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Authors:
Mike Branch, BAsC.
mike.branch@inovex.ca

Bob Bradley, BAsC.
bob.bradley@inovex.ca

Inovex Inc.
220 Wycroft Rd, Suite 201
Oakville ON L6K 3V1
905.337.9514



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Mike Branch, BAsC.
Bob Bradley, BAsC.

Paper Abstract: Instrumentation Readings and Reports from Anywhere

Imagine being able to view the status of your plant in real-time from anywhere in the world. This incredible software solution allows you to custom configure a control screen from your web browser with analog gauges, digital gauges, charts, spider charts and more. The data is securely sent directly from your PLC to a data hub on the Internet, where moving gauges will depict a plant's current state. Trends and reports can be generated with the click of a button. Not only are you able to view real-time data streaming from your plant, but you can also simulate from historical values to identify problems. This case study will illustrate how hassles involving remote troubleshooting become a thing of the past, and how decision-makers will be able to make well-informed decisions from anywhere, while still feeling as though they are in the control room.

MONITORING YOUR PLANT FROM ANYWHERE

INTRODUCTION

In the oil and gas industry, the single most valuable non-mineral asset a company has is their data. The speed and accuracy of the data they collect leads to better business decisions, and increased profits. In the past, there have been systems that were deployed on-site to collect data and show pertinent well information.

To compliment these systems, there are central data repositories both on the web and on local area networks (LANs). These repositories store large volumes of historical data for oil companies, and this data is often entered manually or collected upon the return of an oil rig from deployment.

Until recently, the time gap between receiving real-time data on-site and transferring it to a central repository has not been bridged. Recent advances in software, however, have combined these two entities and created one real-time distributed application that can easily be ported to other verticals, including the pulp and paper industry.

THE NEED FOR SPEED

Oil rigs are equipped with a number of analog and digital gauges to allow operators control of machinery

and ensure that the rig is functioning correctly. These gauges measure variables ranging from hole-depth to engine speed and hook load.

Not so long ago, software versatility and speed issues made it impossible to completely replace traditional gauges with a computer interface. The speed improvements and versatility of current software have now made this a possibility. Oil rigs can be outfitted with a select few critical gauges, and any additional monitoring can be done via software. Custom software applications allow users to tailor the interface to meet their needs, while more advanced software packages allow users to change their user interface "on the fly".

With these software advances, cycle rates (between the "real world" and the computer interface) as low as a few hundred milliseconds can be achieved through an industry standard MODBUS interface, running at speeds as low as 9600 baud.

BRIDGING THE GAP

These recent advances in on-site software have led to improvements in the sharing of data worldwide. Many companies currently choose to export data once a job has completed, and send this to their server for

storage. In the oil and gas industry, this means that engineers in the central office receive this information only after the rig has returned from its task. This information is often sent via fax, e-mail, or even traditional mail. These methods are not only slow but have in the past been security risks.

Technological breakthroughs have allowed for this time to be bridged by maintaining a constant data stream between on-site data and the central server. This connection is maintained through a dedicated secure channel via the Internet (see figure 1).

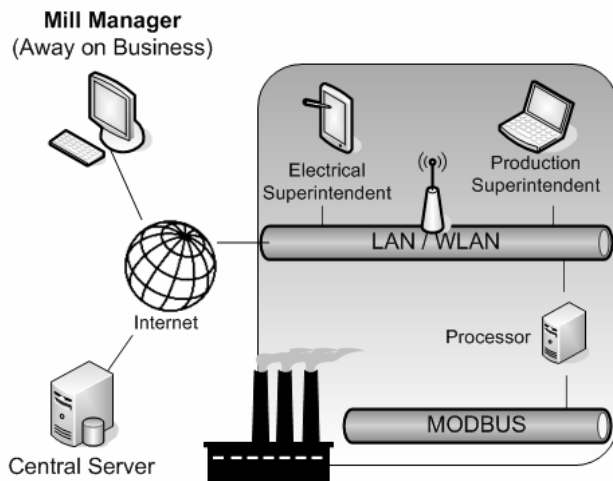


Figure 1: Data Acquisition Software – Mill Interconnectivity

Upon receiving data from the MODBUS, the on-site software will encrypt any changes and send them in real-time to the central server. These updates will be reflected on the web through the same analog and digital gauges that can be used on-site.

