AN EMBEDDED WEB SERVER-BASED REMOTE MONITORING SYSTEM

TAN JIN HONG

APRIL 2008

"I hereby declared that I have read through this report and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Electrical Engineering (Power Electronic and Drives)"

Signature	:	…….
Supervisor's Name	:	Professor Madya Dr. Zulkifilie bin Ibrahim
Date	:	24 APRIL 2008

AN EMBEDDED WEB SERVER-BASED REMOTE MONITORING SYSTEM

TAN JIN HONG

This Report Is Submitted In Partial Fulfillment Of Requirements For The Degree Of Bachelor In Electrical Engineering (Power Electronic and Drives)

Fakulti Kejuruteraan Elektrik
Universiti Teknikal Malaysia Melaka

APRIL 2008

"I hereby declared that this report is a result of my own work except for the excerpts that have been cited clearly in the references."

Signature : …….

Name : TAN JIN HONG

Date : 24 APRIL 2008

Abstract

To design and develop an embedded web server using 8-bit microprocessor and TCP/IP Ethernet connection for office/home automation applications. In this project, the controller developed is based on Rabbit microprocessor and its core module model RCM 3700. Controlling the motor and others I/O like sensor and also alarms through a website base controller. Showing the I/O data through RCM 3700 with the TCP/IP Ethernet connection to personal computer in webpage. The webpage and firmware will be done in Dynamic C programming language.

For a controlling system, most of last time technology is on short distance controlling system, for example, a control system that builds in a system like a car manufacture system at 1970th. The use of internet and local area network at that time is not common so the range control system is quite difficult at that time. For the present day, the long range control system is become very common. Many types of controlling system are developed for long range control system. For example, the controlling of the Lander Beagle 2 (a remote control car that send to the Mars). At the future, this long range control technology may be developing in the speed of communication. The controlling reaction time may be become as fast as the speed of light or may be faster than the light speed.

For the hardware development, I have to do the connection to connect the I/O like motor to the RCM 3700 board. For the software part, I have to develop the embedded webpage base software enable personal computer to communicate with RCM 3700 board.

Abstrak

Projek ini bertujuan untuk mengubasuai dan mencipta satu embedded web server dengan mengunakan 8-bit microprocessor dan TCP/IP Ethernet connection untuk kegunaan automasi pejabat dan rumah. Projek ini megunakan Rabbit microprocessor and its core module model RCM 3700. Projek ini akan mengawal motor dan I/O yang lain seperti sensor dan relay melalui laman web. I/O akan ditunjukkan melalui RCM 3700 dengan TCP/IP Ethernet connection kepada computer peribadi di laman web.

Untuk system control, kebanyakkan teknologi lama menggunakan control system yang hanya boleh berkomunikasi berdekatan. Kegunaan internet dan local area network tidak digunakan dengan luas pada masa itu. Untuk masa kini, control melalui internet adalah sangat biasa. Banyak jenis long range control system telah dibuat hari ini sebagai contohnya control Lander Beagle 2 (satu kereta remote control yang di hantar ke Mars). Untuk masa depan, kelajuan communikasi akan dipentingkan. Sebagai contohnya, pada masa akan datang data – data yang dihantar mungkin akan mencapai kelajuan hadlaju cahaya dan mungkin melebihi hadlaju cahaya.

Untuk bahagian perkakasan, saya akan membuat perikatan dengan I/O untuk menghubungi RCM 3700 board. Untuk bahagian perisian, saya membuat develop dengan embedded laman web software untuk membolehkan computer peribadi bercommunikasi dengan RCM 3700 board.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

Nowadays, controlling a system via PC is very common. A web base control and monitoring system can make us control a system without distance. So developing a cost effective, programmable and high efficiency controller webpage is necessary for the world competition.

This project is titled as “An Embedded Web Server-based Remote Monitoring System”. The propose of this project is to build a remote control system through a webpage. And this system is controlled through local area network by using an embedded TCP/IP Rabbit Core Module 3700. The RCM 3700 is chosen because of have easy Program download utility, ideal for network-enabling security and lots of storage.

This project is divided to hardware and software part. The hardware part is building up an I/O that can connect to the RCM 3700. The connection between the Input/output is connected by a converter that can convert the hardware like sensor and motor signal for RCM 3700.

For the software part, webpage base embedded software will be build for enable personal computer to communicate with RCM 3700 by using Dynamic C. The changing in the I/O will be shown in the personal computer by accessing the webpage.

