WEB BASED (CGI) WEATHER MONITORING & DATA LOGGING SYSTEM

YEOH CHAI TICK

KOLEJ UNIVERSITY TEKNIKAL KEBANGSAAN MALAYSIA

"I / We admit that to have read this report and it has follow the scope And quality in Partial Fulfillment of Requirements for the Degree Of Bachelor of Electronic Engineering (Industrial Electronic)"

Signature :

Supervisor Name : Mr. HO YIH HWA

Date : APRIL 2006

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Kolej Universiti Teknikal Kebangsaan Malaysia

APRIL 2006

I admired that this is an original my own work with the exception which I have referenced them to explained sources.

Signature	:	
Writer Name	:	YEOH CHAI TICK
Date	:	APRIL 2006

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ABSTRACT

The project is to develop a low cost, flexible web based weather monitoring and data logging system. The weather system consists of numbers of weather sensor nodes and a main weather server. The weather sensor nodes were built by microcontroller and several sensors and installed at any Windows™ based computer (PC) anywhere around the world. It can monitor and record the reading of sunlight density, rain, temperature, relative humidity, and pressure 24 hours a day. Weather data would be collected from all weather sensors nodes to a main weather server via VB program through RS-232 link (node to PC) and TCP/IP connection (PC to main weather server). The main weather server with several server programs included database server and web server are needed for weather data collecting, analyzing and displaying. The flexibility features of this weather system allow it to display weather content dynamically to internet and GSM network. Users can retrieve weather information through any web accessible device like computer, 3G/GPRS GSM mobile devices and etc.

ABSTRAK

Projek ini adalah untuk membangunkan suatu sistem cuaca jenis web yang murah, fleksibel dan berupaya menjalankan kerja-kerja pengawasan dan pengimpanan data. Sistem Cuaca ini terdiri daripada beberapa sensor cuaca dan satu pelayan cuaca utama. Nod sensor cuaca ini menggunakan mikro-pengawal bermodel PIC16F877A dan beberapa sensor. Ia boleh digunakan di mana-mana computer (yang mempunyai Windows™) di seluruh dunia. Nod sensor cuaca boleh menbaca ketumpatan cahaya matahari, hujan, suhu, kelembapan relatif, dan tekanan selama 24 jam setiap hari. Data cuaca akan dipungut dari semua nodus sensor cuaca ke pelayan cuaca utama melalui VB program dengan sambungan RS 232 (nod ke PC) dan sambungan TCP/IP (PC ke pelayan cuaca utama). Pelayan cuaca utama dengan beberapa program pelayan termasuk pelayan pangkalan data dan pelayan web diperlukan untuk mengumpul, menganalisis dan penpameran data cuaca. Ciri-ciri fleksibiliti sistem cuaca ini telah membenarkan maklumat cuaca dipamerkan secara dinamik ke internet dan rangkaian GSM. Pengguna-pengguna boleh mendapatkan semula maklumat cuaca yang terkini melalui mana-mana alat yang berupaya internet seperti komputer, alat-alat bergerak GSM 3G/GPRS dan sebagainya.

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LIST OF ABBREVIATION

PCB	-	Printed Circuit Board
LED	-	Light Emitting Diode
MCU	-	Microcontroller Unit
PIC	-	Peripheral Interface Controller
	-	Programmable Integrated Circuit
EEPROM	-	Electrically Erasable Programmable Read Only Memory
IC	-	Integrated Circuit
PICC	-	Peripheral Interface Controller Card
DAC	-	Digital To Analog Converter
ADC	-	Analog To Digital Converter
UART	-	Universal Asynchronous Receiver-Transmitter
CPU	-	Central Processing Unit
ROM	-	Read-Only Memory
I/O	-	Input / Output
SPI	-	Serial Peripheral Interface
RISC	-	Reduced Instruction Set Code
Hz	-	Hertz
MHz	-	MegaHertz
DC	-	Direct Current
RAM	-	Random-Access Memory
PWM	-	Pulse Width Modulation
SSP	-	Synchronous Serial Port
I2C	-	Inter-Integrated Circuit
USART	-	Universal Synchronous / Asynchronous

