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Web Based Interactive Embedded Power Plant Management System

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Abstract: - In this project, the low operational cost but flexible web based power plant automation system is controlled and monitored. The main core of the system is an embedded hardware device. The embedded device communicates through internet which makes it accessible from anywhere in the world through a web server built into the device. In addition, internet provides a bidirectional real-time data transfer allowing interaction. The system is implemented for power plant automation by attaching several real-time modules through appropriate interfaces. The purpose of web is to provide a facility to observe and control the power system from anywhere in the world. Data acquisition system plays an important role in the field of control.

Index terms: - *Internet, power plant, embedded system, data acquisition system.*

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1. INTRODUCTION

The World Wide Web has made it possible to send a lot of data from one side of the world to the other side of the world. The use of the internet for real-time interaction embedded system is to controlling and monitoring the plants. The most logical way for accessing controlling and monitoring systems in a plant via the internet is to use a browser like Netscape or Internet Explorer. The user should be able to rapidly see what is happening in plants. Data acquisition systems with remote accessibility are in great demand in industry and consumer applications. A single person can monitor and even interact with the ongoing work from a single base station. An acquisition unit designed to collect data in their simplest form. Internet-based systems are designed to gather a bulk of data before serving them upon request. In these applications, data are compiled in a central server and are then served to the clients via the internet. A person that needs to access any data, first access the server. An indirect access to the data-acquisition unit makes the system unattractive for real-time control applications, where direct interaction with the system may be required. The need to maintain an additional server will also increase the setup costs and the costs to maintain the acquisition systems, such as regular maintenance costs, system updates, etc.

Interaction with the embedded unit is also an important issue. In an embedded PC card placed on the internet allows limited interaction through commands sent through transmission control protocol/IP and user datagram protocol. The objective of establishing internet-based control systems is to enhance rather than replace ordinary computer-based control systems by adding an extra internet level in the control system. Obviously, for internet-based control systems, the requirements should include process monitoring and control objectives. But some of requirements require a deterministic timing regime, and therefore may not be achievable due to web-related traffic delay. This sort of requirements, which are not entirely

achievable over the internet, should be excluded. The major task in the requirement specification is to identify tradeoffs between goals and constraints of the system that are conflicting or not completely achievable and resolve them.

2. THE BASICS OF POWER PLANT CONTROL

Although remote monitoring is currently one of the hottest topics within automation, it is simply not possible if the basics of plant control are not in order. The basics of power generation are protection, control and supervision. Protection can be thought of as life insurance for the plant and associated assets, control must be accurate, and supervision should provide both comfort and flexibility.

2.1 Functional modeling for Internet-based control systems

A block diagram of an internet-based control system is shown in below figure. The internet-based control system provides a way of monitoring and adjustment of process plants from any point in the internet using standard web browsers and PC.

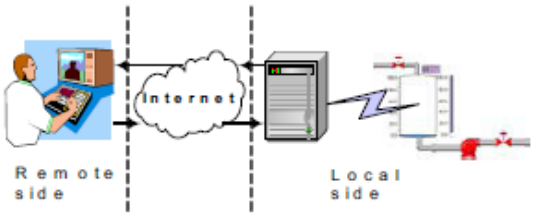

Fig.1.The block diagram of internet-based control system

Obvious advantages include:

- Access to the monitoring functionality independent from location.
- Use of zero cost software on client side to access the information.
- Internally or externally collaboration between participants.

2.2 Interactive data-acquisition system

Interactive internet-based systems provide a way to monitor and adjust using standard web browsers and a PC. The target systems can be monitored and controlled independent from the location and the platform since standard web browsers can be used on the client side.

A typical data acquisition system is made up of three components connected to each other via the internet as shown in below figure.

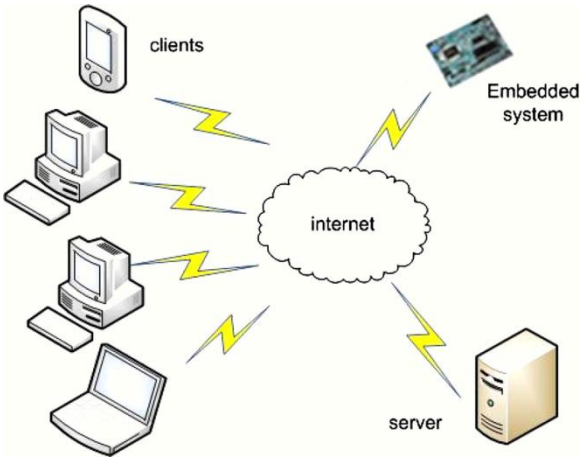

Fig.2. General diagram of data-acquisition and control systems.

