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Evolving HMI/SCADA Software to HTML5 Business Intelligence Dashboard

With HTML5 technology, HMI-SCADA allows users to create remote viewing screens compatible with most any tablet or smartphone, while dashboard tools speed creation of summary screens

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PC-based industrial automation human-machine interfaces (HMI) and supervisory control and data acquisition (SCADA) software packages have been around since the 1980s, with significant growth occurring when Microsoft introduced Windows in the mid-80s. The Windows PC created an industry standard, allowing suppliers to build products to run on a relatively stable target platform, and allowing their customers to use a familiar operating system for their industrial automation applications.

Remote access to these HMI/SCADA software packages presented a challenge for a number of reasons, but now users can quickly and easily create dashboard screens for remote viewing on PCs, tablets and smartphones. Dashboard screens typically show an overview summary of plant or facility operations and include business intelligent information such as key performance indicators (KPIs).

These screens can be viewed using any web browser supporting HTML5, an industry standard markup language used for structuring and presenting content via the Internet and the web. But before we explain these technologies solution, let's take a look at how the HMI/SCADA industry has progressed to this point.

HMI/SCADA History

End users, machine builders and system integrators first used Windows-based HMI/SCADA software packages to provide a local PC-based operator interface, typically located very close to the process or machine. Remote viewing was limited to PCs on the same hard-wired network, most often located in the plant or building control room.

Off-site operator interface was complex and required an extension of the control network, usually via expensive leased data lines. VPN and other forms of highly secure access were required for off-site operator interface, and these software applications had to be loaded and maintained at both the server and the clients. These stringent and expensive requirements limited off-site operator interface implementations, and frequent software changes to keep up with the latest Windows updates created a maintenance nightmare.

A better method of remote access soon followed with the introduction and widespread adoption of the browser in the mid-2000's. The web browser allowed HMI/SCADA users to view data and screens via any PC connected to the Internet. Of particular significance was the fact that the remote PC required no software and no permanent network connection, as all the tools and information required for viewing were instead found on the HMI/SCADA server, and the network was simply the Internet.

As long as the remote viewing station was a PC, this approach worked quite well, as the server PC only needed to allow remote client PCs to view the same screens as displayed on the local PCs at the plant. But trouble arose with the emergence of mobile viewing platforms, namely tablets and smartphones, with their smaller viewing areas and different methods of user interaction, particularly multi-touch gestures such as swipe and pinch.

Tablet and Smartphone Remote Access

The simplest way to present data to tablets and smartphones is by sending the same screens as displayed on the main HMI/SCADA PC. But this simple solution is unsatisfactory as users must pan across large viewing areas to find sections of interest. Once a particular section is located, operator input is expected to be the same as with the main PC, which is primarily via a keyboard and mouse, again unsatisfactory as tablets and smartphones use touchscreens as their primary means of operator interface.

This solution was simple to implement, but it wasn't easy to work with, and for many applications wasn't practical. So, HMI/SCADA software providers began offering tools to feed prepackaged screens and information to tablets and smartphones. While this presented a major advance, it severely limited users as they were restricted to the remote viewing options provided by the supplier.

While it was in theory possible for users to create a custom HMI/SCADA remote viewing experience for every type of tablet and smartphone, in practice this was extremely difficult as it required a great deal of custom programming. It also created a software maintenance nightmare as every update to a remote viewing device's hardware or firmware required changes and testing to the custom HMI/SCADA remote viewing programming.

Fortunately, an industry standard solution emerged in the form of HTML5, a standard platform around which HMI/SCADA software suppliers could craft a solution allowing users to easily create and maintain remote viewing applications for tablets and smartphones.

HTML5 to the Rescue

Virtually every browser supports HTML5, as do many HMI/SCADA software packages. So, HMI/SCADA suppliers can design their software packages to work with HTML5 while browser vendors do the same, with HTML5 serving as the interface connecting local servers to remote clients.

HMI/SCADA suppliers can also provide tools for users to develop custom viewing screens for tablets and smartphones, with the ability to develop once to the HTML5 standard, and deploy many times across any mobile device's HTML5-suppored browser.

HTML5 provides a number of important benefits as listed in detail below.