		Receiver / Transmitter
SCI	-	Serial Communications Interface
PSP	-	Parallel Slave Port
RD	-	Read
WR	-	Write
CS	-	Case Series
BOR	-	Brown-out Reset
SRAM	-	Static Random Access Memory
HC	-	High Capacity
CMOS	-	Complementary Metal-Oxide Semiconductor (transistor type)
PLL	-	Phase-Locked Loop
TTL	-	Transistor-Transistor Logic
VDC	-	Volts Direct Current
DIP	-	Dual Inline Package
ASCII	-	American Standard Code for Information Interchange
SCL	-	Serial Clock
SDA	-	Serial Data
CGI	-	Common gateway interface
PHP	-	Personal Home Page
Perl	-	Practical extraction and reporting language
ppm	-	Perl Package Manager
PC	-	Personal Computer

LIST OF APPENDIX

CHAPTER I

INTRODUCTION

This Web based weather monitoring & data logging system was developed with a goal of flexibility, so that it could be easily adapted and used as part of a home or remote monitoring. Latest valuable weather information can be provided to end users through internet based, 3G/GPRS GSM mobile devices and any web accessible devices. The weather system consists of numbers of weather sensors nodes and a main weather server. Weather sensors nodes are installed anywhere around the world and collecting weather data 24 hours a day. Collected weather data will be forwarded to a main weather server via internet for data storage and analysis. Users can retrieve weather information through any web accessible device like computer, 3G/GPRS GSM mobile devices and etc.

1.1 PROBLEM STATEMENTS

Weather means the state of the atmosphere with respect to wind, temperature, cloudiness, moisture and pressure. It will results wind, storms, rain, snow and etc. Nowadays, weather information is very importance to researcher and public since many activities are weather dependent such as fishery, farming and traveling industry. Statistical weather information for certain areas are hardly available for public and local researchers. In addition, it is almost impossible to get immediate weather information. The only easy way that provide us weather information is on TV, radio and internet. Unfortunately, it is just for certain area only and the weather data are not been updated frequently. Furthermore, commercial weather monitoring systems are too expensive to afford and not flexible.

1.2 OBJECTIVES

The objective of the project is to design and develop a weather monitoring system with a goal of keeping the system flexible enough so that it could be easily adapted and used as part of a home or remote monitoring.

The developed system is able to provide latest weather information to end user, and also be a high quality, web based, low cost, flexible solution to the problem; including 3G/GPRS GSM mobile devices accessible, web accessible and etc. The main target of the project is providing a valuable information service to public and also for scientific research, so that the weather data can be use for further analysis by local researcher.

1.3 SCOPE OF WORKS

This Weather station consists of two paths; there are weather sensor node and main weather server. The weather sensor nodes consist of weather sensors board and a Windows™ based computer (PC) installed anywhere around the world. The weather sensors board was built by a microcontroller, LCD, and several sensors such as temperature sensor, pressure sensor, humidity sensor, sunlight sensor and rain sensor. This weather sensor board will do all the weather sensing, and return the data to PC via RS-232 link when requested. The LCD will display real time status of reading of the sensors. A Visual Basic program was developed for data transferring task between weather sensors board and PC via RS232 and from PC to main weather server via TCP/IP connection. Figure 1.1 shown the block diagram of the weather sensors node.