Users of the web service will see smooth animated gauges and have the ability to perform a number of the tasks that can be done on-site. This includes, but is not limited to, the simulation of historical events, generation of reports, and distribution of data through e-mail.

Information on the web will be displayed to the user in virtually real-time. Overhead from the network delays will be the only limiting factor in terms of speed.

SYSTEM ARCHITECTURE

The system architecture as outlined below describes how a remote monitoring system functions within the

oil and gas domain. Although the primary vehicle for data acquisition remains MODBUS within the oil industry, the software remains versatile enough to accept input via Ethernet communication (as witnessed through replication to other computers over the lease), and through the Well Information Transfer System (WITS) – another form of serial communication.

Using MODBUS, requests are performed at speeds ranging from 9600 baud to 57600 baud. Improved algorithms and increased processor speeds have allowed most data acquisition systems to use devices with a 9600 baud limitation and still maintain acceptable real-time delays. This cuts costs significantly when purchasing RS232 MODBUS interface cards for a PLC.

The software will obtain a series of registers from the PLC in a response via the serial connection. These registers will be read and stored to a local database. Changes in data from subsequent reads will be reflected in gauges, graphs, charts and digital displays (as configured by the end-user).

Similarly, changes in data will be sent out to a number of other sources – the first of which is other computers situated on the LAN.

These computers can subscribe to updates from the machine connected to the MODBUS. A TCP/IP Ethernet or wireless connection allows encrypted data to stream to client machines.

The delay from the MODBUS-connected machine to its clients is negligible. In terms of speed, a typical cycle time would range anywhere from 200ms to approximately 1 second; however, factors such as PLC register configuration, register range size, and speed of communications all play a role in determining the overall cycle speed. See figure 2 below for a basic process flow for the entire system.

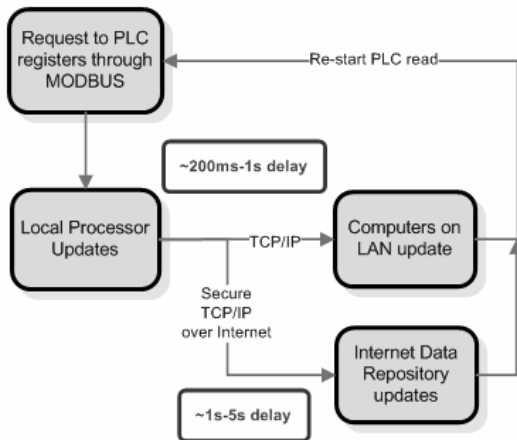


Figure 2: MODBUS to Internet repository basic process flow

In addition to forwarding encrypted data packets to machines within the mill, the software will also fire packets to a database repository on the Internet, so that the real-time information will be available to all authenticated users within a few seconds.

FLEXIBILITY

In the pulp and paper industry, each individual in a mill has unique problems, responsibilities and concerns. As a result, individual workspaces are equipped with a unique set of traditional gauges and digital indicators. In essence, each employee requires his/her own unique window to the mill processes.

Web data-acquisition software is designed to allow for total flexibility. In this manner, each user may configure their own screens with the combination of gauges and graphs that best suit *their* needs. In this way, a mill manager's screen may look different from a production superintendent's screen, but still bring that same pertinent information to the eyes of the appropriate individual from *anywhere*. Software packages allow the configuration to be saved, loaded, and redistributed throughout an organization.