The data-acquisition system needs to relay the acquired information to the requesting clients. The clients also need to send commands. If necessary, this is implemented through a server, and then, an enormous amount of data transfer time would be consumed. Thus, alternative methods need to be explored.

2.3. Establishing a direct communication link between the client and the embedded device:-

Direct communication enables access to only relevant information in the embedded system by preprocessing the data. The embedded system should also handle the web services. This eliminates the need for a central server and reduces the amount of data sent from the remote unit since only the queried data will be transferred.

To directly access an embedded system, the IP address of the embedded device should be made available to the client side. There are two choices available. A static IP could be used, or remote device should initiate a connection by reporting its IP. This choice is straightforward and simple. Although the usage cost remains unchanged, it requires a static IP setup by the service provider and involves monthly recurring costs. The other choice is to use a dynamic IP assigned through a dynamic host configuration protocol (DHCP) server of the GSM provider for every connection established. However, this IP needs to be known by any client requesting an access to the embedded server. One solution is to broadcast this IP to a dummy server and

does not require regular software updates or maintenance. The folder structure of the FTP server is shown in figure.

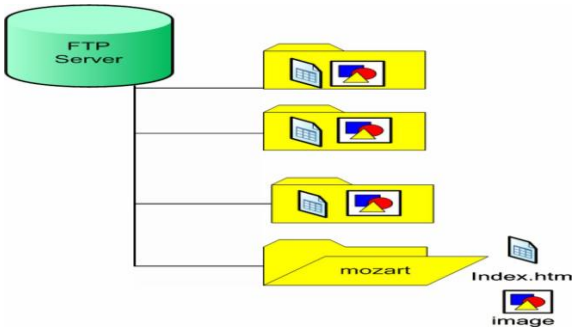

Fig.3. Folder structure of the FTP server.

A script on the embedded device is configured to update its IP address on the FTP server in hypertext meta-language as an index.htm file, under a folder uniquely named by its hostname.

3. DATA MANAGEMENT IN THE SYSTEM

The internet server is used to decrease the management costs by sending all the pictures to the client through a server on the internet. Text data such as coordinates, temperatures and altitude are served from the embedded system. If bulky data are going to be sent, the embedded module is set to send the image only once via GPRS and placed on an FTP server. This approach eliminates the transfer of large data through GPRS more than once, thus reducing the transfer costs, particularly if more than one client is involved or multiple requests to the same data needed as shown in figure.

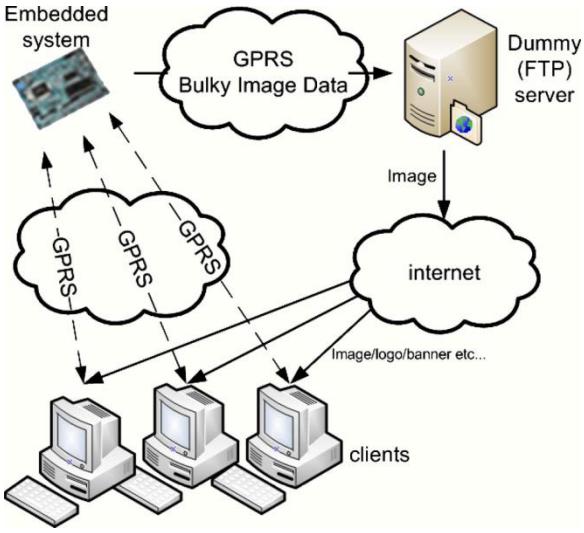

Fig.4. Data management system

3.1 Hardware

The embedded system used in this work is an X86 based standalone unit with four serial ports and parallel port with 16MB onboard removable Flash memory, shown in the figure. One of the serial ports is used in the application design stage for debugging purpose and this port is designed to host more devices with a multiplexer unit. The other serial ports used by the modules are used to test the system functionality. The acquisition units on the device can be varied with no limitation on their functionality and can be added by using appropriate interfaces.