1.1 Objectives of the project

1. Controlling and monitoring a control system through webpage.
2. A personal computer will become a client and the rabbit microprocessor will be a server.
3. Controlled through local area network by using embedded TCP/IP Rabbit Core Module 3700 RCM 3700 as a server.
4. Design and develop an I/O interface for extended device connection to the RCM3700.
5. Develop Webpage application software will run at the PC platform.
6. Develop Webpage base embedded software will be design and develop for communication between personal computer with RCM 3700 by using Dynamic C via local area network (LAN).
7. Controlling and monitoring the I/O like motor, sensor, relay and led via webpage for distance control.

1.2 Project scopes

1. Study the architecture design and technical specification of embedded Rabbit microprocessor base controller.
2. Study the TCP/IP connection protocol.
3. Study the Dynamic C programming language environment.
4. Develop web server program.
5. Develop firmware for RCM 3700.
6. Design and develop I/O interface for devices connection like relay, sensor and motor.
7. Run the prototype controller in real-time and debug.

1.3 Problem statement

1. Controlling a system via PC is very common but PC is too expensive and cannot work continuously for long working time.
2. A web base controlling system can make us control a system without distance.
3. Controlling a webpage use the PLC based controller is very difficult because the programming language too complex.
4. Developing a cost effective, programmable and reliable embedded web controller webpage is necessary for the world competition.
5. The Rabbit microprocessor is chosen because it provide embedded based for remote automation applications like office or factory application controller that can provide good environment for webpage controlling system.
6. Integrated hardware and software development and build in with TCP/IP capabilities.

1.4 PERANCANGAN PROJEK
PROJECT PLANNING

Senaraikan aktiviti-aktiviti utama bagi projek yang dicadangkan. Nyatakan jangka masa yang diperlukan bagi setiap aktiviti.
List major activities involved in the proposed project. Indicate duration of each activity to the related month(s).

	2007							**2008**					
Aktiviti Projek *Project's Activities*	**J**	**J**	**A**	**S**	**O**	**N**	**D**	**J**	**F**	**M**	**A**	**M**	**J**
Study the architecture design and technical specification of Rabbit microprocessor.	/	/	/										
Study the TCP/IP connection protocols.			/	/	/	/	/						
Study the Dynamic C programming language and programming environment.			/	/	/	/	/						
Develop web server program.			/	/	/	/	/						
Develop firmware for RCM 3700.				/	/	/	/	/	/	/			
Build up I/O interfaces.						/	/	/					
Functional testing of the prototype controller in real-time and debug.								/	/	/			
Final report PSM I & II				/	/	/	/	/	/	/			
Presentation PSM I					/								
Presentation PSM II										/			

Table 1.1 The Gantt chart shows the project planning of the major activities in PSM1 and PSM2.

CHAPTER 2

LITERATURE REVIEW

2.1 Remote Monitoring System

The remote and monitoring system can be control by many kind of different technology. The progress can be control and monitor system via field bus, and Ethernet, power line carrier, SMS, EPRS, ADSL, GPRS, CDMA-Based, 3G-Based wireless network, telephone control and other communication means are applied to realize data transmission between data acquisition modules and data collection center. The remote and monitoring able system can be the temperature control and monitoring system, streetlight monitors and control system, remote monitoring of air-quality system, online power system, crop field remote monitoring system, remote measurement and control system for greenhouse, home automation system and some other system that will appear on our living life.

2.1.1 Embedded Web-server-monitoring System and CDMA Service (Crop Field Remote Monitoring system)

Remote monitoring systems based on web-server-embedded technology and mobile telecommunication will become a core node technology in sensing network construction because of a great deal of mobile users and spreads of digital services in next generation telecommunication in the world. Soil, environmental, and crop information monitoring are important in production management and decision-making in precision agriculture. Therefore, reliability, security and inexpensive characteristics required will be essential in the crop field information monitoring. Three improved field monitoring servers (FMS) using code division multiple access

(CDMA) services combined with IPSec-based virtual private network (VPN) function have installed to two rice practical fields in Shanghai and one maize experimental field in Beijing for constructing a remote wireless sensing network. [1]

This crop field remote monitoring system as a ubiquitous node infrastructure in wireless sensing networks is useful and powerful to collect soil, environment, and crop information in remote for precision agriculture. The real-time soil and environment data, and crop images can be dynamically collected in remote area by the crop field monitoring systems in remote. This crop field remote monitoring system using web-server-embedded technology and CDMA service with IPSec-based VPN function as a node infrastructure is powerful and useful to construct a ubiquitous wireless sensing network in low-cost and high-security for crop production. [1]

2.1.2 GSM-SMS Based Remote and Control System for Greenhouse Application

GSM (Global System for Mobile Communications), SMS (Short Message Service).

