

*Remote Monitoring & Control
of
Industrial Processes and Equipment*

Software Concepts, Inc
“Right Solution...First Time”

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Overview

It is often desirable to monitor or control industrial equipment from a remote location. Whether for the purpose of controlling a process, monitoring performance or performing remote diagnostics, the cost and time saving of remote monitoring can often justify large expenditures in infrastructure costs. Fortunately, with the advent of the Worldwide Web and low-cost Web server hardware, remote monitoring and control can often be added for very little additional cost to the manufacturer. This report describes the technology needed to implement remote monitoring and control via the Worldwide Web.

Remote Monitoring Before the Worldwide Web

Prior to the advent of the Worldwide Web most remote monitoring and control was performed via a leased line or dial-up connection to the equipment site. This typically involved proprietary software on both ends of the connection and proprietary protocols for communications. This method was expensive for several reasons. First, the time and effort required to develop the software and hardware was costly. Also, communications cost were often high, as leased lines are expensive. Even if a dial-up connection was utilized, the cost of long-distance calls could be expensive as the monitoring location is usually far from the equipment site.

Another problem with this approach was that since it required proprietary software, monitoring could only be performed from computers equipped with that software. This limited access to a small set of individuals and often required a technician to drive to his office to call into the equipment site.

With the advent of the Internet, some companies attempted to leverage this resource to lower their remote monitoring costs. These early systems used the backbone of the Internet to eliminate the need for leased lines, and replaced long distance calls to the site with a local call to an Internet Service Provider (ISP). Most implementations used simple data transfer protocols (such as FTP) to transfer raw data between the equipment site and the monitoring location. However, they still relied on proprietary software to transfer and view the data. This was all about to change with the introduction of the Worldwide Web and web browser software.

Remote Monitoring via the Worldwide Web

The Internet provides a low cost way to connect to a computer anywhere in the world. Any computer that can dial-up to a local Internet Service Provider (ISP) can communicate with any other computer with access to the Internet. And with the proliferation of the Internet, more and more facilities have a constant Internet connection via DSL or T1/T3 lines.

The real boon to remote monitoring and control came with the introduction of the Worldwide Web and web browsing software. The web provides a means to communicate information in a visually rich format. This is facilitated by a simple protocol (HTML) that can be rendered using a web browser program. These programs are available for virtually every computer platform and are often supplied at no cost. This means that virtually any computer – anywhere in the world – can access any given web server for the cost of a local phone call.

Hardware Requirements

One of the things that makes monitoring via the Web so attractive is that the hardware required for a web server is very inexpensive. While web browsers tend to be large programs that require a fair amount of computing horsepower, a simple HTML web server can be created in a couple dozen lines of C code. This means that a web server can run on low-cost, low-end computer.

Software Concepts has developed several low-cost products specifically for this market. For many applications, the additional cost to add a web server to your product is less than \$50. In some situations, a computer that's already part of the equipment to be monitored can be utilized as the web server.

System Architecture

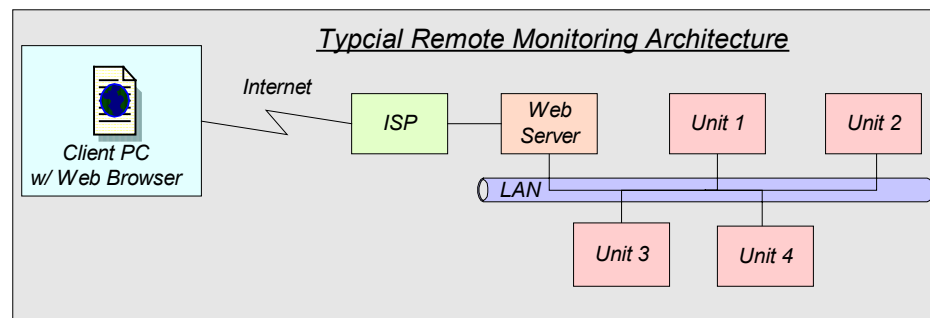
In a typical application, one server is used to monitor several pieces of equipment. Typically the equipment communicates to the server using a standardized bus architecture such as I²C, CAN, LONWORKS or Ethernet. In recent years Ethernet has gained a foothold in this market, as the cost for an Ethernet network is very low – primarily due to its popularity in the commercial sector.

If a constant connection to the Internet is available at the site, the server can serve up pages at any time. If the only connection available is a dial-up connection through a Modem, there are a couple monitoring alternatives available. The server can download its pages to a surrogate host located

elsewhere. This could be located on the web site associated with the equipment owner, a site associated with the equipment vendor, or a separate site dedicated to mirroring the server. There are many web-hosting companies that will provide web sites for only a few dollars a month.

Many Internet Service Providers (ISP) don't limit the time a computer can be connected to the Internet through their service. In this case the web server can dial out and maintain a connection by periodically pinging another server. Most services will disconnect the computer after a prescribed time – typically 24 hours – so the server will need to re-dial when the connection is lost. The problem with using a dial-up account is that the client attempting to monitor the site will need to determine the IP address of the monitored site to establish a connection. The usual approach is for the server to post its IP address to another server whenever it connects to the Internet.