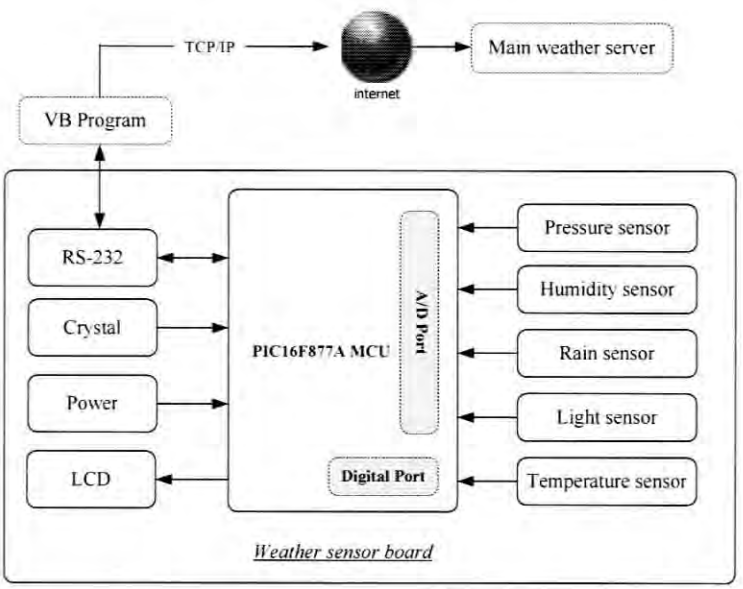

Figure 1.1: Block diagram of the weather sensors node

The main weather server is a computer which is containing a several open sources program such as apache web server, MySQL database server and PHP program. The main weather server will receive weather data from all weather sensors nodes installed around the world. Weather data will be stored into database server for further analysis. A GD library that comes together with PHP program was used for dynamically information displaying through any web capable devices such as PC and 3G/GPRS mobile phone. Figure 1.2 shown the Block diagram of the main weather sensor and Figure 1.3 shown the block diagram of the entire system.