<u>HTML5 Benefits for HMI/SCADA</u>

- Cross platform compatibility – PC, tablet, smartphone
- OS independent, works with Mac OS, Linux, Windows, Android, iPhone iOS, others
- No additional software required on client side
- Easier for mobile devices to access key data.
- Plant engineers and supervisors walking on factory floor can quickly view data on their mobile phone without having to connect with a PC.
- Easier for IT to manage security on PCs and mobile devices because no additional software is required at client
- Improved overall robustness and reliability

Cross platform compatibility is a big benefit of the HTML5 standard as it allows the user to configure application viewing screens once and then run these screens on any desktop, server, tablet or smartphone supporting the standard. As virtually all modern operating systems support the standard, HTML5 offers true cross-platform capability and operating system independence.

With HTML5, each screen viewed on a remote device automatically resizes, orients and adjusts based on the capabilities of the specific viewing device, whether it's a full-size tablet of a compact smartphone.

Even if the device operating system changes, HTML5-compliant viewing screens will still work as designed, and will also automatically adjust as required to fit the requirements of the updated device. At the server end, no new application development is required because of remote device operating

system changes, and it's not necessary to recompile and download applications when the device operating system changes.

The ability to remotely view server-based applications on mobile devices allows quick access to data. With cellular access available throughout most facilities and plant areas, critical production data becomes quickly and remotely available to key plant personnel, with no need for access to the server PC.

Standard, off-the-shelf commercial software supporting HTML5 simplifies IT personnel's job with its built-in security and other features and tools. Every time an improvement is made to the HTML5 standard, such as a security patch or other fix, this change is automatically incorporated at both the server and the remote viewing devices.

But although HTML5 is a great step forward, many users are still faced with the difficulty of creating an HTML5-compatible viewing experience, which often requires significant programming effort at the server to enable remote viewing. Advantech provides a solution to this dilemma with their WebAccess Dashboard, a tool allowing easy configuration of commonly used remote viewing screens.

Dashboards with Business Intelligence

Local and remote clients need to view animated graphics, real-time data, historical trends, and alarm information, and may need to acknowledge alarms and change set-points and other data. Furthermore, the raw data may need to be arranged into business intelligent information for manager to make some business decision. All of these functions need to be configured at the server, and in some cases made available to the remote viewing devices such as tablets and smartphones.

One of the most common remote viewing applications is the dashboard because it provides a quick overview of the status of a building, a plant, a process or a machine. WebAccess provides a way for users to quickly and easily create these dashboards without the need for custom programming by utilizing the power of HTML5.

The system integrator (SI) or system administrator edits dashboards and creates widgets. The SI may also import built-in vertical solution widgets for applications such as building automation, renewable energy and water treatment (Figure 1).

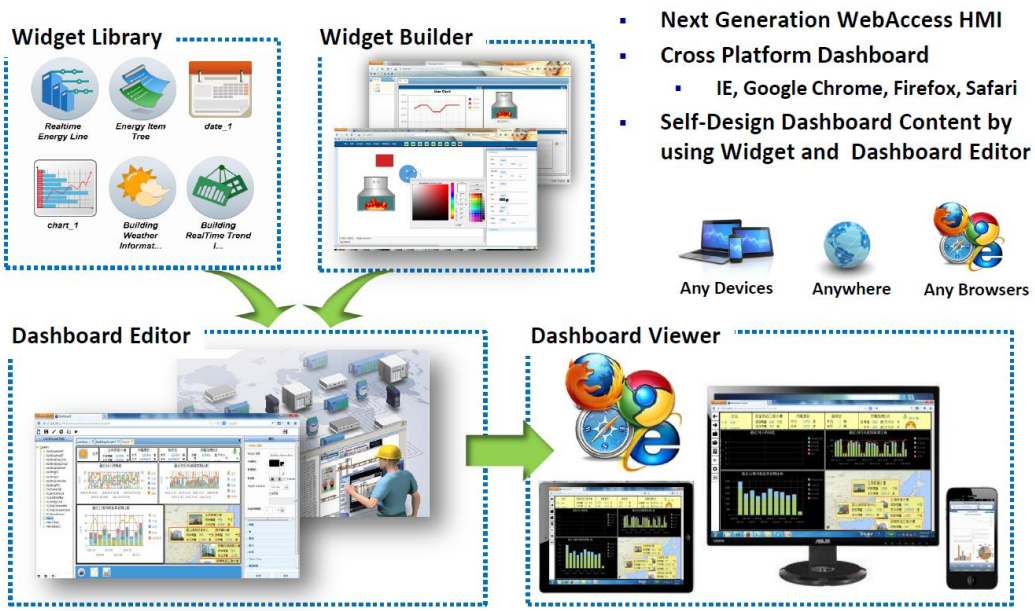

Figure 1 - Library and custom widgets can be combined with the Dashboard Editor to create screens viewable on a wide variety of devices.

