(Binary)

Therefore, a hexadecimal is used as the expression which it is easy for the person to understand. As for the hexadecimal, 16 numbers are used for 1 digit. It is from 0 to 9 that it is expressed by the figure. So, six of the remainder are expressed by the alphabet.

10 → A,
11 → B,
12 → C,
13 → D,
14 → E,
15 → F

The figure has begun with 0. Therefore, 10 of the figure shows the 11th and 15 shows the 16th. 16 kinds of conditions are expressed by 4 bits in the binary. Oppositely, the hexadecimal is used because that it is possible to express 16 by 4 bits. There is the octal which is expressed by 3 bits. In case of the hexadecimal, 1 byte is expressed by 2 digits. Also, it puts "h" to distinguish the hexadecimal from the decimal. *h* is the initial of hexadecimal(16). It shows in 00h or H'00' or 0x00. However, an expression isn't unified.

2.2.4 The correspondence of radix

The correspondence of Binary, Decimal and Hexadecimal is as follows.

Decimal	Binary	Hexadecimal
0	0	0h
1	1	1h
2	10	2h
3	11	3h
4	100	4h
5	101	5h
6	110	6h
7	111	7h
8	1000	8h
9	1001	9h
100	1100100	64h
127	1111111	7h
128	10000000	80h
200	11001000	C8h
255	11111111	FFh
256	100000000	100h
300	10010110000	12Ch
400	110010000	190h
500	111110100	1F4h

511	111111111	1FFh

Figure 2.1 : The correspondence of Binary, Decimal and Hexadecimal

The change of Binary, Decimal and Hexadecimal can make simple if you use the function electronic calculator which is attached to the Windows. When changing without using the calculator, it is possible to do in the following way.

- Binary to Hexadecimal:

It is possible to change simply if dividing 4 bits.
It is easier if learning a binary pattern to Fh from Ah.

Example: 1 1 1 0 0 0 1 0 0 1 0 0 0 1 0 0 0 0 1 0 0 → 1C4884h

- Hexadecimal to Binary:

It is possible to change 1 digit of the hexadecimal into the binary in the order.

Hexadecimal	Binary
5F37Bh	1 0 1 1 1 1 1 0 0 1 1 0 1 1 1 1 0 1 1

Figure 2.2 : Hexadecimal to Binary

- Binary to Decimal:

Binary	1	1	1	0	0	0	1	1	0	1
Decimal	512	256	123	64	32	16	3	4	2	1

Figure 2.2 : Hexadecimal to Binary

This is troublesome a little.

First, you write a decimal value every bit like the following figure. Total the decimal value of the bit of "1".

Example: 512 + 256 + 128 + 8 + 4 + 1 = 909

- Decimal to Binary:

This is terrible a little, too. Subtract the maximum number of power of two(1,2,4,8,16,32,64,128,256,512,1024,...) which can be subtracted from the decimal number. It makes the bit which corresponds to the number of power of two which could be subtracted to "1". Subtract the number of power of two which could be subtracted from the remainder more. Hereinafter, repeat similar subtraction until the remainder passes away. The row of "1" and "0" by above result is a binary number.

Example: "582"

582 – 512 = 70 6 – 4 = 2

70 – 64 = 6 2 – 2 = 0

Decimal	512	256	128	64	32	16	8	4	2	1
Binary	1	0	0	1	0	0	0	1	1	0

Figure 2.3 : Decimal to Binary

- Decimal to Hexadecimal:

Change a decimal into the binary first and change a result into the hexadecimal more. In case of the example (D B) which was shown above, 582 = 1001000110 = 246h. When changing directly, there is a way of dividing by the value of 4 bits.

582 / 256 = 2 remainder 70

70 / 16 = 4 remainder 6

The result is 246h.

When changing directly, there is a way of multiplying the value of 4 bits.

3 x 256 = 768

8 x 16 = 128

The result is 768 + 128 + 13 (Dh) = 909.