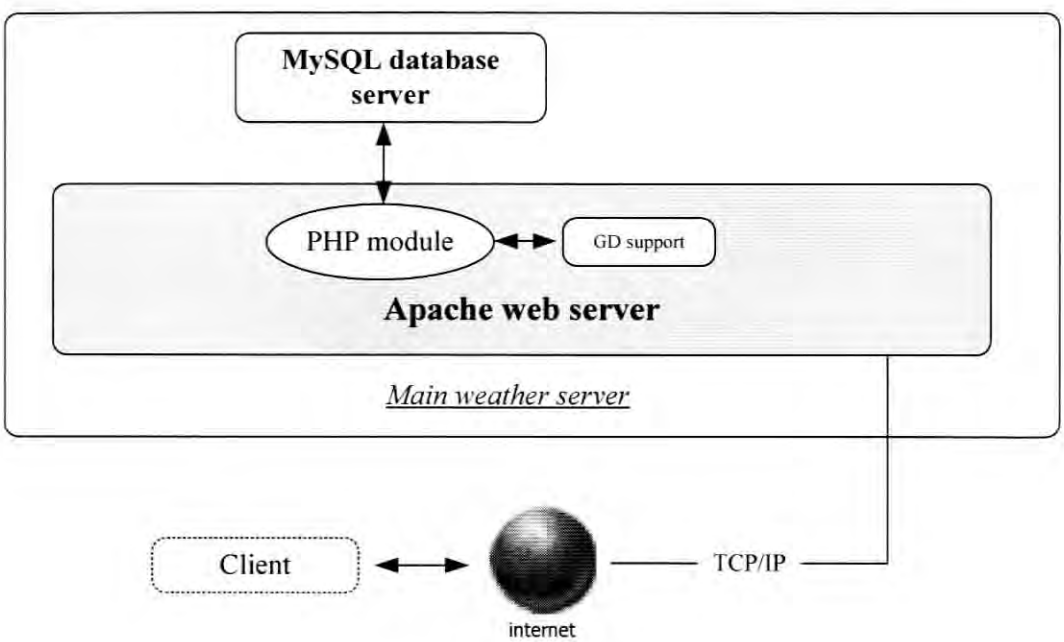

Figure 1.2: Block diagram of the main weather sensor

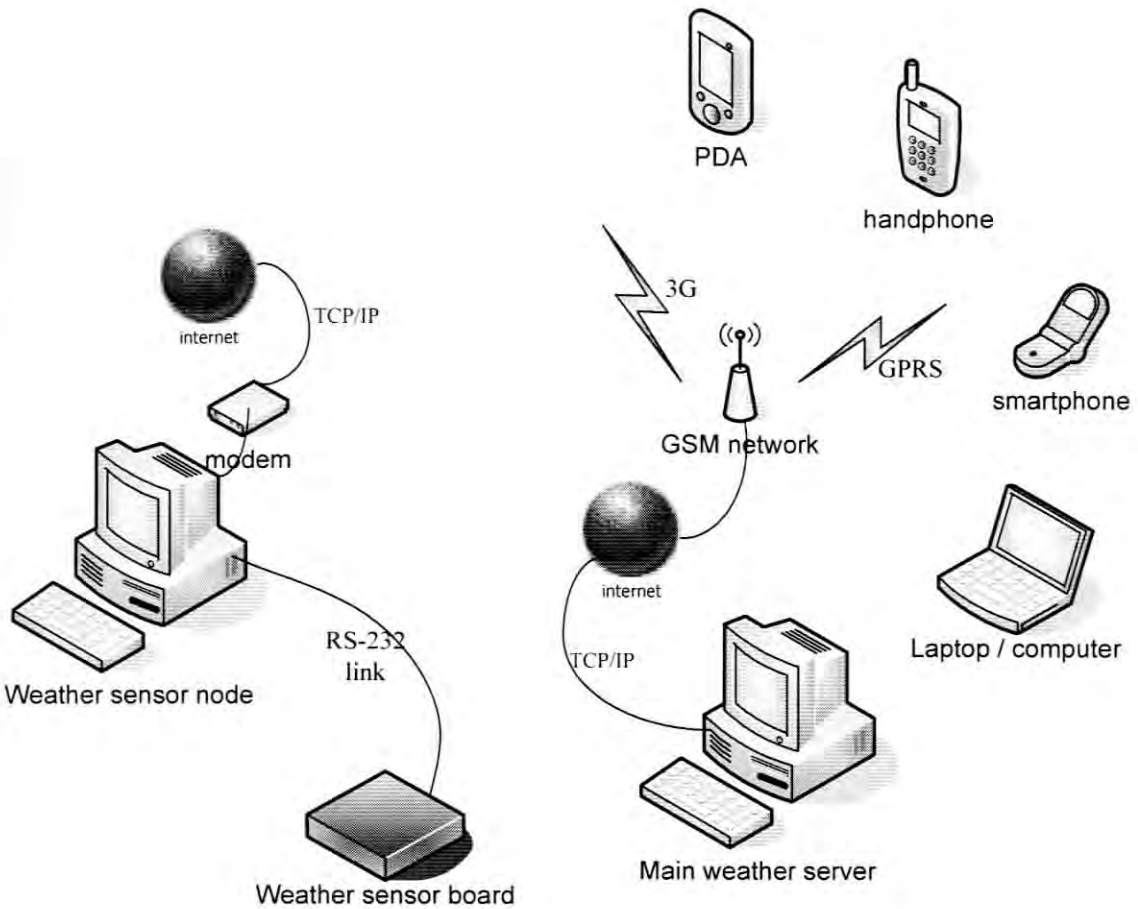

Figure 1.3: Block diagram of the web based weather monitoring & data logging system (entire system)

CHAPTER II

LITERATURE STUDY

2.1 Microcontrollers

The PICmicro®MCU is a Microcontroller that has included all the CPU, memory, oscillator, watchdog and I/O incorporated within the same chip. This saves space, design time and external peripheral timing and compatibility problems. The PIC family of microcontrollers offers a wide range of I/O, memory and special functions to meet most requirements of the development engineer.

Advantages of using PICmicro®MCU for the project, instead of using other MCU likes MSP430, 8085. as shown as Table 2.1:

Feature	Description
Code Efficiency	The PIC is an 8 bit Microcontroller based on the Harvard architecture , which means there are separate internal busses for memory and data. The throughput rate is therefore increased due to simultaneous access to both data and program memory.Conventional microcontrollers tend to have one internal bus handling both data and program. This slows operation down by at least a factor of 2 when compared to the PICmicro®MCU.