Global System for Mobile communications is the most popular standard for mobile phones in the world. Its promoter, the GSM Association, estimates that 82% of the global mobile market uses the standard. GSM is used by over 2 billion people across more than 212 countries and territories. Its ubiquity makes international roaming very common between mobile phone operators, enabling subscribers to use their phones in many parts of the world. GSM differs from its predecessors in that both signaling and speech channels are digital call quality, and thus is considered a second generation (2G) mobile phone system. This has also meant that data communication was easy to build into the system.

Short Message Service (SMS) is a communications protocol allowing the interchange of short text messages between mobile telephone devices. The SMS technology has facilitated the development and growth of text messaging. The connection between the phenomenon of text messaging and the underlying

technology is so great that in parts of the world the term "SMS" is used colloquially as a synonym for a text message from another person or the act of sending a text message. SMS as used on modern handsets was originally defined as part of the GSM series of standards.

As a new planting mode, modern greenhouse installations are marked by their high efficiency and uniformity in production of vegetable, fruitage, flower, medicinal materials, and others. The new mode breaks the restriction of region, environment, climate and other factors, and has become an incomparable planting mode. It can efficiently improve the agriculture ecology and production condition while promoting the scientific exploitation and reasonable use of agriculture resource. Moreover, output rate of earth as well as working efficiency is enhanced, and good social and economic benefits are received. Survey and control of greenhouse environment parameter is the key part in the realization and development of greenhouse installations. [2]

A greenhouse environment measurement and control system based on GSM-SMS was developed. The system adopted mobile communication between computer and microcontroller; it comprises a centre station and some base stations. The central station consists of a server together with its application software, a GSM module and a database system; the base station consists of a microcontroller, sensors, actuators and a GSM module. Modularization design procedures were taken in hardware and embedded operating system in software development, which make it easy to extend, maintain and update the system. [2]

2.1.3 The 3G-Based Wireless Networked & Intelligent Monitoring System (Pharos Management)

An intelligent monitoring system of pharos based on GSM/GPRS, GPS and GIS short message service is introduced. For the data collection, data treatment and GSM/GPRS-base data communication are implemented via field instrument. The working states and messages of pharoses, including working current and voltage, unloading voltage, GPS parameters and other environment information, are sent by SMS on GSM/GPRS system. All the information can be sent to control and

management center and the mobile telephone of manager on the watch. So the central computer of the system is able to carry out centralized management of data and remote control for wireless remote monitoring of pharoses. [3]

In practical application of pharos management system, the information transferred via SMS include parameters like location of pharos, charging current, battery cell voltage, load current and other working states. The implementation of intelligent management on pharos with GSM & SMS technology, as a wireless remote monitoring system, it is of wide application. In the navigation channel management, pharoses spread widely in inland and near-sea. To check the status of these pharoses artificially not only cost a great deal of man power and material resources, but the inspection cannot be done in time. Even worse, sometimes the artificial operation may endanger man's life. It has gear significance to apply wireless monitoring system of pharos for improving the management level &quality of pharos and navigation. [3]

2.1.4 Remote Telephone-Controlled System (Home Automation)

Home Automation System using telephone lines, will be consists of two subsystems. One is the Remote Control system. The other one is the Phone Monitoring system. The Remote Control system used the Dual Tone Multi-frequency signals to control the operations of various appliances. The hardware and software are designed based on the standard telephone system. The Phone Monitoring system provides convenient services for the user to better monitoring the usage of their phones. [4]

The systems can be installed for public use widely. Both systems were designed based on the DTMF (Dual Tone Multi-frequency) signals that are produced by the telephone system. The DTMF signals were sent from the user end to the destination end. The RC (Remote Control) system detects the number of phone ring and a set of defined codes to determine if a remote control signal has been sent out to control the operation of target appliance. If the control signal is confirmed by the system, the system will send out a control signal to initiate the operation of the appliance. The PM (Phone Monitoring) system will send out a warning signal and

automatically record the content of the conversation if it detects an in or out call of the phone.