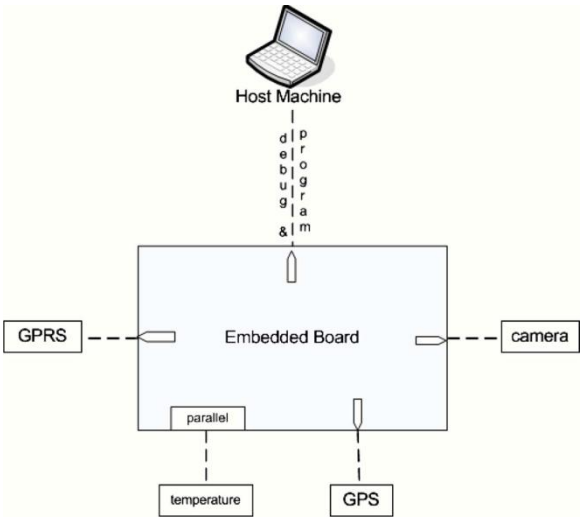

Fig.5. Block diagram of the embedded system with sample devices attached.

3.2. Integrated management

In making a connection between the client side and the server side via internet it should be avoided that too many services are available simultaneously in the internet. Also it is important that the services are integrated properly. To overcome these problems a kind of management can be used. This management will allow the individual services to register themselves through various physical links by providing it with a set of parameters describing service that the service can offer.

There are several reasons for doing the management in this way. Firstly, the joint management is the only joint, which directly communicates with web clients in control systems. All control elements are located behind the joint management. Once malicious hackers are trying to attack to control systems, they are actually attacking the joint management rather than the control system itself. This structure will reduce the risk of being attacked by malicious hackers. Secondly, the integrated architecture reduces the number of actual links with the

internet into one but at the same time provides control elements with unlimited virtual links with the internet.

3.3. Security

When designing the architecture for a web based monitoring and control system it also has to keep in mind that this has to be secured against attacks from outside. The internet technologies make it possible to connect these systems with control and information networks. Plant monitoring and control systems have conventionally been constructed as closed systems. Using a connection to an open network and the use of universal technology causes new problems. The most serious of those new problems concern data security. Hackers constantly invent new methods to get access of services to cause a lot of damage. Unauthorized access, wiretapping, system failures caused by viruses and denial of services due to network and server overload are most used to cause lot of damage. However, never forget that security countermeasures are 100% perfect and new techniques for avoiding attacks have to be constantly devised.

3.4. Data security measures

Unauthorized access to the monitoring and control systems, which are key systems in industrial plants and production lines such as to shut down the power generation are serious. Intranets are protected by a firewall when connected with the Internet. The reality is that intranets are not entirely safe from illicit access. The number of network crimes Perpetrated from within by employees has increased. A WBCS has to be developed in the way to allow operation by authorized users via an information network while excluding unauthorized operation.

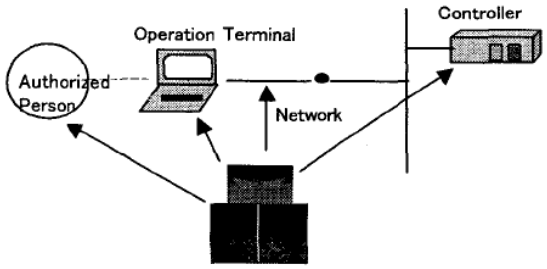

Fig.6. Targets of malicious WBCS.

As shown in Figure 6 the targets for malicious attacks on a WBCS can be classified into four categories:
1. Directly attack of controllers and devices, which are in the control network.
2. Monitor the information network to obtain information that would suggest methods of attack.
3. Gain access to an authorized operation terminal and use it to make an indirect attack.
4. Obtain information that suggests a method attack from an authorized person or become an authorized person.

3.5. Secure WBMC

The most common way of identifying a user is to use a user ID and password. Passwords are generally combinations of a number of alphanumerical characters. Because most protocols pass them on as plain text over the network, they are easily broken by wire-tapping. Therefore it is highly recommended using encryption in combination with a one-time password protocol. Public Key Infrastructure (PKI) has been proposed as one of the best methods for securing a WBCS. PKI works as follows. A password encrypted with the target's public key on the user side is authenticated on the target side. Next a challenge code given by the target side is digitally signed with the user's private key on the user side, and the signed code is authenticated on the target side. This procedure is performed both on the user side and the operated side. Here, the authentication is based on a certificate that is issued by a trusted Certification Authority (CA). Protecting the operation equipment can be realized by using a single firewall for the whole network or by giving each unit of operated equipment its own individual protection. This last case is not recommended because the amount of traffic on the network cannot be controlled and most of these systems are designed for compactness in consideration of limited resources.

4. RESULT ANALYSIS

To improve the speed of power plant management system TCP/IP is used. The low operational cost but flexible web based power plant automation system is controlled and monitored. Productivity increased by using internet communication.

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