Safety	All the instructions fit into a 12 or 14 bit program memory word. There is no likelihood of the software jumping onto the DATA section of a program and trying to execute DATA as instructions. This can occur in a non Harvard architecture microcontroller using 8-bit busses.
Instruction Set	There are only 33 instructions to write software for the 16C5x family and 14 bits wide for the 16Fxxx family. Each instruction, with the exception of CALL, GOTO or bit testing instructions (BTFSS, INCFSZ), executes in 1 cycle.
Speed	The PIC has an internal divide by 4 connected between the oscillator and the internal clock bus. This makes instruction time easy to calculate, especially if use a 4 MHz crystal. Each instruction cycle then works out at 1uS. The PIC is a very fast micro to work with e.g. a 20MHz crystal steps through a program at 5 million instructions per second, almost twice the speed of an Intel 386SX 33 processor.
Static Operation	The PIC is a fully static microprocessor; in other words, if the clock stopped, all the register contends are maintained. When PIC turned into a Sleep mode, the clock will be stopped and it will sets up various flags within the PIC to allow PIC back to normal operation while wake-up. In Sleep mode, the PIC takes only its standby current which can be less the 1uA.
Drive Capability	The PIC has a high output drive capability and can directly drive LEDs and triacs etc. Any I/O pin can sink 25mA or 100mA for the whole device.
Options	A range of speed, temperature, package, I/O lines, timer

	functions, serial comms, A/D and memory sizes is available from the PIC family to satisfy many application.
Versatility	The PIC is a versatile micro and in volume is a low cost solution to replace even a few logic gates; especially where space is at a premium.

Table 2.1: Feature of PIC MCU

2.1.1 PIC 16F877A MCU

PIC16F877A is a powerful (200 nanosecond instruction execution) yet easy-to-program (only 35 single word instructions) CMOS FLASH-based 8-bit microcontroller packs Microchip's powerful PIC® architecture into an 40- or 44-pin package and is upwards compatible with the PIC16C5X, PIC12CXXX and PIC16C7X devices. The PIC16F877A features 256 bytes of EEPROM data memory, self programming, an ICD, 2 Comparators, 8 channels of 10-bit Analog-to-Digital (A/D) converter, 2 capture/compare/PWM functions, the synchronous serial port can be configured as either 3-wire Serial Peripheral Interface (SPI™) or the 2-wire Inter-Integrated Circuit (I^2C™) bus and a Universal Asynchronous Receiver Transmitter (USART). All of these features make it ideal for more advanced level A/D applications in automotive, industrial, appliances and consumer applications. Figure 2.1 shown the pin layout of the PIC16F877A MCU.

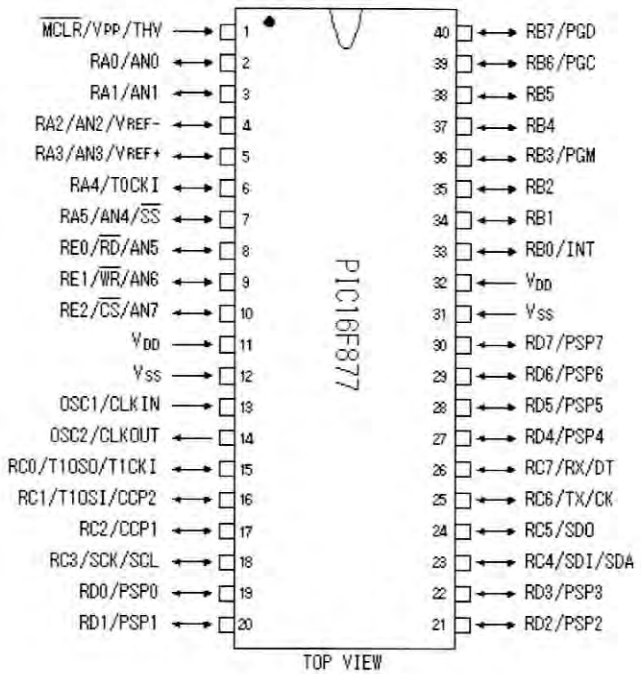

Figure 2.1: PIC16F877A pin layout

(Source: PIC16F877A datasheet)

Table 2.2 shown the PIC16F877A Pin description in details. Pin RA0-RA5, RB0-RB7 and etc are the input/output pins of the PIC. They are organized in I/O ports, each no more than 8 pins, labeled port A, port B, etc. Some of the I/O port pins will have more than one function. For example, some pins may be attached to the hardware serial port; some may be attached to the ADC's, in this case, port A and port E is attached to the ADC's.

Pin MCLR (Master clear/reset) is the reset and program mode pin. When it connected to ground, the PIC will reset itself. Normally it will connected to +5V through a pull-up resistor (10K pull-up resistor). If supplied 13V DC to this pin, PIC will automatically turn into program mode.