The remote control system provides a couple of convenient services to promoting the living lives of families. The users have better control on their home appliances. This is especially important if they need such a control when they are far away from the location of their homes. This remote control style can also be applied to the control of factories. A careful design can possibly reduce the operation cost. The phone monitoring system can record the conversation on the phone. The circuit is quiet small and can be insert in telephone set easily. The circuit can be installed in series with the phone lines. The serial resistance is below 100 ohms. Therefore, the circuit will not affect the performance of telephones. [4]

The circuit extracts the power from the phone line directly and has low power dissipation. Therefore, there are no battery and antenna in the circuit. The user can listen to the conversation far to 25 meters. A commercial cascade player can record the conversation easily. The parents can use the utility to better understand the development of their children. By the way, the bulb wills turn on automatically when the phone is ringing. This function will be helpful in lighting up the room for picking up the phone when a deep night call is coming. The design of a remote control system and a phone monitoring system. Both systems are operated based on the standard telephone lines. People can have better control on their house and their lives even they are traveling in another country. [4]

2.1.5 Remote Monitoring over Internet (Air-Quality)

Air-quality remote monitoring systems, consists of monitoring controllers, monitoring agents, MNIB (MoNitor Information Base), protocols and the Internet. The air-quality monitoring systems will in 4 models: organization model, information model, communication model and functionality model. The information model deals with monitoring information structure and MNIB. The basic unit of monitoring information is a monitored object with 6 attributes. MNIB takes a tree-like structure and its leaves store a monitored object. The communication model discusses how the monitoring information is communicated between monitoring

controllers and monitoring agents. The system devise a proprietary network application layer protocols, termed as ARMP (Air-quality Remote Monitor Protocol), dedicated to air-quality remote monitoring systems. ARMP operates in four modes: monitor, monitor-next, set and trap. [5]

In Monitor mode, a monitoring controller will send a request to monitoring agents, and specify the pollutants. The Set mode is designed for a monitoring controller to write values to monitored objects in a monitoring agent. After Set operation, the monitoring agent will return to the monitoring controller for response with the same value in the object-bindings and with status information indicating whether the Set operation is successful in addition. It should be noted that the monitoring agent, instead of the monitoring controller, is active in the Trap operation. The monitoring agent initiates a communication session with a monitoring controller when any emergency occurs. [5]

2.2 Computer network

A computer network is an interconnection of a group of computers. Networks may be classified by what is called the network layer at which they operate according to basic reference models considered as standards in the industry such as the four-layer Internet Protocol Suite model. While the seven-layer Open Systems Interconnection (OSI) reference model is better known in academia, the majority of networks use the Internet Protocol Suite (IP) as their network model.

2.2.1 LAN (Local Area Network)

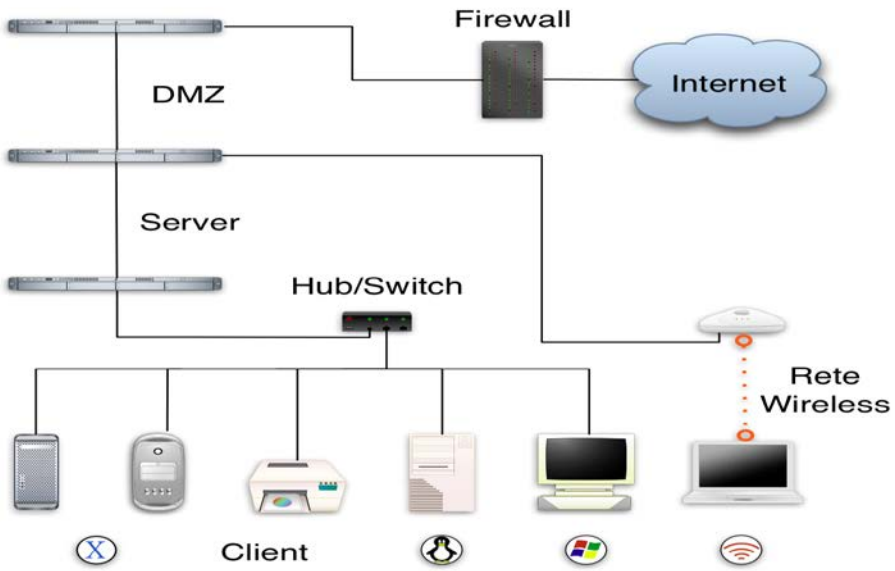

Figure 2.1 LAN connection flow

A local area network (LAN) is a computer network covering a small geographic area, like a home, office, or group of buildings. The defining characteristics of LANs, in contrast to Wide Area Networks (WANs), include their much higher data transfer rates, smaller geographic range, and lack of a need for leased telecommunication lines. [6]

Ethernet over unshielded twisted pair cabling, and Wi-Fi are the two most common technologies currently, but ARCNET, Token Ring and many others have been used in the past. Although switched Ethernet is now the most common data link layer protocol and IP as a network layer protocol, many different options have been