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A WEB-BASED CONTROL AND MONITORING SYSTEM

AHMAD ABDUSALAM FIRJANI

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A WEB-BASED CONTROL AND MONITORING SYSTEM

By

AHMAD ABDUSALAM FIRJANI

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia
in Fulfilment of the Partial Requirement for the Degree of Master of Science**

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In the name of God, Most Gracious, Most Merciful

Dedicated to,

My family



Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of
the partial requirements for the degree of Master of Science

A WEB-BASED CONTROL AND MONITORING SYSTEM

By

AHMAD ABDUSALAM FIRJANI

July 2002

Chairman: Abdul Rahman Ramli, Ph.D.

Faculty : Engineering

The Internet has become the latest medium for communication through the advanced features available on the internet such as file transfer, transaction application, advertising and much more. Recent years have been people use it also for remote control and monitoring devices.

With advances in the Internet technologies, a lot of electronic goods such as laser printers, fax machines, computers, VCRs, TV, security monitors and other home appliances will be connected by a global network called the Embedded Internet.

These systems can be built with improved diagnostic features and flexibility in terms of configuration parameters. Efficient methods of monitoring/configuring such



systems are the subject of current research and development. Remote monitoring and configuration of such systems is of great interest and importance

A web-based device monitoring and control system has been developed. This project is an integration of three systems, i.e. computer-based control system, Small web server and Internet .This integration is achieved by the use of the small web server and a designed web page using HTML, SiteObject, java script and java applet.

The developed system when connected to the network via another network or internet allows users to remotely control and monitoring home appliances. The device can be controlled via serial port of the small server and can be controlled through the designed web page. A server program was installed in the web server to instruct the small web server to perform a particular function.



Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ijazah Master Sains

SISTEM KAWALAN DAN PEMANTAUAN MENGGUNAKAN LAMAN WEB

Oleh

AHMED ABDUSALAM FIRJANY

Julai 2001

Pengerusi: Abdul Rahman Ramli, Ph.D.

Fakulti : Kejuruteraan

Internet telah menjadi medium yang popular untuk komunikasi, pengiklanan dan pemindahan fail. Mutakhir ini, ia juga digunakan untuk kawalan dan pemantauan jarak jauh. Perkembangan teknologi Internet telah membolehkan peranti-peranti elektronik seperti mesin pencetak, mesin faks, TV dan alatan-alatan elektrik di rumah bersambung dengan Internet untuk mewujudkan suatu sistem yang dikenali sebagai Sistem Terbenam Internet (*Embedded Internet System*). Tesis ini menerokai keupayaan penyambungan Internet untuk sistem kawalan dan pemantauan menggunakan web. Sistem yang dibangunkan ini terdiri daripada tiga bahagian utama iaitu kawalan berasaskan komputer, pelayan web kecil dan Internet. Bahagian-bahagian ini

disepadukan dengan menggunakan teknologi HTML, *SiteObject*, *java script* dan *java applet*.

Apabila system ini disambungkan dengan Internet, ia dapat memantau dan mengawal peralatan-peralatan elektrik di rumah. Peralatan-peralatan boleh dikawal melalui laman web melalui pengkalan sesiri. Program ditanam pada pelayan web untuk membolehkan kod-kod pelayan web menjalankan sesuatu operasi yang dikehendaki ke atas peralatan-peralatan elektrik yang disambungkan.

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I certify that an Examination Committee met on 10th July 2002 to conduct the final examination of Ahmed Abdsalam Firjani on his Master of Science thesis entitled “Web-Based Control and Monitoring System” in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

Borhanuddin Mohd Ali, Ph.D.

Associate Professor,
Faculty Engineering
Universiti Putra Malaysia
(Chairman)

Abdul Rahman Ramli, Ph.D.

Faculty Engineering,
Universiti Putra Malaysia.
(Member)

Nor Kamariah Nordin,

Faculty Engineering,
Universiti Putra Malaysia.
(Member)

Mohd Khair Hassan, Ph.D.

Faculty of Engineering,
Universiti Putra Malaysia.
(Member)



SHAMSHER MOHAMAD RAMADILI, Ph.D.,

Professor / Deputy Dean,
School of Graduate Studies,
Universiti Putra Malaysia

Date: 21 AUG 2002

This thesis submitted to the Senate of Universiti Putra Malaysia has been accepted as fulfilment of the requirements for the degree of Master of Science. The members of the Supervisory Committee are as follows:

Abdul Rahman Ramli, Ph.D,
Faculty of Engineering,
Universiti Putra Malaysia.
(Chairman)

Nor Kamariah Nordin, Mrs.
Faculty of Engineering
Universiti Putra Malaysia.
(Member)

Mohd Kair Hassan, Mr.
Faculty of Engineering
Universiti Putra Malaysia.
(Member)

AINI IDERIS, Ph.D,
Professor/Dean,
School of Graduate Studies,
Universiti Putra Malaysia

Date:



DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.



Ahmed Abdusalam Firjani

Date 15/08/2002

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CHAPTER I

INTRODUCTION

There has been an explosive growth in Internet for the last few years. Millions of computers are connected together and can exchange information through World Wide Web (www), or global networking. The availability of connection through the web has introduced many new things, such as e-commerce, Internet telephone, telemedicine and virtual library.

Nowadays Web-based control system is one of the popular control systems. Web-based control means using web pages to control external devices or automation processes. In web-based control, software isn't required to present to user a friendly GUI (graphical user interface). The web page can solve complicated control process. User can monitor and control various kinds of system by using the web browser. Thus, factory, office and home, etc. can be monitored and controlled easily by using a remote computer.