2.2.5 2's Complement

The 2's complement is the one which shows negative numerical value.

For example, "-1" of the decimal number is 11111111 when showing by the binary with byte. It is as follows when confirming.

0 0 0 0 0 0 1 (1)

\+

1 1 1 1 1 1 1 (-1)

0 0 0 0 0 0 0 (0) The overflow occurs but the numerical value becomes zero.

A binary addition is done from the lower rank figure like the decimal number. When there is a carry, it calculates a higher rank figure including it.

To use a negative value, there is a condition. The numerical value which it is possible to show at the byte is 256 kinds of 0 to 255. However, when using the negative value, it becomes 255 kinds of - 127 to +127. The reason why the numbers are few is because 10000000 aren't used. The row of these bits shows -0 but in the calculation, it can not use. Most significant bit 7 is used as the sign bit which shows negative or positive. The type with numerical value must be considered when processing it. For example, it is 10000001 when showing -127 in the binary number. It becomes 129, supposing that this is only plus numerical value.

A change into the 2's complement is done as follows.

Example of attempt to change 56 into -56:.

(1) Subtract 1 from the value 56 - 1 = 55

(2) Change this into the binary 55 00110111

(3) It makes 0 and 1 opposite 00110111 11001000

11001000 is the binary number which shows -56.

It is as follows when confirming.

(+56) 00111000

\+

(-56) 11001000

00000000 The answer became zero.

2.3 PIC 16F877A

2.3.1 PIC 16F877A Pin Diagram

This diagram was taken directly from datasheet of PIC16F877A from Microchip.com.

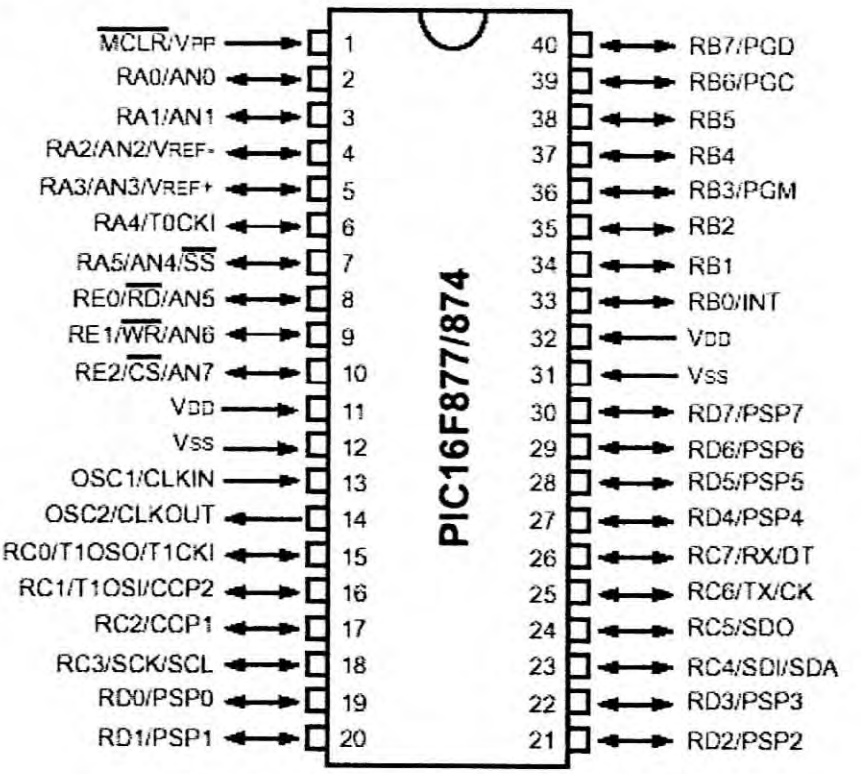

Figure 2.4 : Pin Diagram of PIC 16F877A