The diagram on below depicts a typical installation for remote monitoring using a dedicated connection.



In some cases it may be desirable to simply dial into the monitored site, but still use the web server approach. This maintains the benefits of a standardized client program (the web browser) along with all of the advantages of using a web server.

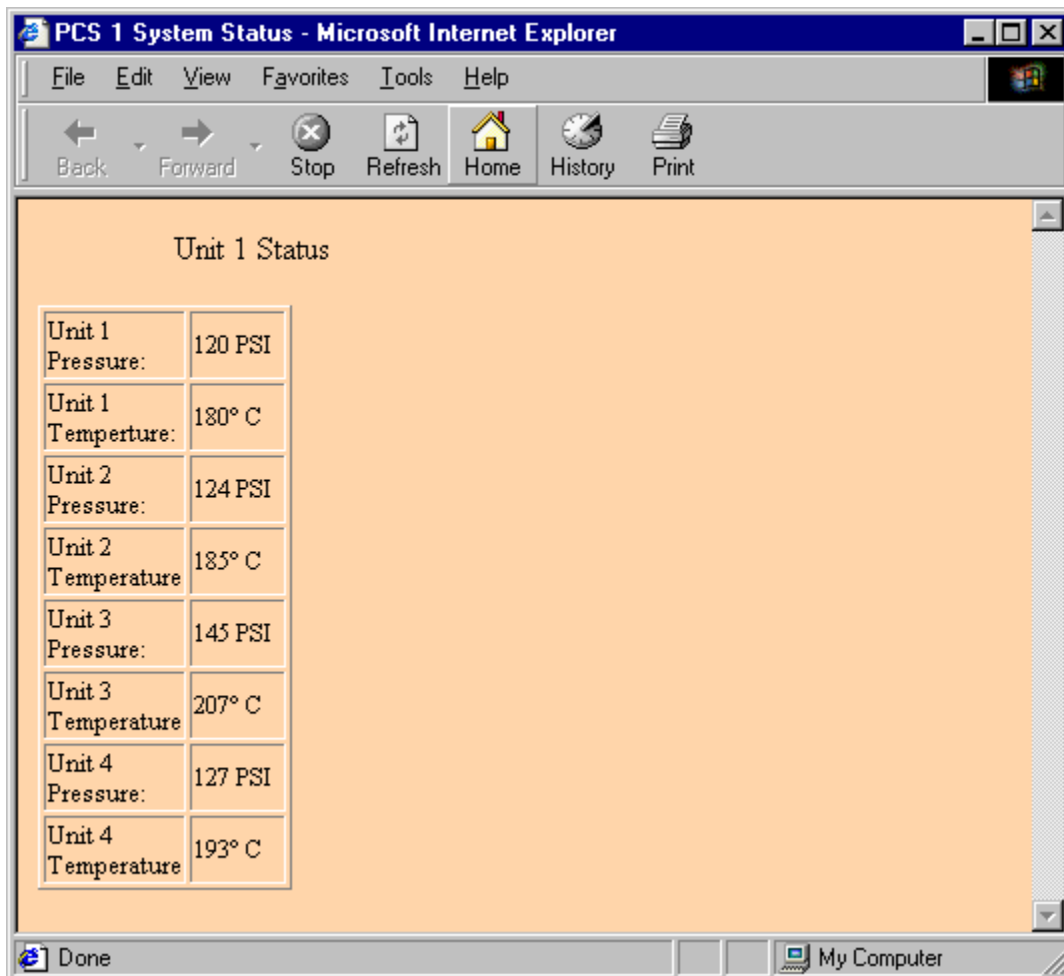
Typical Application

A typical application for remote monitoring would be to verify the status of a piece of equipment at a remote site. Older systems typically ran data-logging software that periodically captured a number of operational parameters from the equipment. This data was then downloaded to the monitoring location for display and analysis.

Most modern applications have foregone this approach for a more streamlined system. Many engineers have found that it's not necessary to maintain a lot of long-term historical data to ascertain the condition of a piece of equipment. Instead most of them tend to focus on a few data points gathered at critical times, as most of the time the parameters will be within specifications. This greatly reduces the amount of data that has to be collected and presented to the user.

This approach can leverage the web server architecture to create a web page whenever the user connects to the server. The resulting display can show which parameters are out of spec and quickly pinpoint problem areas. The display can usually be a simple table showing only the data of interest. If multiple pieces of equipment are being monitored the display can show all of the equipment on one page, or provide a separate page for each piece of equipment. Sometimes the main page shows a simple Go/No-Go status of all of the equipment with a separate detail page for each piece.

The image below depicts an example of a simple monitoring page .



Remote Control

So far we've only discussed remote monitoring. This same architecture can be used to control equipment from a remote location. In this case the web server presents a page that allows the user to modify parameters and then parses the returned post to determine which parameters were changed. The web server then sends a command to the equipment via the local area network. As long as the equipment supports modification through the network, remote control is as simple to implement as remote monitoring.