There are wide varieties of application that can be implemented using the web-based monitoring and control system. The basic is a PC-based monitoring and control system through a web browser. Others include; factory automation, office automation, and home automation. Nowadays, major factory automation depends on computer to perform control and data acquisition process. Besides,



computers have been widely used in office automation such as information displaying in moving LEDs sign.

This study involves the use of monitoring device for controlling and integrating a small server over the Internet. It combines both hardware and software in constructing the prototype.

1.1 Objectives:

The objectives of this thesis are:

- To develop and implement a prototype of web-based control system.
- To develop an interface that can be used to control the DC motor from the Internet.
- To simulate the DC motor to obtain the best result to control speed using MATLAB.

1.2 Importance of Web-Based Monitoring and Control

The ability of monitoring and controlling a remote system (or simply a device) is very useful. This means one just has to sit in front of a computer in order to monitor and control the operation of a remote system. Once monitoring and controlling task have been done successfully, the followings can be reduced:

- i. Time – the response time will be reduced.

- ii. Operation cost – it is cost effective.
- iii. Manpower – can be managed by a single user.

Besides, the efficiency of the operation system can be increased by centralizing control and monitoring.

1.3 Thesis Organization

This thesis is organized as follows: Chapter 1 gives a general background and overview of the thesis, it highlights some of the main benefits in using web-based monitoring and system especially in areas related to Internet applications. Chapter 2 covers the literature review. Further, it looks at some optimal control method in TCP/IP protocol and Embedded Systems to the Internet. Chapter 3 consists of the methodology used in designing the proposed system. The results and analysis are fully discussed in Chapter 4. Finally, Chapter 5 summarizes the finding. Conclusion and suggestion for future studies were also given.



CHAPTER II

LITERATURE REVIEW

Web technology is rapidly penetrating many business areas. Systems and network management is not exceptional. The technology is based on Internet and offers a number of benefits in terms of openness and ubiquity of its standards and tools. The ability to use a universal browser to access management functions, device status and statistics, and to configure remote managed objects from anywhere at anytime gives many advantages to a network administrator. For developers, system development cost and time can be saved by standardizing on browser instead of workstations, and by the use of existing standards and numerous supporting tools. Recently, two approaches have been proposed for Web-based management by industrial standardization bodies: Web-Based Enterprise Management (WBEM) (Subramanian 2000) and Java Management eXtension (JMX) (John et al 1999). The result from WBEM is fairly stable, but still not quite ready to deploy. JMXs technology dependency on Java results in less generality, especially for embedded environment (Arnold and Gosling 1996). Web-based technology for network management has already made the breakthrough with different practical solutions. Those solutions are fragmented and concentrated on viewing and information distribution capabilities. Researchers have extended the HTTP/HTML (Fielding, et al 1999) by Java, Web push, XML, dynamic Web technologies, and the like. Although these technologies are rapidly maturing, the

developer of Web-based management system is ~~pretty much left to his own idea~~ to figure out how to link the technologies to the management system development. No guidelines exist to help put all of these technologies and standards into perspective.

Internet technology is also forming part of embedded systems in power engineering allowing remote access to such systems. Described by Itschner (1998) *et al*, remote access is enabling cost savings in development, commissioning, use, and maintenance. These are the major driving forces for transferring Internet mass technologies from the office and commercial sectors to industrial applications. The author developed a GLASS system that provides remote monitoring capabilities to a large range of industrial facilities, from “unmanned substations to large plants or devices on mobile platforms like trains or ships. GLASS uses off-the-shelf technology and products wherever possible. GLASS proxies accumulate data from embedded system monitoring devices and store this information on the database of a server. Client applications, running in browsers with Java applets, retrieve this data through CGI scripts on the server. An unlimited variety of devices can be accessed and combined through Java-based intelligent proxies. Remote monitoring with global access through the world-wide Internet opens new service business opportunities and the foundation for cost-effective just-in-time maintenance.

Remote monitoring and control are not new features. For years, developers have included serial diagnostic ports in system with interface to PCs (personal computers), terminals, or networks. Some developers have included telephone connections for dial-

up access. These interfaces have always been custom designed, however, and dedicated to specific user equipment. In many cases, a developer created abbreviated user interfaces with cryptic coded comments to attain compact code for the interface's embedded side.

Many researchers use a PC as a Web server. Sundramoorthy (2000) had done a project to monitor or control home appliances using Internet. In his project, PIC16F84 microcontroller was used to interface between appliances and local computer. The local computer is configured as a server using free available software called OmniHttpd. Local program in the server is being used to interface directly with the hardware system. The remote program runs at the remote computer and communication with the local computer program using socket connection.

Dhuru et al. (1999) uses X10 protocol in his research entitled Home Automation and Security System. The protocol was designed to communicate between the X10 transmitters and X10 receivers over home wiring. The X10 transmitters send the commands like “off”, “on” or “dim” over the home wiring preceding the identifying code of the appliance to be controlled.

2.1 Internet Technology

The Internet has established itself as a global medium for information exchange over the last two decades. Computers have played a major role in providing new tools

and methods in varied areas of work, from medical, imaging, satellite control, and banking services (Nielsen, et al. 2000).

The Internet is a world that is both old and new. Although it has existed in various forms for well over 20 years, in the last three years it has gone through explosive growth. Although the most visible growth has been within the World Wide Web, much of the real growth to date has been in the infrastructure. It is the expanding network bandwidth and increasing number of servers available that makes the Web and the Internet possible. The communications products and servers that enable voice and data transfer serve as the first two links in the information pipeline that has enabled the Internet to have such tremendous success. More and more computers are being connected to networks and the Internet. The Web continues to evolve from a vehicle providing static information to an infrastructure delivering dynamic information (Raggett, et al 1999).

2.1.1 Transport Control Protocol and Internet Protocol

TCP/IP consists of four layers. The following Figure 2.1 shows the TCP/IP Architectural layers.