The remote clients use WebAccess for access to tags anytime and anywhere through all supported platforms and browsers. WebAccess runs on platforms such as desktops, laptops, tablets and smartphones. It supports any HTML5 compliant browser including Chrome, Firefox, Safari, Internet Explorer and Opera.

Capabilities of the next generation WebAccess HMI, with cross-platform dashboard features allow content creation using Widget and Dashboard Editor and will be covered in this section and are summarized below.

<u>Cross-Platform HTML5 Dashboard Features</u>

- View on any device, anywhere, using any browser
- Widget Library and Vertical Solution Widgets
- Widget Builder
- Dashboard Editor
- Dashboard Viewer

Widget Builder is an HTML5 graphical interface which allows creation of custom widgets without programming. Widgets can be created with these and other functionalities:

- Basic shape
- Animation
- Picture import
- Macro command

Once created, all these custom widgets can be run on the WebAccess Dashboard platform side-by-side with the supplied widget library. Both supplied and created widgets can be used together to create dashboards with the following and other functionalities:

- Data analytics
- Alarm/Action logs

- Real-time/Historical data
- Meter/Linear gauge
- Maps
- Manufacturing Information
- Goods Tracking

Dashboard Editor is a WebAccess HTML5 interface that allows users to create their own dashboard by using combinations of widgets. A comprehensive library of widgets is supplied with WebAccess, and users can also create their own widgets using the Widget Builder.

The editor, in addition to adding, configuring and modifying the dashboard and widget properties and appearance, allows dashboard layouts to be previewed. The preview modes include PC/Pad, small portrait, small landscape, and a user-defined width and height. Preview mode allows HMI design personnel working on a PC to see exactly what screens will look like when viewed with a remote device.

The Dashboard Viewer resides in the PC-based HMI/SCADA software server and provides data which can be viewed via any HTML5-suppored browser and platform. With Dashboard Viewer, the user can display the dashboard on any small-screen PC or tablet with the high performance look and feel of a large-screen server.

Figure 2 - The Dashboard Viewer shows designers how screens will look on remote viewing devices such as small-screen PCs and tablets.

The user can also display the dashboard on a smartphone with the appearance of an app, and there are special widget arrangements for smartphones.

Figure 3 - Mobile smartphone screens can be seen using Dashboard Viewer allowing designers to create easily viewable displays for small screen areas.

Remote access allows connection to a fully featured SCADA system to monitor and control multiple remote sites. With real-time database and remote connection to the data, engineers can remotely administer, monitor and control parameters such as flow, level, pressure and temperature. With the integration of Google Maps, actual, real-time data such as power usage or production rates can be overlaid on a map.

Advantech's Building Automation Solutions highlight WebAccess and its remote access capabilities. It's a single product for control and monitoring of HVAC configurations. The solution features customizable software controlling local Direct Digital Controller (DDC) I/O using function block programming. The product offering also includes a DDC Coordinator (local controller) to handle up to 10 groups of I/O, and a central SCADA server capable of controlling 100 coordinators.

Advanced energy management functionality and a control library supporting the latest technology provide maximum efficiency. The open architecture of the system eliminates any proprietary restrictions. The Pullman South Hotel in Beijing is a good example of how WebAccess Dashboard can be used to create custom remote HTML5 interfaces for tablets and smartphones.

Intelligent Hotel Application with WebAccess

The goal of having an intelligent building starts with early planning in the design stage, necessary to realize the enormous benefits to be gained by creating a smart structure. The Pullman South Hotel in Beijing is managed by the Accor Group in France and is seated in the central area of the new Economic & Technological Development Area. It's the only 5-star hotel in this new area, which makes its profile that much higher. With 19 floors, the hotel is equipped with guest rooms, dining, entertainment, and recreation facilities.

The Pullman South Hotel required a supervisory level automation system to control and monitor the numerous sub-systems within the hotel including a cold source, a heat exchanger, air-conditioning, fresh air, air supply and exhaust, water supply and drainage, elevators, and transformer and electrical distribution.