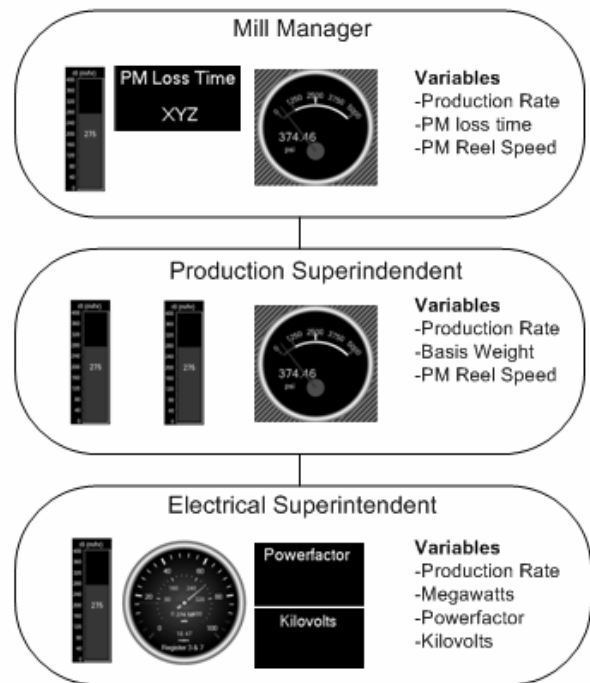


Figure 3 - Flexibility in screen configurations

REPLAYING THE PAST

Another noteworthy feature in today's web-based data acquisition software is the ability to replay historical events. For instance, information gathered from a pulp and paper mill can be used to simulate the events of the mill at a later date. If a power spike occurs in a mill, the E/I superintendent can go back to that point in time and simulate the activity in the mill. He/she can choose which information he/she wishes to see, thus providing a powerful troubleshooting tool (both remotely and locally).

Furthermore, it gives teams of individuals the power to collaborate in making decisions by logging onto the secure server and watching the simulation from their own office, as depicted in figure 4.



Figure 4: Troubleshooting through remote simulation and collaboration

Well built software can be configured to work with any PLC and register combination. The software need not be concerned with what it is monitoring, but must only deliver results to the screen as quickly as possible.

INTERCONNECTIVITY

This type of software solution connects all employees in an organization, whether they are situated locally or internationally. Those in the control room have a direct connection to the PLC, and receive true real-time data, using their own custom screens to perform tasks that could only be done through a series of analog gauges. Other off-site users receive this same data via a TCP/IP connection with a negligible delay. This provides all users with their own window to the mill's operations.

Robust software solutions make the look and feel of an interface identical for all users, independent of the connection method in which they acquire the data. An engineer may load his configuration file into a PC in the mill, or in an office halfway across the country, and expect that he/she will see the same screens.

Through a connection with the central server, each mill can provide this real-time data to engineers and supervisors across the globe. Secure web interfaces and encrypted data allow for safe transmission of information. In the oil industry, process speeds have been drastically improved. No longer do geological engineers need to wait for a drilling rig to complete

its work, a supervisor to fax a spreadsheet, or a disaster to happen before they make critical decisions. In an industry where data and speed are critical, this solution provides users with a great advantage over their competition.

SECURITY

To ensure that security breaches are not possible, all traffic sent between PCs and the internet is encrypted using Advanced Encryption Standard (AES) and patented key establishment algorithms based on probability theory. Only those machines that have successfully subscribed on the LAN and the web server would have the key to unlock this encryption. This prevents against many forms of data theft, the most crucial of all, packet sniffing.

Malicious users who attempt to sniff incoming packets on a LAN or through wireless 802.11b or 802.11g access points will not be able to decipher the data.

More advanced data encryption algorithms also contain compression techniques that are useful for transmitting the data to the centralized server. This reduces network lag times and overhead, making the system faster and more secure.

The web server itself will also be built with layers of security for its users. Typical login and password accounts can be used to limit the access any single user, or group of users has. This same technique may or may not be used on-site to log errors and events with an associated user.

APPLICATIONS IN PULP AND PAPER

The incredible flexibility of modern software coupled with the use of the industry standard MODBUS make the porting of these solutions to the pulp and paper industry seamless. The stringent requirements for both security and speed of the oil and gas industry ensure that neither will be a concern in adapting current techniques to pulp and paper.

Any PLC, coupled with an RS232 MODBUS card, can feed information to these software packages. This information can be plotted, recorded, and displayed in any manner imaginable. Custom software solutions allow end-users to develop their own custom controls, or to select from a library of existing ones.