The hotel required an intelligent monitoring system that was network-based, with distributed control and remote monitoring capabilities. Designers wanted to create a combination of an intelligent control system and an environmental management solution to maintain comfortable accommodations while reducing the cost of energy within the hotel and cutting maintenance expenses.

Cold source system monitoring: The hotel's cold source system consists of freezing unit, freezing pump, cooling tower, cooling pump, expansion tank and pressure difference bypass. The central monitoring system shares real-time information with the freezing unit through a Modbus interface in order to monitor the working condition of the system, the field controller, and the relevant field devices.

Air-conditioning and fresh air system monitoring: 5-star hotels have demands above and beyond that of standard hotels, and this includes the occupant comfort conditions. Pullman South depends on the central monitoring system to monitor the working condition of all devices. Various high precision components capture the temperature and humidity information in the hotel and adjust the blower and humidifier through the field controller in the air-conditioning room to ensure air, humidity, and temperatures in the hotel are precisely controlled at all times without resulting in excess energy consumption.

Air supply and exhaust system monitoring: The hotel's air supply and exhaust system relies on the central monitoring system to observe the status and mode (manual or automatic) of all exhaust units and air handlers. When any of the systems is in an abnormal condition, the central monitoring system displays the field conditions as messages or graphics onscreen. Voice alarms are also sent to alert maintenance staff, and message and alarm data can be printed as records.

Water supply and drainage system monitoring: The hotel's water supply and drainage system relies on the central monitoring system to monitor device working conditions including conservation pool high/low level alarm, water tank high/low level alarm, water pump running state, water pump malfunction alarm, conservation high/low water level alarm, drainage pump running state and drainage pump malfunction alarm. As with other systems, this data can be viewed locally and also sent to remote devices.
WebAccess is designed for ease-of-use in intelligent building projects. In this application, it is integrated into the Pullman South Hotel to ensure all devices not only work safely and reliably, but also provide energy saving capabilities while extending the life span of devices.
WebAccess also provides the capability to view all data visible on the server on any remote viewing device such as a table or a smartphone. Dashboard features and functionality as previously described allow the creation of remote viewing screens via simple configuration without the need for complex programming.

Conclusion

Advantech's browser-based WebAccess software package provides HMI and SCADA functionality. Using a web browser, all the features of HMI/SCADA software—such as animated graphics, real-time data acquisition, control, trending, alarms and logs—are available. With the internet of things and its careful implementation in private and public clouds (see Sidebar below), WebAccess provides substantial benefits while simplifying implementation.

Remote access via any browser and any platform opens up many options for HMI/SCADA applications, providing users with cost-effective solution for remote management, diagnostics, and maintenance.

SIDEBAR: Simultaneous Use of Private and Public Clouds Provide Security and Universal Access

WebAccess and other HMI/SCADA software packages readily lend themselves to cloud-based implementation but there are security concerns with the use of the public cloud. The public cloud's

shared access opens the door for hackers, and access control and data protection are major concerns. However, the public cloud is easily scalable, cost-effective and widely accessible—leading to its widespread use.

HMI/SCADA remote access capability is often implemented using the public cloud infrastructure to push data from the server to the client devices, creating security concerns. In some cases, remote devices are also allowed to make changes to server data, furthering heightening security fears.

Fortunately, WebAccess is already a private-cloud solution with its combination of the Project Node and SCADA Nodes, allaying concerns by providing secure two-way communications.

The Project Node is WebAccess' development platform. It is the web server used to remotely monitor and control the system, and it allows clients to connect to the development project. The graphics, configuration and project database is securely stored at the Project Node.

The SCADA Nodes provide real-time data to all remote clients, and enable local control and monitoring. WebAccess users can collect data on-site with SCADA nodes, and report data back to main data center's Project Node database.

WebAccess enhances the system architecture from private cloud to public cloud as it can be configured to keep sensitive data in the on-site private cloud for secure, high-speed, real-time data acquisition. However, the system co-works with the public cloud as it lets users publish less sensitive data to the public cloud. Using this capability, large amounts of data can be cheaply stored in the public cloud for viewing and analysis on remote devices.

The system thus takes advantage of the security inherent with a private cloud, while also providing public cloud functionality to inexpensively distribute less sensitive data.

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