Information from across a mill can be shared at a central location, allowing users to have a better picture of the overall mill performance. Moreover, inexpensive PCs (or micros) and software can replace the bulky and costly control boards that are often used today. A single PC or micro can monitor any and all data received from the MODBUS and can ship this data quickly and safely to a central internet-based server.

The applications for this type of interconnected real-time monitoring software are endless. The following presents a few sample scenarios of its use within a pulp and paper mill.

MILL USE CASE SCENARIOS

While away on business, the superintendent of operations in a mill may be concerned with the production rate, among other variables. He/she can simply login to a secure internet site and promptly be at ease as all plant operations lay right before his/her eyes. The software will allow the superintendent to see the data they want, in the manner that they want, from wherever they want. A sample screen shot from the oil and gas industry can be seen below in figure 5.

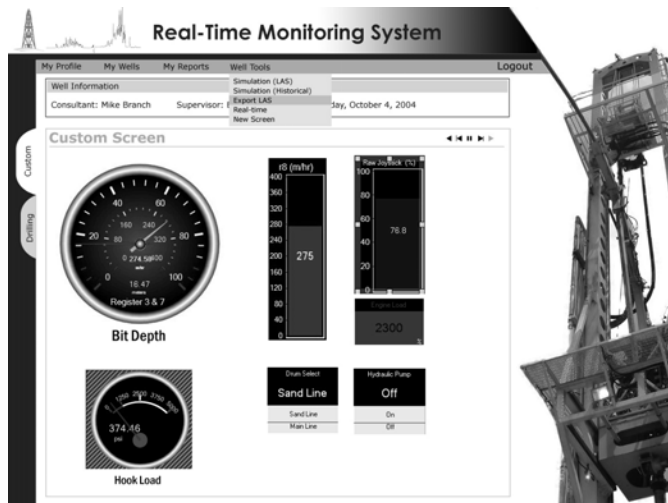


Figure 5 - Oil and Gas Remote Monitoring Screen Shot

Similarly, for mills that generate their own power, a steam plant superintendent will want to see information such as steam flow, kilowatts produced, and load. They can just as easily setup a configuration and begin watching or simulating past occurrences.

Furthermore, an electrical maintenance superintendent will want to measure the amount of incoming power consumed, voltage sags and swells, and load. They too can have their own window into the plant through one convenient web-accessible site.

With a solution like this in place, mill managers and VPs can get an overall picture of the mill from anywhere in the world. Superintendents who are traveling can keep a close watch on their mill from any location with an internet connection.

Also, the data is not only stored digitally forever, but can be used to generate reports, run simulations, and the user can perform any number of other mathematical operations on it. It is available to export to any number of formats and custom packages can be built to tailor reports to industry standards.

BENEFITS AND CONCLUSIONS

Usage of an interconnected real-time monitoring system presents several benefits for managers, VPs and engineers alike. Current software and hardware technologies have alleviated security and speed concerns of the past and have empowered users everywhere.

Benefits of using systems like these include:

- Increased Productivity
- Rigorous security for data protection across wired and wireless networks
- Quicker troubleshooting for engineering through a global interconnection
- Archived data that is digitally stored forever allowing for simulation of past events
- Dynamic configuration of control screens providing flexibility for system users
- Real-time monitoring means that users will experience only a few seconds delay from actual plant events to halfway around the world
- Simultaneous monitoring of multiple plants for company VPs
- Installation versatility through direct connection with industry standard MODBUS

These are only a handful of the benefits brought forth by making use of such an interconnected system. Key decision makers will ultimately have up-to-the-second information at their disposal, and will no longer have to waste time tracking numbers down. Management will always be aware of what is going

on within their mill and can quickly take steps to seek remote help from others or simply monitor events while on the road.

The advent of this technology has given the oil industry the key to unlock endless possibilities in the

realm of interconnected real-time monitoring. For the pulp and paper industry, this same technology is a necessary component that can easily fit into your mill's existing infrastructure and give your data interconnectivity, versatility, and security.

*innovate.
explore.
deliver.*

